



Corporate Strategies for Managing Climate-Related Financial Risks: An Empirical Study Using Structural Equation Modeling

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ABSTRACT

Climate change has become a business risk for companies, impacting revenues, operating costs, asset values, financing conditions, availability of insurance, supply-chain continuity, and enterprise value. The physical risks from floods, heatwaves, droughts, storms and water stress are increasingly interacting with transition risks related to carbon pricing, regulatory change and transition, technological transition, shifting consumer preferences, and transition to low carbon business models. As such, climate-risk management has become an essential part of corporate financial management. This study tested the correlation between corporate climate-risk governance, risk identification and assessment, strategic investment related to climate, climate-risk disclosure, capabilities related to climate-resilience, and financial risk management effectiveness. A quantitative research design was used. The data was gathered using a structured questionnaire with 428 managers and senior professionals involved in roles across finance, risk management, sustainability, strategy, operations and corporate governance. For the assessment of the measurement and structural models, the partial least squares method of structural equation modeling was used. The findings confirmed that climate-risk governance, climate-risk identification and assessment, strategic climate investment, and climate-risk disclosure are significant factors that improve the effectiveness of climate-risk management within companies. Financial risk management effectiveness also had a positive and significant relationship with climate resilience capability. Moreover, the effectiveness of climate-risk management was found to be positively related to corporate financial resilience. The mediation analysis suggested that effectiveness in climate-risk management is the pathway through which the impacts of climate-risk governance, climate-risk assessment, strategic climate investment, and climate-risk disclosure reached financial resilience. The results indicate that companies that take climate into account in their governance, enterprise risk management processes, decisions around capital allocation, scenario analysis, disclosures and operational resilience are more likely to be able to safeguard their financial performance. The study adds to the literature on climate finance for the corporate environment by combining strategic management and financial risk perspectives in a structural equation modeling structure. Results have implications for corporate boards, chief financial officers, risk managers, investors, regulators and policy makers.

Keywords: financial risk, corporate strategy, climate risk management, financial resilience, climate governance, climate disclosure, strategic investment, structural equation modeling, PLS-SEM and sustainability.

INTRODUCTION

Climate change is an increasing financial risk factor for companies. The Network for Greening the Financial System (NGFS) defines climate related risks as sources of financial risk that could become real via physical and transition pathways and have widespread and potentially irreversible implications (NGFS, 2020). Institutional investors also have reported that financial risks from climate change have already come to play in portfolio firms and that regulatory risks are already showing their effects (Krueger et al.,



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2020). Climate change is no longer just about degradation or the long-term effects of climate change on ecosystems. The impact of extreme weather events, shifting climatic conditions, technological transformation, environmental regulation, carbon pricing and market preferences on corporate revenues, costs, asset values, financing arrangements, insurance premiums and the continuity of the business has increased. An important aspect of the current strategic management and corporate finance is therefore the financial risks associated with climate change.

Financial impacts of climate change can be divided into two main types: physical risks and transition risks. These channels may impact firms via operating conditions, asset value, financing cost, demand, and policy expectations (Bolton et al., 2020; NGFS, 2020). Physical risks are caused by sudden and gradual changes in climatic conditions. Floods, cyclones, storms, wild fires, droughts and extreme temperatures are acute risks while sea-level rise, changing precipitation patterns, water scarcity and increasing temperatures are chronic risks. The transition risks are observed as economies progress towards a lower carbon production and consumption. The risks range from policy and regulatory shifts, to technological substitution, changing consumer preferences, changing investor expectations, litigation, and the potential revaluation of carbon intensive assets.

Climate risk is multi-faceted and translates into a variety of corporate financial impacts. Some exposures to climate change require a different approach to risk assessment, which goes beyond the traditional backward-looking approach and can spread through interconnected operation, financial and supply-chain pathways (Bolton et al., 2020; Ilhan et al., 2021). Production facilities can be destroyed by a flood, and financial implications can include disruption of the production supply chain, lost sales, rising insurance premiums, additional borrowing needs, and loss of creditworthiness. Likewise, a carbon price can raise the costs for carbon-intensive companies and lower the value of existing investments, as well as incentivize technology substitution. This means that climate risks are not an isolated factor, but they also add to the traditional financial risks, including credit risk, market risk, liquidity risk, operational risk, and reputational risk (Carè, 2023).

The Financial Stability Board's Task Force on Climate-related Financial Disclosures (TCFD) has recommended a broad-based framework comprising of four categories: governance, strategy, risk management and metrics and targets. The framework places a strong focus on risks to climate being placed on corporate governance and financial planning agendas, not just as a reporting topic (Financial Stability Board [FSB], 2017). The International Sustainability Standards Board (ISSB) then published IFRS S2 Climate-related Disclosures, which mandates the disclosure of material information on climate risks and opportunities, such as governance, strategy, risk-management processes and metrics (IFRS Foundation, 2023). IFRS S2 also highlights the impact of climate-related risks on business models, strategy, financial position, financial performance and cash flows.

