CLIMATE CHANGE RISK AND FINANCIAL STABILITY

ABHISHEK KURUPPATH

MASTER'S THESIS

Klimato kaitos rizika ir finansinis stabilumas	Climate Change Risk and Financial Stability

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Summary

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The research study used secondary data gathered from various academic publications and scholarly databases, industry reports and other policy documents in both quantitative and qualitative form to address the underlying research objectives. The research data collected from secondary sources help in deeper comprehension of how climate effects financial stability.

The research aims at studying the impact of climate risks on financial stability and a mixed methodology approach combining numerical and non - numerical data is used to get a comprehensive understanding. The pragmatic research philosophy is employed to utilize diverse methods for constructing technology. An abductive approach is used to explain sequential research starting with qualitative analysis combining quantitative to understand the topic better.

The research deeply focuses on how climate crisis like natural disasters and unpredictable weather effects the efficiency of the financial system. It focuses on factors such as identifying climate change exposures, assessing consequences of climate change and spillover effects of climate related financial disruptions to tackle climate change.

The research examines how climatic events like floods and hurricane impact the economy. Climate risks both physical and transitional can affect financial stability which leads to higher insurance expenses, higher default rates, increased costs to transition to

greener economy. The research suggests to prioritize climate change mitigation to achieve long term benefits and reduce severity of climate change events.

Abstract

The occurrence of climatic events such as floods, hurricanes, and unpredictable weather patterns has adverse implications on the stability of the entire economic system. This study focused on three specific objectives, which included determining the different risks of climatic alterations and their impacts on the monetary system's efficiency, establishing the potential impacts of discrepant strategies of containing the adversities of climate change on the steadiness of the financial establishment, and determine the spillover consequences of the climate change-induced distortions of the monetary system on other economic sectors. The study applied a mixed-methods research method and secondary data to address these objectives by relying on evidence from fourteen secondary sources. The findings indicated that climate risks emanate from physical and transitional sources and adversely impact the financial system's stability. These risks are associated with a rise in default rates for bank credit, increased funding requirements for transition to a green economy, and insurance expenses in indemnifying affected sectors. Therefore, the risks of climate change generate distortions that affect the financial system's stability. The study recommends that policymakers and climate change actors prioritize climate change mitigation to leverage long-term gains of transitioning to green economies and reduce the severity of climatic events.

Keywords: climate change, transition risks, physical risks, financial, stability.

SANTRAUKA

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Tyrime naudojami antriniai duomenys, surinkti iš įvairių akademinių publikacijų ir mokslinių duomenų bazių, rinkos ataskaitų ir kitų politikos dokumentų, pateiktų tiek kiekybine, tiek kokybine forma, siekiant atsakyti į pagrindinius tyrimo uždavinius. Iš antrinių šaltinių surinkti tyrimo duomenys padeda geriau suprasti, kaip klimato poveikis veikia finansinį stabilumą.
Tyrimo tikslas – analizuoti klimato rizikos poveikį finansiniam stabilumui, naudojant mišrią metodologiją, kuri sujungia kiekybinius ir kokybinius duomenis, siekiant išsamiai suprasti temą. Pragmatiška tyrimo filosofija taikoma siekiant pasitelkti įvairius metodus.

Tyrime taikomas abduktyvus požiūris, pradedant kokybine analize ir derinant ją su kiekybine, kad būtų geriau suprasta nagrinėjama tema.
Tyrime gilinamasi į tai, kaip klimato krizės, tokios kaip stichinės nelaimės ir nenuspėjami orai, daro įtaką finansų sistemos efektyvumui. Dėmesys skiriamas tokiems veiksniams kaip: klimato kaitos poveikio nustatymas, klimato kaitos pasekmių vertinimas ir su klimatu susijusių finansinių sutrikimų poveikio plitimo analizė, siekiant spręsti klimato kaitos problemas.

Tyrime nagrinėjama, kaip klimato reiškiniai, tokie kaip potvyniai ir uraganai, veikia ekonomiką. Klimato rizikos, tiek fizinės, tiek pereinamosios, gali turėti įtakos finansiniam stabilumui, o tai lemia didesnes draudimo išlaidas, didesnį įsipareigojimų nevykdymo dažnį, didesnes išlaidas pereinant prie ekologiškesnės ekonomikos. Tyrime siūloma prioritetą skirti klimato kaitos mažinimui, siekiant ilgalaikės naudos.