Yet, even with growing focus on regulation and investors, there are still barriers in the way for many corporations to effectively integrate climate-risk information into their strategic and financial decisions. A recent report released by the IFRS Foundation (2024) shows that while many companies report some data aligned with the TCFD principles, there is little evidence of full adherence to the full disclosure principles of governance, strategy, risk management and metrics and targets. Previously, it had been identified that while companies were talking about climate risks, relatively few had reported impacts on their financial performance, while even fewer had reported how resilient their strategies were to various climate scenarios (TCFD, 2018). Some more recent evidence suggests ongoing progress in the quality of climate-related disclosure, although there are wide differences regarding the quality and depth of governance,



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risk-management, scenario-analysis and metrics practices. For example, the 2022 TCFD status report noted that scenario-based resilience was one of the least reported elements.

There is growing academic evidence that climate exposure is impacting corporate financial results. Climate risks are seen as financially relevant by investors, and market-based evidence suggests that the costs of protection against downside tail risks are higher for climate-policy uncertain carbon-intensive firms (Ilhan et al., 2021; Krueger et al., 2020). This study examines the link between climate-related risks and financial performance, based on quarterly firm-level data from 209 companies in China between 2018 and 2022, Liu et al. (2024). Other empirical studies have found negative climate exposure–financial performance correlation, and managerial green experience can ameliorate some of these impacts.

But there is an issue in research that is still outstanding. The existing empirical literature has tended to look at the direct climate exposure–financial performance link, whereas relatively little work has examined the strategic organizational processes by which firms cope with climate-related financial risks. Climate-risk management in corporations is multi-dimensional, ranging from governance structures, risk identification, strategic investment planning, through to disclosure, scenario analysis, operational resilience, and finally financial planning. A combined empirical model is needed to understand how these mechanisms work together to affect financial resilience.

Based on this, this study proposes and validates a structural model that links corporate climate-risk governance, climate-risk identification and assessment, strategic climate investment, climate-risk disclosure, and climate resilience capabilities with climate-risk management effectiveness and corporate financial resilience.

Research Objectives

The study aimed at achieving the following:

Research Objectives

1. To investigate the relationship between climate-risk governance and the effectiveness of climate-risk management.
2. To assess the impact of climate-risk identification and climate-risk assessment on the effectiveness of climate-risk management.
3. To analyse how strategic climate investment affects the effectiveness of climate-risk management.
4. To explore how climate-risk disclosure affects the effectiveness of climate-risk management.
5. To evaluate the effect of climate resilience capability on the effectiveness of financial risk management.
6. To analyse and understand the correlation between the effectiveness of climate-risk management and corporate financial resilience.
7. To test whether the effectiveness of climate-risk management acts as a mediating variable between corporate climate strategies and financial resilience.



Research Questions

The following research questions were addressed in the study:

1. Does climate-risk governance significantly affect the effectiveness of climate-risk management?
2. Do climate-risk identification and assessment have a significant impact on the effectiveness of climate-risk management?
3. Are strategic climate investments critical to the effectiveness of climate-risk management?
4. Is there a significant relationship between climate-risk disclosure and climate-risk management effectiveness?
5. Does climate resilience capability significantly affect the effectiveness of financial risk management?
6. Is the effectiveness of climate-risk management positively associated with corporate financial resilience?
7. Does the effectiveness of climate-risk management act as a mediator between corporate climate strategies and financial resilience?

LITERATURE REVIEW

Climate-Related Financial Risks

Financial risk due to climate change is the financial impact of physical climate risk and the transition towards a low-carbon economy. Climate risks may manifest through the existing financial risk classes instead of being a standalone risk class (NGFS, 2020; Bolton et al., 2020). Climate risk isn't necessarily all financial risk. Instead, it is a catalyst of traditional risk groups. Creditworthiness, market valuation and liquidity, operational continuity, insurance costs and investment decisions are some of the impacts that climate exposure can have (Carè, 2023).

Physical risks can result in harm to corporate assets and infrastructure. The NGFS defines acute hazards as short-term challenges and chronic changes as long-term shifts, and it highlights the importance of structured physical-risk assessment, as a starting point to build resilience and be better prepared for financial exposure (NGFS, 2022). Flooding can cause disruptions in manufacturing operations and damage manufacturing facilities in flood-prone areas. Drought and variability in precipitation can be issues for agricultural enterprises, while extreme heat, water shortages and ecosystem degradation can impact tourism enterprises. These effects can impact operating income and capital expenditure.

Transition risks are those that are linked to structural change as part of the decarbonization process. Financial markets evidence also indicates that the uncertainty of climate-policy is priced in for downside tail risk, especially for carbon-intensive companies (Ilhan et al., 2021). Carbon taxes, emissions bans, introduction of renewable energy, electric vehicles, energy efficiency requirements and investor confidence can make companies that rely on carbon-intensive technologies less competitive. When



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technological and/or regulatory developments make an asset economically unviable before its anticipated useful life, it is considered to be a stranded asset.

There is recent empirical evidence confirming the financial relevance of these risks. The results of climate-risk exposure on the financial performance of the company indicate that climate-risk exposure is positively associated with the financial performance of the company (Liu et al., 2024); the evidence generated from climate-risk disclosure research reveals that climate-risk disclosure with financial material information can enhance the usefulness of information for financial analysts (Ben-Amar et al., 2024). Research on firm-level data shows adverse effects of climate exposure on financial performance, and research on climate risk and ESG performance has highlighted the effect of climate risk on corporate reactions through financing constraints and stakeholder attention.

Corporate Climate-Risk Governance

Climate-risk governance are the governance structures, responsibilities, mechanisms of oversight, incentives and accountability systems by which boards and senior management manage climate-related risks.

Good governance sets in place accountability for climate risk at the board and executive level. More recent empirical studies also show that better corporate governance is linked to higher levels of climate-related disclosure, further highlighting the role of governance in climate-risk transparency (Gebhardt et al., 2024; Simsek et al., 2024). It integrates a consideration of climate into strategic planning, investments, risk appetite, executive compensation, and internal control systems.

The TCFD framework also emphasizes the importance of governance as a key pillar of managing climate risks, mandating firms to report on governance responsibilities and actions of the board (FSB, 2017). IFRS S2 also calls for the presentation of governance processes, risk and opportunity controls and procedures that a company has established to monitor, manage and oversee climate related risks and opportunities.

Good governance enhances accountability within the organization. Frequent climate scenario and climate financial exposure review by boards provide better incentives for managers to consider climate in capital budgets and enterprise risk management.

Based on that, the following hypothesis was formulated:

Climate-risk governance has a positive and significant influence on the effectiveness of climate-risk management.

Identification of Climate Risk And Assessment

Identifying climate risks requires a systematic process to identify physical and transition risks across the firm's operations and value chain. Assessment is the process of determining the likelihood, impact, timing and cost of those risks.

To conduct effective climate-risk assessment, organisations need to consider direct assets, suppliers, customers, logistics chains, financial risk and regulatory dependencies. Climate risks are characterized by uncertainty, long time horizons, and nonlinear interactions, making forward-looking scenario analysis



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important (Bolton et al., 2020; NGFS, 2024). Climate risks have various timeframes and scenarios under climate policies; this is relevant for scenario analysis.

IFRS S2 sets out a framework for the identification, assessment, prioritization and monitoring of climate-related risks by organizations and explains whether the framework includes the identification, assessment, prioritization and monitoring of climate-related risks within the framework of overall risk management.

Well- established assessment systems enable organisations to measure the potential losses and implement suitable mitigation actions. Climate-risk assessment is hence a crucial antecedent to the effectiveness of climate-risk management.

The effect of climate-risk identification and assessment on the effectiveness of climate-risk management is quite significant.

Strategic Climate Investment

Strategic climate investment is a type of corporate investment that aims to decrease climate exposure and enhance long-term climate resilience. These can be renewable-energy systems, energy efficiency, low-carbon technologies, resilient infrastructure, water-management systems, supply-chain diversification, climate-smart production, adaptation measures, etc.

Climate investment should not be regarded exclusively as a cost. Corporate green-finance evidence suggests there is a link between green financing and better environmental performance and greater long-term and green investor participation (Flammer, 2021). It can help lower energy use, increase resource efficiency, decrease regulatory risk, conserve production capacity and increase access to capital.

Studies have shown that carbon-reduction activities can be seen to be linked to long term financial benefits, even when carbon performance improvements do not equate to immediate returns (Trencher et al. 2018). The need for organizational capacity to decrease exposure is supported by existing empirical evidence, which has shown that climate exposure can have adverse effects on companies' financial performance (Liu et al., 2024).

Accordingly:

H4: Strategic climate investments are important for the effectiveness of climate-risk management.

Climate-Risk Disclosure

Climate-risk disclosure offers financial stakeholders information regarding climate risk exposures, strategies, governance processes and performance.

Disclosure diminishes information asymmetry among companies and investors, lenders, insurers, regulators etc. For U.S. companies, evidence indicates that, when climate risks are financially material at the industry level, the level of precision in analyst forecasts is related to the disclosure of such risks (Ben-Amar et al., 2024). Also, high-quality disclosure promotes internal governance as companies need to develop governance systems to gather, validate, monitor and report climate-related data.



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The TCFD framework has four interrelated disclosure pillars: governance, strategy, risk management, and metrics and targets (FSB, 2017). IFRS S2 furthers these principles and introduces disclosures of climate-related governance, strategy, risk management and performance.

There have been recent signs that disclosure about climate change has become common. The IFRS Foundation collected data showing that over 1,000 companies mentioned IFRS standards and many jurisdictions made steps towards IFRS-based frameworks. Meanwhile, there were substantial shortcomings around comprehensive disclosure in areas of governance, strategy, risk management and metrics.

H4: The effectiveness of climate-risk management is significantly and positively affected by climate-risk disclosure.

Climate Resilience Capability

Climate resilience capability is the capacity of the firm to anticipate, absorb, adapt and recover from climate-related disruption.

Some of the key components of resilience are operational flexibility, diversification of suppliers, preparedness for emergencies, insurance, financial buffers, technological adaptability and business continuity planning.

A climate-resilient organisation isn't just a reactive climate organisation. Forward-looking resilience assessment and scenario analysis can be used to assess the reaction of strategies and business models to climate-related change and uncertainties (IFRS Foundation 2023; NGFS 2024). It builds skills ahead of the crisis. This involves having enough liquidity, multiple suppliers, placing critical assets outside of the high-risk zone, climate-resilient infrastructure, and alternative production arrangements.

One of the most critical aspects of integrating climate resilience into financial planning is that the impacts of a climate disruption can impact revenues, costs, liquidity, asset values, and borrowing.

The impact of Climate Resilience capability on financial risk management effectiveness is statistically significant and positive.

Climate Risk Management Effectiveness and Financial Resilience

The effectiveness of climate-risk management is indicated by how much climate-related information is integrated into the decision-making processes of an organisation and financial risk-management processes.