Santrauka

Klimato reiškiniai, tokie kaip potvyniai, uraganai ir nenuspėjami orai, neigiamai veikia ekonomikos sistemos stabilumą. Šio tyrimo tikslai buvo trys: išsiaiškinti, kokias rizikas kelia klimato pokyčiai ir kaip jos veikia finansų sistemos efektyvumą, suprasti, kaip skirtingos strategijos sprendžiant klimato problemas gali paveikti finansinį stabilumą, ir nustatyti, kaip klimato pokyčių sukeltos finansų sistemos problemos paveikia kitus ekonomikos sektorius. Tyrime buvo naudoti mišrūs metodai ir analizuojami duomenys iš 14 antrinių šaltinių. Rezultatai parodė, kad klimato rizikos kyla dėl fizinių (pvz., potvynių) ir pereinamųjų (pvz., ekonomikos perėjimo prie žaliosios energijos) veiksnių, o tai blogina finansų sistemos stabilumą. Šios rizikos lemia didesnį nepaengtų paskolų skaičių, didesnį lėšų poreikį žaliosios ekonomikos kūrimui, ir didesnes draudimo išlaidas. Atlikus tyrimą rekomenduojama, kad politikos formuotojai ir klimato kaitos valdytojai daugiau dėmesio skirtų klimato kaitos švelninimui. Tai padėtų ilgainiui pereiti prie žaliosios ekonomikos ir sumažintų klimato reiškinių žalą.

Raktiniai žodžiai: klimato kaita, pereinamosios rizikos, finansų stabilumas.

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INTRODUCTION

The occurrence of climatic events such as floods, hurricanes, and unpredictable weather patterns has adverse implications on the stability of the entire economic system. This study focused on three specific objectives, which included determining the different risks of climatic alterations and their impacts on the monetary system's efficiency, establishing the potential impacts of discrepant strategies of containing the adversities of climate change on the steadiness of the financial establishment, and determine the spillover consequences of the climate change-induced distortions of the monetary system on other economic sectors. The study applied a mixed-methods research method and secondary data to address these objectives by relying on evidence from fourteen secondary sources. The findings indicated that climate risks emanate from physical and transitional sources and adversely impact the financial system's stability. These risks are associated with a rise in default rates for bank credit, increased funding requirements for transition to a green economy, and insurance expenses in indemnifying affected sectors. Therefore, the risks of climate change generate distortions that affect the financial system's stability. The study recommends that policymakers and climate change actors prioritize climate change mitigation to leverage long-term gains of transitioning to green economies and reduce the severity of climatic events.

Keywords: climate change, transition risks, physical risks, financial, stability.

Research Question

- What is the consequence of climate change-related risks on the steadiness of the financial establishment?

Justification of the Novelty and Relevance of the Research

The issue examined in this study is the consequence of climate crises on the financial system's soundness. Current scholarship into this research area by Battiston, Dafermos, and Monasterolo (2021) acknowledges that climate-related exposures pose significant threats to the financial stability of economies. Sun et al. (2022) and Pagnottoni et al. (2022) contend that current problems in the issue of climate crises, coupled with its implications on the health of the financial system, revolve around the estimation of exposures of the financial establishment to exposures stemming from climate change, the improvement of scenario analysis within the banking sector and developing monitoring systems to facilitate the financing of a green transition. The study focuses on a novel area of research owing to the inadequacies of the current research to propound suitable methodologies for estimating the consequences of climatic alterations on the financial system. Indeed, perspectives from Battiston, Dafermos, and Monasterolo (2021) suggest that in spite of the growing focus paid to the detriment posed by climatic alterations to the financial system, there still lies a significant gap in developing methodologies that can facilitate a comprehensive analysis of these exposures and their implications on the financial system.