Good management will minimize the risk and impact of financial losses due to climate change. This lines up with the logic of treating climate-related risks as part of a financial-risk management framework, rather than as an environmental matter (NGFS, 2020). It enables organisations to invest in resilient assets, provide suitable insurance, have alternative supply chains, ensure liquidity buffers and address transition risks.

Financial resilience is the capacity of the firm to sustain its financial position when the climate makes a difference. Climate risks may have multiple impacts on revenues, costs, asset values, financing and cash flows, so resilience needs to be able to anticipate and withstand multiple interconnected shocks (Bolton et



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al., 2020; IFRS Foundation, 2023). It includes consistent cash flows, liquidity, profitability, debt-servicing capacity, financing capacity, and the capacity to withstand unforeseen losses.

Empirical studies have shown that climate risk can have an impact on financial performance and financial policies. Research based on various data and methods at the firm level obtains results linking climate risk and profitability, operating cash flows, debt, and sales growth (Liu et al., 2024; Wang et al., 2023).

The effectiveness of climate-risk management significantly positively affects corporate financial resilience (H6).

Mediating Role of Climate-Risk Management Effectiveness

The study suggested that a climate governance framework, risk assessment, strategic climate investments and disclosure have a partial effect on financial resilience by increasing the effectiveness of managing climate risks.

Governance helps to create accountability, risk assessment gives information, strategic investment gives resources, disclosure gives transparency. These organising processes are monetised when they translate to effective risk-management practices.

Hence, the following hypotheses were formulated:

H7a: The effectiveness of climate-risk management lies between climate-risk governance and financial resilience.

The effectiveness of climate-risk management in between climate-risk identification and assessment and financial resilience is mediated by H7b.

H7c: Effective climate-risk management is a mediator between strategic climate investment and financial resilience.

H7d: The effectiveness of climate-risk management is a mediator between disclosure of climate-risk and financial resilience.

Theoretical Framework

The study was primarily based on the three theoretical perspectives, which were the resource-based view (RBV), stakeholder theory, and dynamic capabilities perspective.

The RBV suggests that firms have sustained advantages based on valuable and hard-to-imitate resources and capabilities (Barney, 1991). The ability to manage climate risks is a resource that can be built, maintained, and leveraged by the organization to plan ahead, allocate resources effectively, and remain resilient when the environment is disrupted.

The stakeholder theory, introduced by Freeman (1984), is the rationale for corporations' climate-related responses to investor, regulatory, employee, customer, community, and other stakeholder expectations. Climate-risk disclosure and governance are thus ways that companies respond to the demands of various stakeholders.



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Dynamic capabilities theory also helps to understand that the way organizations respond to external changes involves their sensing, seizing and transforming ability (Teece et al., 1997). The external environment is uncertain due to climate change, and adaptation is a never-ending process. When assets and processes are at risk because of climate change, firms must be alert to the prospects of climate change risk and the opportunities of the low-carbon technologies, as well as the need to change their business models.

This integrated theoretical framework suggests that governance, climate-risk assessment, climate investment, and disclosure increase organizational capacity, as a result of which their capacity to manage climate risk is enhanced and financial resilience is increased.

Conceptual Model

The conceptual model contained six principal constructs:

1. Climate-Risk Governance (CRG)
2. Climate-Risk Identification and Assessment (CRIA)
3. Strategic Climate Investment (SCI)
4. Climate-Risk Disclosure (CRD)
5. Climate Resilience Capability (CRC)
6. Climate-Risk Management Effectiveness (CRME)
7. Corporate Financial Resilience (CFR)

The structural relationships were specified as:

CRG → CRME

CRIA → CRME

SCI → CRME

CRD → CRME

CRC → CFR

CRME → CFR

The four indirect relationships from CRG, CRIA, SCI, and CRD to CFR through CRME were also tested.

METHODOLOGY

Research Design



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The research design used was quantitative and cross sectional research. The data was gathered through a structured questionnaire to assess the practices and financial robustness of the company's climate risk management.

The unit of analysis was the organization, and respondents were managers and professionals with knowledge of corporate strategy, finance, risk management, sustainability, operations management, and/or governance.

The research design was suitable, as it investigates relationships between several latent constructs and the measurement of reliability and structural relationships were evaluated simultaneously.

Population and Sampling

The population consisted of corporate management and senior professionals from companies facing physical and/or transition climate risks. Those included in the respondents were from finance, accounting, risk management, sustainability, strategy, operations, supply-chain management and senior management.

500 questionnaires were handed out. Out of these, 451 questionnaires were returned. The number of questionnaires that were screened out for incomplete responses was 428 questionnaires, which showed an 85.6% usable response rate.

Organizations from manufacturing, banking and financial services, energy, telecommunications, construction, transportation, retail, hospitality and other service organizations were included in the sample.

Data Collection Instrument

The data was gathered using a structured questionnaire that followed a theoretical framework developed using the dimensions of climate governance, climate-risk management, corporate sustainability, and financial resilience.

Five-point Likert scales ranging from: were used in all constructs.

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree.

The questionnaire included statements which measured the following constructs.

Climate-Risk Governance

Items measured:



Board involvement in climate-related risks.

- Senior-management responsibility for climate risk.
- Incorporation of climate risk into corporate governance.
- Climate-related accountability.
- Incentives and performance monitoring related to climate.
- Identify and assess climate risks. Identifying and assessing climate risks.

Items measured:

- Physical climate risks identified.
- Risk identification for transition.
- Climate-risk assessment throughout the value chain.
- Scenario analysis.
- Estimating climate risks financially.
- Strategic Climate Investment

Items measured:

- Energy efficiency investments.
- Investment in renewables.
- Resilient investments in infrastructure.
- Low-carbon technology adoption.
- Climate-related capital budgeting.
- Climate-Risk Disclosure

Items measured:

- Climate Risk Disclosure.
- Disclosure of financial effects.
- Public commitment to climate targets.

Reporting of GHG emissions.



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- Transparency on climate strategy.
- Climate Resilience Capability

Items measured:

- Business continuity planning.
- Supply-chain resilience.
- Operational flexibility.
- Emergency preparedness.
- Adaptation capability.
- Climate-Risk Management Effectiveness

Items measured:

- Reporting of climate risks.
- Effective climate-risk monitoring.
- Climate-risk mitigation effectiveness.
- Timely management response.
- Climate-risk decision integration.
- Corporate Financial Resilience

Items measured:

- Liquidity in the event of disruption.
- Ability to safeguard profitability.
- Ability to cover cash flow.

Ability to pay back debts.

- Being able to obtain external funding.

DATA ANALYSIS



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Partial least squares structural equation modeling (PLS-SEM) was used to analyze the data. With the incorporation of several latent constructs, predictive relationships, mediation, and a somewhat complex structural model, PLS-SEM was chosen for this study.

The analysis was conducted in two phases. The measurement model was examined for the indicator loadings, Cronbach's alpha, composite reliability, average variance extracted (AVE), and discriminant validity. Second, the path coefficients, bootstrapping, coefficient of determination (R^2), effect sizes (f^2), predictive relevance (Q^2), and indirect effects were evaluated for the structural model.

The focus of PLS-SEM research is to assess the indicators' reliability and internal consistency reliability of reflective constructs, convergent validity, and discriminant validity (Hair et al., 2022; Sarstedt et al., 2022).

The statistical significance of path coefficients was estimated with a bootstrapping procedure with 5,000 resamples.

RESULTS

Respondent Profile

The 428 respondents who provided valid responses included 61.2% men and 38.8% women. In terms of organizational role, 16.4% reported as senior executives, 27.6% as middle level managers, 31.5% as departmental managers, and 24.5% as professional staff with finance, sustainability, risk, strategy or operations-related responsibilities.

About 34.1% experienced over 15 years of professional work, 38.8% experienced between eight and 15 years of professional work, and 27.1% experienced less than eight years of professional work.

The sample thus comprised respondents with a high level of organizational knowledge and experience in strategic and financial decision making.

Descriptive Statistics

The descriptive results showed a relatively high score for corporate climate-risk governance and disclosure, and a comparatively low score for climate scenario analysis and quantification of climate-related financial impacts.

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Construct

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Mean



SD

Climate-Risk Governance

3.71

0.74

Climate-Risk Identification and Assessment

3.62

0.77

Strategic Climate Investment



3.48

0.81

Climate-Risk Disclosure

3.55

0.79

Climate Resilience Capability

3.59

0.76



Climate-Risk Management Effectiveness

3.67

0.72

Corporate Financial Resilience

3.74

0.70

The results indicate that respondents generally perceived their organizations as moderately to strongly engaged in climate-risk management.

Measurement Model

Indicator Reliability

The standardized outer loadings of the retained items ranged from 0.704 to 0.891. All retained indicators exceeded the commonly accepted threshold of 0.70.

These findings established adequate indicator reliability.



Internal Consistency Reliability

Cronbach's alpha values ranged from 0.861 to 0.924, while composite reliability values ranged from 0.901 to 0.943.

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Construct

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Cronbach's Alpha

--

Composite Reliability

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AVE

--

CRG

--

0.902

--

0.927



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0.718

CRIA

0.891

0.919

0.694

SCI

0.874

0.909



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0.666

CRD

0.861

0.901

0.645

CRC

0.883

0.915



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0.683

CRME

0.924

0.943

0.769

CFR

0.913

0.935



0.741

All composite reliability values exceeded 0.70 and all AVE values exceeded 0.50. The measurement model therefore demonstrated satisfactory internal consistency and convergent validity.

Discriminant Validity

Heterotrait-monotrait ratio (HTMT) was used to assess the discriminant validity. As to the constructs, all the HTMT values were less than 0.85, which means that the constructs were empirically distinct. The results showed that climate governance, risk assessment, investment, disclosure, resilience, management effectiveness and financial resilience were distinct rather than alternative measures of the same construct.

Structural Model

The structural model produced the following results.

Hypothesis

Relationship

β

t-value



p-value

Decision

H1

CRG → CRME

0.241

4.91

<0.001

Supported



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H2

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CRIA → CRME

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0.286

--

5.83

--

<0.001

--

Supported

--

H3

--

SCI → CRME

--



0.198

3.97

<0.001

Supported

H4

CRD → CRME

0.176

3.61



<0.001

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Supported

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H5

--

CRC → CFR

--

0.271

--

5.42

--

<0.001

--

Supported

--



H6

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CRME → CFR

--

0.462

--

9.18

--

<0.001

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Supported

The results provided support for all six direct hypotheses.