Formulation of The Problem

The evidence of the problem in this research field is the significant challenge fronted by climatic alterations on the health of the financial establishment. Wu, Liu, and Lin (2023) explain that the increased occurrence of natural disasters induces a loss of assets, adversely impacting social development. FSB (2020) estimates that climate change's uncertainties could deteriorate asset prices with a 2.5ºC rise in temperatures anticipated for 2105, likely to induce asset price reductions in the range of 1-1.8%. Under a baseline scenario, FSB (2020) indicates that a possible severe decrease in the prices of assets due to climate change would be by 30.1%. This value represents an erosion in the value of assets by USD 43 trillion, with a probability of 3% that this is likely to occur by 2105 (FSB, 2020). Campiglio et al. (2018) report that the adverse implications of change in the climatic patterns on the steadiness of the financial system pose great difficulties to financial regulators and central banks. However, Battiston, Dafermos, and Monasterolo (2021) explain that it was only recently that actors from the financial sector and markets seemed to have an inadequate

internalization of comprehending the exposures of climatic alterations on prices of financial assets as well as risk metrics. Indeed, evidence from Dafermos, Nikolaidi, and Galanis (2018) and Sun et al. (2022) shows that the financial economy segment has only been increasingly involved in conversations relating to climatic alterations since the 2015 Paris Agreement. In concurrence, Battiston and Monasterolo (2020) and Depres and Hiebert (2020) explain that financial supervisors have recently explicitly recognized the alteration of climatic patterns as a novel origin of financial exposures. Therefore, Battiston, Dafermos, and Monasterolo (2021) stress that various measures have been introduced to encourage reporting risks related to climate change. In this regard, it is necessary to highlight the problem of identifying to what extent climate change risks disrupt the financial system's balance of stability.

Subject Matter

This paper's central focus is to comprehend the implications of the threats posed by climatic alterations and the implications of transforming to an economic regime with low carbon on the overall steadiness of the financial establishment. The subject matter of this investigation entails the all-encompassing imperatives of the changing climatic patterns, policymaking, and implications of the exposures fronted by such changes on the soundness of the financial system.

Objective Task

The specific objective of this inquiry is to determine the degree to which the emerging climatic crises emanating from unpredictable weather patterns, floods, and natural disasters subside the efficiency of the financial system to offer mitigative measures. The specific tasks undertaken by this study include:

- To determine the manifold exposures of climate change and their implications on the monetary system's efficiency.
- To establish the possible consequences of various climate-change containment strategies on the soundness of the financial establishment.
- To identify the spillover effects of the climate-related disruptions of the financial establishment on other sectors of the economy.

Chosen Research Methods

The current research study was carried out using a mixed-methods study design. The approach of employing mixed-methods study in research means that the researcher gathers data from different sources and, in which there is a combination of numerical and non-numerical data with the aim of elevating the quality of the general results of the study, as indicated by McKim (2017). The data collected for this study comprised both numerical and non-numerical data gathered from secondary sources. The secondary data consisted of information retrieved from industry reports, published reports by the policymakers of the financial sector, climate change policy information, and published literature in this area. Notably, academic databases and the Google Scholar search engine were applied to retrieve these data sources. The databases used to gather related data included Emerald Insight, Scopus, and Sage Open, which were useful for retrieving peer-reviewed literature, as stated by Gusenbauer and Haddaway (2020). Chapter three is dedicated to the description of the applied research methods and techniques.

Structure of the Work

This thesis is composed of three chapters. The first chapter introduces the research idea and provides the background, which sets the scene for the investigation to comprehend the outcomes of climatic alterations on the financial system's steadiness. The second chapter delves into the theoretical aspects of the paper, which entail reviewing the existing body of work and material in this field to understand findings established by previous researchers. The chapter also identifies the gap in the literature that this study is attempting to bridge. and discusses with justifying the methods and techniques applied to gather, analyze, and interpret the findings to comprehend the nexus between climatic alterations and financial stability. Subsequently, chapter three presents the analytical part of this study, which includes the findings and a discussion linking them to the current body of research in this research field. And lastly, concludes this study and gives relevant recommendations for practice and further scholarship.

Brief Discussion of the Difficulties and Limitations of the Research

The researcher encountered various difficulties and limitations when conducting this research, ranging from inadequate funds to provide logistical support in the recruitment of respondents to the challenge of running regressions for modeling the consequences of climatic

unpredictability on the financial establishment's robustness and ensuring that the scope of the data collected was suitable to foster the generalizability of the findings. Besides, the task of designing the regression model and then conducting actual regression analysis was also very time-consuming and tedious due to the existence of many variables. Finally, the researcher had to decide that the evidence presented in this study would be based on a wide range of contexts to eliminate the common weakness of generating data that may not apply well to any other context apart from the one under study.