Effect of Climate-Risk Governance

The climate-risk governance had positive and statistically significant relationships with the climate-risk management effectiveness ($\beta = 0.241$, $t = 4.91$, $p < 0.001$).

The discovery shows that companies that have more robust board oversight, executive accountability, climate-related responsibilities and governance systems have more effective climate-risk management.

This aligns with the TCFD and IFRS S2 frameworks, which emphasize governance as the hub of climate-related risk oversight.

As such, the support of H1 was warranted.

The impact of Climate-risk identification and assessment is discussed at 9.2.



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The greatest direct effect of the four strategic antecedents of climate-risk management effectiveness was demonstrated by the identification of climate risks and their assessment ($\beta = 0.286$, $t = 5.83$, $p < 0.001$).

This outcome shows that enterprises must have trustworthy exposure data to effectively manage their climate risk. Companies that understand physical and transition risks, know their financial impact, and can conduct scenario analysis can better manage to incorporate climate risk into their strategic and financial decisions.

Hence, H2 was advocated.

The strategic Climate Investment is 9.3.

The strategic climate investment had a significantly positive impact on the effect of climate-risk management ($\beta = 0.198$, $t = 3.97$, $p < 0.001$).

The discovery suggests that the organization will be better able to manage climate risk as a result of investments in energy efficiency, renewable energy, resilient infrastructure, and low carbon technologies.

This is in line with evidence which suggests that corporate carbon-reduction strategies can have long-term financial returns (Trencher et al., 2018).

Thus, it was accepted that H3 was supported.

Effect of Climate-Risk Disclosure

The effectiveness of climate-risk management showed to be positively and significantly related to climate-risk disclosure ($\beta = 0.176$, $t = 3.61$, $p < 0.001$).

There was a statistically significant relationship, but the coefficient was smaller for the relationship between risk assessment and governance. This means that disclosure does not just happen as a way of communicating externally. Development of climate related information fosters internal accountability and inspires companies to set up monitoring and reporting mechanisms.

So, H4 was endorsed.

Impact of Climate Resilience Capability

Financial resilience of the company was significantly positively influenced by capability in climate resilience ($\beta = 0.271$, $t = 5.42$, $p < 0.001$).

This discovery suggests that companies with more resilient supply chains, more flexible business operations, better emergency preparedness and adaptation are more financially resilient.

Hence, the support was given to H5.

Enhance the effectiveness of climate-risk management.



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The direct effect was the highest for climate-risk management effectiveness ($\beta = 0.462$, $t = 9.18$, $p < 0.001$) with regards to corporate financial resilience.

The outcome shows that financial value is added through climate strategies mainly if they are embedded in existing risk-management processes. Publishing climate commitments is one thing, but capital allocation, liquidity planning, insurance, supply-chain decisions, operational planning, and strategic choices are all aspects of a company's financial resilience where climate information plays a role.

So, H6 was backed.

Coefficient of Determination

The structural model accounted for 67.8% of the variance in the climate-risk management effectiveness ($R^2 = 0.678$).

This model also accounted for 61.4% of the variation in corporate financial resilience ($R^2 = 0.614$).

The results show a considerable amount of explanatory power.

The relatively high R^2 for climate-risk management effectiveness shows that governance, climate-risk assessment, strategic investment and disclosure are all important determinants of effective corporate climate-risk management.

Likewise, the R^2 value for financial resilience confirms that a significant share of the financial resilience variation of companies is accounted for by the effectiveness of climate-risk management and the companies' climate-resilience capabilities.

The Concept of Effect Size and the Relevance of Prediction

The effect-size analysis showed that the identification and assessment of climate risks (76%) and climate-risk governance (72%) were the greatest contributors to the effectiveness of climate-risk management, as was climate-risk disclosure (65%) and strategic climate investment (64%).

The effectiveness of climate-risk management has a large effect on financial resilience, while the financial resilience capability has a medium effect.

The values of Q^2 for the endogenous constructs were positive, indicating predictive relevance of the model.

The findings show the proposed model was found to be statistically significant as well as practically helpful in predicting the corporate climate-risk management and financial resilience.

Mediation Analysis

To test for mediation, the effectiveness of climate-risk management was tested for the transmission of the effects of the strategic climate variables to financial resilience.



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Mediation Path

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Indirect β

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t-value

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p-value

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Result

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CRG $\rightarrow$ CRME $\rightarrow$ CFR

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0.111

--

4.52



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--

<0.001

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Supported

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CRIA → CRME → CFR

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0.132

--

5.11

--

<0.001

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Supported

--

SCI → CRME → CFR



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0.091

3.48

0.001

Supported

CRD → CRME → CFR

0.081

3.22

0.001



Supported

All indirect effects were statistically significant.

The findings indicate that climate governance, risk assessment, strategic investment, and disclosure improve financial resilience partly because they strengthen the effectiveness of corporate climate-risk management.

Climate-risk identification and assessment generated the largest indirect effect. This result demonstrates that accurate identification and financial assessment of climate risks provide the information base for effective managerial action.

All four mediation hypotheses were therefore supported.

DISCUSSION

The results show that climate related financial risk management is about the organization's strategy and not just the limited scope of environmental management.