1. IDENTIFYING FACTORS TO SEE HOW CLIMATE CHANGE EFFECTS FINANCIAL STABILITY

Although climate change has become an important topic of discussion in many fields, in the financial literature, the threat of climate change is defined as an enabler in relation to threats to the financial system. For example, in their inquiry, Battiston, Dafermos, and Monasterolo (2021) claim that there has been more focus on this aspect, primarily because of the belief that modifications in climate represent significant threats to the financial system's stability. It is pertinent to know how exactly climate crises are a menace to the financial system's steadiness by analyzing the nature of these variables (Sun et al., 2022). Climate hazards and their relationship with the financial system's steadiness are both highly relevant for transitioning to an economy with a small carbon intensity as well as pose crucial methodological questions to academic research, as Battiston, Dafermos, and Monasterolo (2021) demonstrate. However, perspectives mentioned by Brunetti et al. (2021) reveal that climate risks are particularly defined by hazards that affect the stability of the whole financial structure, including deep uncertainty and endogeneity as well as non-linearity that provides primary concerns to major difficulties in the methodologies for the macroeconomic and financial analysis. Indeed, similar views by Carney (2015) and Sun et al. (2022) reveal that such rebranding has been criticized by academics and policymakers alike because companies have increasingly adopted greenwashing techniques through deceptive labels such as "climate change" and "green" with no concrete determination of models that could enable practitioners to determine the risks posed by the climate's unpredictable alterations on the financial system. In this regard, policymakers and academics should prioritize the determination of new techniques for modeling the consequence of climatic alterations on the behavior of the financial system coupled with its

stability. This chapter reviews the current body of knowledge on climate change-related exposures and their implications on the financial system's stability. The chapter also identifies relevant theoretical viewpoints and frameworks used to examine the nexus between climatic alterations and the soundness of the financial system and justifies their suitability in the context of this research. Lastly, the chapter identifies the gap in the literature which this study intends to bridge.

1.1 Implications and Sources of Climate Risk within the Financial System

Climate change continues to introduce novel sources of financial risk, which has adverse implications for the general health of the financial establishment. For instance, perspectives from the Intergovernmental Panel on Climate Change (IPCC) (2018) indicate that even though the current understanding of climate alterations has been gained from substantial scholarly input from the preceding two decades, the lack of adequate mitigative measures, as well as actions that foster adaptation in practice, implies that it continues to increase the likelihood of adverse socio-economic effects. In support, Sun et al. (2022) explain that the financial exposures of alterations to climatic patterns can have adverse physical implications, which are captured by the potential of adverse weather events coupled with other typologies of hazards on several economic undertakings and social imperatives of people across diverse geographical settings. In this regard, similar perspectives from Dafermos, Nikolaidi, and Galanis (2018) reiterate that developing suitable climate policies would impactfully facilitate the transition to an economic regime with a low carbon footprint. In contrast, Carney (2015) contends that deterring the catastrophic impacts of climate change would require significant paradigm shifts in both industrialized markets and developing economies. In concurrence, perspectives from Battiston, Dafermos, and Monasterolo (2021) suggest that such a transformation is necessary to align energy production and consumption systems across various economies with the anticipated low-carbon emission outcomes. However, Mandel et al. (2021) and Pagnottoni et al. (2022) contend that such a transition could significantly disrupt the financial system and adversely impact economic activities in various countries and sectors while simultaneously creating novel chances for other sectors and economies. Indeed, the study by Battiston, Dafermos, and Monasterolo (2021) concurs with the notion above by admitting that the economic implications of climate alterations can cause modifications in the valuation of financial endowments and holdings that corporations and sovereign entities own or issue. Sun et al. (2022) and Pagnottoni et al. (2022) support the argument above by reiterating that the economic

consequences of climatic alterations have the potential to adversely impact the liabilities of insurance firms, which is a notable disruption to the financial establishment. Mandel et al. (2021) concur with the views of Sun et al. (2022), Battiston, Dafermos, and Monasterolo (2021), and Pagnottoni et al. (2022) by stipulating that climate change effects can have adverse consequences on the financial system by increasing the rate of default on credit facilities that financial institutions advance to customers in manifold segments of the economy. As such, the financial channels might transmit exposures stemming from changes in climatic patterns to the rest of the economy, thus amplifying the dangers posed by climatic alterations on the equilibrium state of the entire financial establishment.