Climate-risk identification and assessment was the most powerful predictor of effective climate-risk management. The discovery underscores the need for not only raising awareness about climate but also for financial-relevant risk measurement. Organisations should be made aware of the physical vulnerability of their assets, the vulnerability of their suppliers, the impact of regulatory change on costs and the impact of technological transition on asset values.

The significant relationship between governance and climate-risk management confirms the importance of board-level accountability. Climate risks may take a longer time to emerge than traditional business planning. In the absence of board oversight, managers may choose short-term profits over long-term sustainability. Good governance sets climate risk on the agenda.

Significant linkage between strategic climate investments and climate-risk management suggests financial resources are needed for climate adaptation and transition. Energy efficiency, renewable energy, resilient infrastructure and low carbon technologies can help to decrease future exposures. The finding is significant as disclosure alone is not enough to support the climate-risk management.

The positive correlation between disclosure and climate-risk management suggests that climate-risk management may be impacted by the disclosure requirement, within the organization. The process of climate disclosures involves companies identifying risks, defining responsibilities, gathering data and determining performance indicators. Therefore, when disclosure is linked to decision making, it can help enhance management systems.

The model's strongest direct connection was that between financial resilience and the effectiveness of climate-risk management. This result validates the claim that strategies related to climate change can be of financial value if incorporated in enterprise risk management.



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The results are also in line with the general literature. Empirical studies suggest that climate exposure can negatively impact corporate financial performance, and organizational capabilities can help buffer against those impacts (Liu et al., 2024; Wang et al., 2023).

The results also align with the direction of the Institutions as per IFRS S2. The IFRS S2 doesn't just mandate that organisations link climate risk to business strategy, financial position, performance and cash flow; it also calls for it to be viewed as a whole sustainability disclosure rather than as a standalone item.

Corporate Strategies in Climate-Related Financial Risk Management

Based on the empirical findings, a holistic corporate strategy is identified.

This section addresses how to incorporate climate risk into enterprise risk management. This section covers the integration of climate risk into enterprise risk management.

Risk due to climate change needs to be embedded in current enterprise risk-management frameworks. Firms need to determine the impact of climate exposure on credit, market, liquidity, operational, insurance, legal and reputational risk.

Climate risk should therefore be included in risk registers, risk appetite statements, internal controls, investment approvals and in board risk reports.

Contribute to the Development Of Board Level Climate Governance

Boards should take a clear leadership role in climate-related risks and have clear reporting procedures between management and the board.

Directors should be trained in the field of climate expertise, and climate targets should be linked to top management evaluation.

Implementing Climate Scenario Analysis

A tool for evaluating resilience at different climate and transition scenarios is scenario analysis.

Companies should consider the scenarios of:

- accelerated decarbonization;
- delayed transition;
- higher carbon prices;
- extreme physical climate events;
- prolonged water scarcity;
- supply-chain disruption;



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- technological substitution; and
- changes in consumer demand.

Scenario analysis should be linked to financial projections, and not used as a sustainability exercise.

Relationship between Capital Allocation And Climate Risk

Climate-related financial variables should be considered in capital budgeting.

In making investment decisions they should take into account:

- carbon costs;
- energy prices;
- physical climate exposure;
- regulatory changes;
- asset-stranding risk;
- adaptation expenditure;
- insurance costs; and
- expected disruption losses.

This can help companies identify assets that will continue to be financially viable in future climates, and those that are becoming more vulnerable.

Strengthening Supply-Chain Resilience

The risk stemming from climate change often lies beyond the immediate scope of a firm's operations.

Businesses should prioritize minimizing supply exposure to climate vulnerability and diversifying their suppliers. Financial impacts of climate disruption can be mitigated through geographic diversification, strategic inventories, supplier partnerships, and digital supply-chain monitoring.

Establishing Climate-Related Financial Metrics

For companies to develop measurable indicators, they should include:

- Scope 1 emissions;
- Scope 2 emissions;
- relevant Scope 3 emissions;



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- carbon intensity;
- climate-related capital expenditure;
- physical-risk exposure;
- transition-risk exposure;
- internal carbon prices;
- climate-related insurance costs;
- climate-related losses;
- energy intensity; and
- advances toward climate goals.

IFRS S2 particularly highlights the following cross-industry metric categories: emissions, transition risks, physical risks, climate opportunities, capital deployment, internal carbon pricing and management remuneration.

Maintaining Financial Buffers

The ability to be resilient to climate change depends on having the right liquidity.

Businesses vulnerable to climate physical risks should have adequate cash reserves, credit facility, insurance and contingency financing.

Firms can make unplanned losses without reducing productive investment because of financial buffers.

Building Human Capital Resilience to Climate Change

Climate-risk knowledge is needed for finance, strategy, risk, operations and procurement.

Climate-risk competence should entail:

- climate scenario analysis;
- financial risk modeling;
- carbon accounting;
- climate disclosure;
- sustainable finance;
- Risk assessment of the supply chain; and



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- adaptation planning.

THEORETICAL CONTRIBUTIONS

The study makes several contributions to the literature.

Firstly, it combines corporate climate strategy and financial risk management. Often, direct links between climate exposure and financial performance are the focus of existing studies. This study, on the other hand, clarifies how climate strategies affect financial resilience by examining the organizational mechanisms that link the two.

The second is that this study illustrates the mediating role of the effectiveness of climate risk management in the organizational capacity.

Third, the study shifts the resource-based view and dynamic capabilities approach by envisioning the climate-risk management as a financial resource protection strategic capability.

Fourth, the study offers empirical evidence that governance, assessment, investment and disclosure are complementary, rather than separate, climate strategies.

Lastly, the study shows the applicability of structural equation modeling for investigating multidimensional corporate climate-risk relationships. Previous studies have also used structural equation modeling to analyse the interconnected constructs of corporate climate strategies (Trencher et al., 2018), which shows that SEM is suitable for analysing interconnected constructs.

Managerial Implications

The results have several implications for corporate managers.

Climate risk should be on the agenda of any board of directors in strategic oversight and enterprise risk management.

CFOs should factor climate risks into capital budgeting, financial forecasting, liquidity planning, asset valuation and financing strategies.

Chief risk officers should integrate climate risk into their risk identification, scenario analysis, stress testing, insurance management and business continuity planning.

Climate disclosure for sustainability managers should come hand in hand with operational performance and financial information.

Investors should consider the extent of the disclosure link with, rather than by the volume of, climate disclosures as part of the assessment, the findings suggest.

The findings support the creation of uniform disclosure and governance guidelines for climate risks from a regulator's perspective.

POLICY IMPLICATIONS



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The conclusions also have policy implications for the emerging markets.

Monitors and investors should create uniform disclosure frameworks for climate risks and encourage incorporation of climate risk into corporate governance.

Financial regulators should motivate banks and financial institutions to consider climate exposures in their lending and investment portfolios.

Governments should also enable companies to adapt through suitable financial incentives, technical and climate resilient infrastructure.

Standardized reporting frameworks, like IFRS S2, offer a valuable starting point as they mandate that organizations link climate risks to governance, strategy, risk management and metrics.

LIMITATIONS

There are a few limitations of the study.

First, the cross-sectional research design makes it difficult to determine temporality. Long-term follow-up studies can explore the long-term consequences of climate strategies on financial resilience.

Secondly, the study was based on the perceptions of managers. Respondents selected for the survey were identified by their organizational roles, but future research could merge survey responses with objective data on financial and climate performance.

Thirdly, there are significant differences in climate risks among industries. The agriculture, construction, energy, and transportation sectors are especially vulnerable to physical risks, and fossil-fuel-based sectors may be more vulnerable to transition risks.

Fourth, countries have different norms for climate regulation. As a result, the relationship strengths found in this research study could differ in various institutional settings.

Finally, the study looked at the climate-risk management of companies at organizational level and did not consider the financial impacts on specific physical risks separately.

Future Research Directions

Future research should use longitudinal datasets to explore whether the use of climate-risk management leads to lasting benefits, in terms of profitability, liquidity, market valuation and financing costs.

Objective climate exposure indicators, including geospatial physical-risk indicators, emissions intensity, exposure to carbon prices, and climate-related financial losses, should also be included in the researcher's consideration.

The relationship between firm size, industry, leverage, ownership structure, board characteristics, and environmental regulation could be explored in future research to determine whether they moderate the relationships identified here.



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Further studies are also needed on the use of AI for climate-risk prediction. AI-based systems can combine climate data, financial information, satellite observations, supply-chain information, and market data to develop dynamic climate-risk assessments.

Lastly, future studies may explore the link between climate-risk management and cost of capital, credit ratings, stock-price volatility, and corporate valuation.

CONCLUSION

Climate change is now a very large corporate financial risk affecting business continuity, profits, asset value, financing, long-term enterprise value and liquidity. Therefore, good management involves using climate factors as a tool for corporate strategy and financial risk management and goes beyond compliance.

This study investigated corporate strategies for dealing with financial risk stemming from climate change through structural equation modeling. The empirical model was tested with data on 428 managers and professionals, and relationships were examined between climate-risk governance, climate-risk identification and assessment, strategic climate investment, climate-risk disclosure, climate resilience capability, and climate-risk management effectiveness, as well as between the latter and corporate financial resilience.

The outcomes show that the four climate-risk governance tools significantly enhance the effectiveness of climate-risk management. Financial resilience is highly benefited from climate resilience capability, and the effectiveness of climate-risk management is the highest direct influence on financial resilience.

The mediation findings also showed that the effectiveness of climate-risk management mediated the impact of key corporate climate strategies on financial resilience. The findings thus indicate an integrated approach for which governance is responsible for setting up accountability, risk assessment is responsible for giving out information, strategic investment is responsible for providing resources, disclosure is responsible for increasing transparency, and climate-risk management is responsible for turning these organizational inputs into financial resilience.

The findings are relevant to the context of the shift from TCFD based recommendations to ISSB. IFRS S2 calls for communicating about governance, strategy, risk management, and climate-related metrics and targets, and links climate risks with financial position, performance, and cash flows.

This research's main finding is that, climate-risk management in businesses is most effective when the integrated climate consideration is part of the business' core decision-making framework. Climate governance on its own is not enough, disclosure on its own is not enough, and investment without strategic prioritization is not enough. The most effective solution integrates governance, identifying risks and scenarios, climate investment, disclosure, operational resilience, and financial planning.

Corporate climate strategy has thus become part of the company's long term financial strategy. Building finance resilience through systematic identification of climate exposure, investing in resilience, improving governance, providing financial buffers, and incorporating climate risks into enterprise risk management (ERM) are keys to financial stability and competitiveness in a climate-constrained economy.

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