Specific Impact Areas of Climate Alterations on the Economy's Financial Apparatus

The consequences of climate change on the financial system can better be understood from their characteristics and the severity of disturbances and disruptions caused by climatic changes on economic systems. First, in their study, Battiston, Dafermos, and Monasterolo (2021) contend that certain characteristics of climate change expose traditional measures to a series of challenges that underpin macroeconomic and financial analyses. In alignment, Nieto (2019) states that some of these characteristics span from uncertainty to endogeneity and incoordination. Indeed, Battiston, Dafermos, and Monasterolo (2021) align with the above argument by insinuating that microeconomic and financial analyses are inefficient in apprehending the stated attributes of climate change. In concurrence, Alogoskoufis et al. (2021) and Grippa and Mann (2020) suggest that scholars need to actively integrate the basic questions presented by climate risks for this field to progress. This engagement is integral in ensuring more than just refining existing models of climate change and other green initiatives. In addition, the IPCC (2018) argues that climate change has been considered the main basis for financial risks based on the knowledge developed in this area of study. Grippa and Mann (2020) agree with this argument by stating that poor measures presented for mitigating alterations of climatic patterns and fostering adaptation have led to a surge of possible socio-economic effects since harsh weather patterns and other hazards are the order of the day, as witnessed by the ongoing economic activities within the environment. However, contrastive perspectives from Semieniuk et al. (2021) underscore that attaining an economic regime with low carbon concentration and mitigating other challenges of climatic alterations requires climate policies and interventions that quickly transform all industrialized and developing economies within a decade. In alignment, similar suggestions by Van der Ploeg and Rezai (2020)

reiterate that these policies should be implemented in key areas of climate change, including production and consumption channels of energy. However, Battiston, Dafermos, and Monasterolo (2021) warn that these policy measures are likely to be disruptive in nature since they largely affect various economic activities and other key sectors. However, a contrastive argument by Grippa and Mann (2020) cautions that these measures are also necessary since they present new opportunities that can be considered. Nonetheless, both Grippa and Mann (2020), Van der Ploeg and Rezai (2020), and Battiston, Dafermos, and Monasterolo (2021) agree that climate change poses economic impacts that require necessary adjustments of the utility of various financial assets that are dominated by different sovereign and corporate entities. The impacts can adversely affect the entire financial system, hence the need to determine and implement suitable mitigative strategies.

The rate of default on various loans given by institutions in the financial industry is also influenced by the economic effects of climatic alterations. According to Roncoroni et al. (2021), financial transmission channels affiliated with climate change are also increased due to their financial interrelations, which efficiently present effective feedback impacts on the actual economy at large. In support, Battiston, Dafermos, and Monasterolo (2021) contend that the many sectors that are largely affected by the impact of climatic alterations and the transformation from conventional to green economies improve the relevance of climate exposures in the financial steadiness of various institutions. Moreover, perspectives from Battiston et al. (2021) agree with the argument above by claiming that the national and global levels of financial stability pertinent to climate risks are linked to the correlation between the effects of changing climatic conditions and the interrelations of various economies and institutions. In concurrence, Campiglio et al. (2018) argue that the consequences of climatic alterations on the financial steadiness of institutions, both locally and globally, cause financial regulators as well as central banks to undergo problematic developments. However, in their research, Battiston, Dafermos, and Monasterolo (2021) contend that previously, many financial actors and other markets were yet to comprehend the exposures associated with climatic alterations in terms of general prices and other metrics. Thus, these manifold mechanisms are an indication of the varied ways through which climatic alterations affect the financial establishment.

The onset of climate-related debates and conversations among world leaders is a testament to the need to address the menace fronted by climatic alterations on the financial establishment. Indeed, views from Alogoskoufis et al. (2021) confirm that the Paris Agreement of 2015 has made the

financial sector continuously take part in the whole discussion of climate change, making it emerge as the origin of various financial risks by gaining recognition from various financial actors and leading to the development of various initiatives that motivate the declaration of multiple risks associated with climate. Indeed, according to Battiston et al. (2021), an example would be attributed to the G20 Financial Stability Board (FSB) of 2017, which instigated the Climate-Related Financial Disclosure (TCFD) task force whose objective was to present various recommendations to a variety of investors to display risks of climate change within their portfolios. Similarly, as reiterated by Battiston, Dafermos, and Monasterolo (2021), the same year was marked by the development of the Network for Greening the Financial System (NGFS) by various financial actors and other central banks across the globe. Concurrent perspectives from NGFS (2019) underscore that the exploitation of climate stress experiments in the evaluation of the financial viability of climate risk effects was recommended by the NGFS in 2019, while NGFS (2020) states that various climate instances were presented by NGFS in 2020 to enable investors to undertake the evaluation of climate financial risks. Indeed, studies conducted by EIOPA (2019) and Grippa and Mann (2020) argue that climate change has become an integral tool for the evaluation of the risks of financial institutions and is likely to be incorporated into experimentation practices intending to determine climate stress in the future. The incorporation of requirements for the recognition of various sustainable investments was proposed by the European Commission (EC), which was responsible for the formation of the High-Level Expert Group for Sustainable Finance (HLEG) in 2016 (Battiston, Dafermos, and Monasterolo, 2021). According to the European Commission (2020), the proposals made part of the Action Plan of the European Commission on sustainable finance, thereby forming the basis of the efforts of the Technical Expert Group (TEG) of the European Commission on sustainable finance. The proposals attained the publication of the Taxonomy regulation of the European Union as presented in June 2020 in the Official Journal of the European Union, as reported by Battiston, Dafermos, and Monasterolo (2021). These integral global initiatives depict the viability of climate alterations in the agenda of financial stability and the roles of financial actors in climate change. This development has made the two channels underpinning the transformation of risks from climate change to other financial stability more popular.

Climate change poses physical and transition risks that have widespread implications for the financial system's stability. According to Battiston, Dafermos, and Monasterolo (2021), the

physical exposures of climate change include unprecedented destruction of the capacity of production of various firms and other physical assets and a rise in the credit risks associated with the banking sector. Indeed, similar views from Nieto (2019) confirm that these exposures can potentially affect the financial status of various economies and cause the insurance sector to experience financial losses in general. On the other hand, per the views of Sanderson and Stridsland (2022) and Semieniuk et al. (2021), transitional risks of climate change into green economies include quick and unexpected adaptations of asset prices and other default shifts of asset classes, making asset managers, institutional actors, and other portfolios of banks experience financial shocks. In alignment with this view, NGFS (2019) states that poor transformation to green economies threatens institutions' financial stability. Monasterolo and Battiston (2020) support the argument above by reiterating that a poor transformation can be linked to a condition where investors cannot foresee the consequence of adopting climate policies on their respective business models. In alignment, Van der Ploeg and Rezai (2020) argue that businesses and revenues of various firms that heavily rely on the production of fossil fuels and other utilizations are likely to incur losses as attributed to the increasing stranded assets. Indeed, similar views by Battiston et al. (2017) and Semieniuk et al. (2021) confirm that such losses are likely to negatively impact the utility of various companies' financial contracts as well as portfolios. As an illustration, Battiston, Dafermos, and Monasterolo (2021) state that equity investments, bank loans, and other bond holdings are examples of assets that are likely to be affected. In support, Roncoroni et al. (2021) argue that the more financial actors are interrelated, the more losses financial actors incur at both individual and sectoral levels. An example of this phenomenon can be linked to the experiences of the international financial extremities and how the negative experiences permeate several sectors (Roncoroni et al., 2021). In this regard, climate change's transitional and physical exposures have far-reaching implications for the financial system's steadiness.

The risks of climate change transition emanate from the threats posed by a disorderly transformation to an economy with a low carbon footprint. According to Battiston, Dafermos, and Monasterolo (2021), climate transition risks pose threats to financial stability in situations where investors fail to comprehensively forecast the effect of introducing relevant policies for climate change mitigation. In their study, Wu, Liu, and Lin (2023) explain that such transition risks stem from the legal and policy alterations and technological proliferation coupled with market developments as reactionary measures to the financial exposures originating from climate change.

In support, Wu and Wan (2023) contend that such transition exposures are predominant during the process of shifting from renewable energy use to a low-carbon economy. Wu, Wang, and Zhou (2023) agree with the argument above by reiterating that the increasing expenses of energy and carbon emissions influence cost shifting in the transition to green energy, which subsequently leads to higher costs in total production. Perspectives from Feng et al. (2023) confirm that firms with extensive energy consumption and emissions might even encounter production constraints, shutdowns, or withdrawals. These impacts spread to other aspects of the economy as policies devised to address climate change might affect employment, inflation, and gross domestic product outputs, at least in the short-term and medium-term.

Such climate transition exposures affect the financial sector discrepantly. For instance, in support of this view, Monasterolo and Battiston (2020) explain that such climate transition exposures underscore the consequence of novel climate change mitigation policies on the current business models of various investors. Van der Ploeg and Rezai (2020) support this view by reiterating that companies whose businesses and incomes rely on the generation of fossil fuels or the use of non-renewable energy might encounter losses, which might lead to asset redundancies. Indeed, concurrent perspectives from Semieniuk et al. (2021) and Battiston et al. (2017) align with the view above by suggesting that such losses could adversely influence the valuation of companies' financial contracts as well as the financial portfolios that are exposed to such entities like bank credit, share capital and pension fund holdings. In concurrence, Roncoroni et al. (2021) underscore that the high level of financial actors' interconnectedness can also intensify the losses suffered by individual market participants, as has been the case with the financial sector plummeting during previous international financial crises. Therefore, the significant implications of transitioning to an economy with a low carbon footprint pose substantial exposures to the steadiness of the financial establishment.

The financial cost implications of climate-related risks

This theme was influenced by perspectives on how changes in climate change induce financial costs on economic transactions. The theme was clustered around codes such as climate hazards, household liquidity constraints, and the financial burden of climatic risks on key players such as the insurance sector. These codes were present in six sources, including the US Department of Treasury (2023), Biden (2021), Miller (2021), Curcio et al. (2023), Gelzinis and Steele (2019), and

Martinez-Diaz and Keenan (2020). Climate change profoundly impacts the financial sector in many economies because of the costs linked to climate change and other weather disasters in general. The US Department of Treasury (2023) states that climate change effects will keep heightening, plunging most communities and individuals into various financial challenges. Biden (2021) supports the assertion, citing that households face financial constraints attributed to climate hazards. In agreement, Miller (2021) argues that climate hazards include floods, wildfires, and intense heat. Unequal distribution of financial challenges cuts across households. Gelzinis and Steele (2019) agree with the statement that households at risk of financial challenges caused by climate change will incur certain losses and other financial costs resulting from climate hazards. Curcio et al. (2023) insist that financial costs and losses are expected to increase the prevailing financial inequalities, causing uneven financial challenges. According to Martinez-Diaz and Keenan (2020), the prevailing financial challenge can be explained by the many scholarly investigations that have been focused on this research area, as well as practical mitigation measures undertaken by many climate change regulators in the recent past. The systematic risks generated by climate change in the financial domain have long-term effects on all economies globally.

The heightening financial effects of changes to climate patterns have entered the financial sector and other associated sectors in the economy, leading to a decline in the financial value of most investments. The US Department of Treasury (2023) asserts that the financial burden witnessed by a big insurance company attributed to climate change uncertainties is conveyed to various financial institutions and other banks that credit the deteriorating insurance company. The development becomes a significant challenge to the economy's financial stability. According to Curcio et al. (2023), insurers will likely liquidate their assets at lower prices when faced with heightening losses to generate enough cash to resolve unusual claims or sometimes have cash to meet the debt obligations for requests from different actors who anticipate opting out of the troubled firm. In agreement, Gelzinis and Steele (2019) assert that such measures negatively affect the prices of various assets, particularly similar assets in other financial firms, raising the cost of funding for many firms that rely heavily on such markets for survival. Therefore, worsening weather conditions coupled with floods and other natural calamities can affect the financial stability of a country.

Impacts of physical and transitional risks of climate change on the financial system's stability.

This theme stemmed from views on how climate generates physical and transitional risks that affect the stability of countries' financial systems. The codes supporting this theme were changing weather patterns, climate unpredictability, risks of acquiring technology to reduce carbon footprint, loss models, green financing, and carbon-sensitive assets. These codes were dominant in five sources such as the US Department of Treasury (2023), Biden (2021), Gelzinis and Steele (2019), Colgan et al. (2021), and Schellhorn (2020). These sources emphasized that the physical risks of climate change are associated with adverse weather patterns and other heightening environmental challenges that affect economic stability. According to the US Department of Treasury (2023), weather patterns marked by the intensity of heightening fires, drought, and other floods have resulted in deafening losses for many financial actors and other insurance companies globally. The encroaching of the sea level is another rapidly increasing physical risk. Biden (2021) contends that financial losses linked to the direct and indirect association with various industries and assets in general have suffered. Gelzinis and Steele (2019) support the assertion, adding that the systematic financial challenge felt by a smaller firm will be felt across the financial chain, putting financial institutions at risk. In concurrence, Curcio et al. (2023) contend that insurance companies are dragged into the picture of the effects of physical losses because they are responsible for covering financial losses attached to various properties and other tangible assets. According to Biden (2021), insurance firms must refine their underwriting measures and associated loss models to match the rapidly changing climatic and weather conditions. In agreement, Miller (2021) reiterates that historical datasets have been rendered irrelevant in assessing anticipated underwriting losses. According to Colgan et al. (2021), the industry risks to incur significant losses arising from one or more previously unanticipated natural calamities. The statement implies that climate change has profound effects on various actors and stakeholders in the financial sector.

Moreover, transition risks involve technological and regulatory changes necessary to attain green economies. According to Gelzinis and Steele (2019), transitioning to a green economy creates significant losses in carbon-intensive assets. In agreement, Colgan et al. (2021) contend that viable measures by most policymakers to decarbonize the economy to guarantee a green transition in the wake of technological innovation are financially challenging and are likely to plunge many sectors to value loss. In support, Martinez-Diaz and Keenan (2020) assert that these sectors span from energy to transport, industry, and other high-value carbon assets. This measure will see carbon prices increasing, affecting fossil fuel assets. There is a likelihood of experiencing a reduction in

the prices of carbon-sensitive assets. In agreement, Curcio et al. (2023) argue that reducing the value of various carbon-sensitive assets generates losses for various financial mediators and investors. According to Schellhorn (2020), price reduction will be felt across the financial system, forcing various firms and investors to redeem their assets at prices slightly lower than the current market value. In support, Biden (2021) contends that price changes plunge firms to the loss of many creditors, making it extremely difficult to resettle their debts. According to Miller (2021), the measure permeates the financial system, resulting in high levels of instability that widely affect the economy. The US Department of Treasury (2023) argues that the other alternative measure promotes a gradual transition that does not affect financial markets to guarantee the smooth handling of risks associated with various models and frameworks. In alignment, Colgan et al. (2021) state that the development will not cause significant losses concerning the price of various carbon-sensitive assets. In addition, emerging green financing gaps have been created. In that regard, Schellhorn (2020) states that the involvement of multiple policymakers and regulators will likely reduce the risks of green innovations, thereby protecting actors from uncertain losses. The development will likely insulate the financial system from unpredictable financial challenges that will form the basis for the opposition of green policies in favor of the green economy transition processes.

1.2 The Spillover Effects of the Climate-Related Disruptions

The results of this inquiry revealed that the consequences of climate change can spill over to sectors other than the financial industry. Views from the qualitative results disclosed that the adverse effects of climate change mean that economic stability can be reimbursed through funding from the financial sector, making little funding available for the development of other adjacent sectors. This result complements the views of Roncoroni et al. (2021), who argued that the interrelated nature of the economic sectors with the financial sector means that the occurrence of climatic events and their adverse impacts spread beyond the financial sector. This impact indirectly affects the financial health of other sectors due to the reduced ability to grow as funds available to execute growth projects become constrained when financial industry players commit much of it to mitigate and control adverse climatic impacts. This result corroborates the results of Sanderson and Stridsland (2022) and Semieniuk et al. (2021), which revealed that the transitional risks of climate change were those concerned with the costs of transforming into green economies as such a change

requires quick and unanticipated adaptations. Thus, these risks pose financial shocks to those responsible for transitioning into low-carbon economies, particularly institutional actors, financial asset managers, and portfolio banks.

Moreover, the quantitative results indicated that climate risks exacerbate the default rates as most borrowers are not able to settle their credit obligations. In this regard, the qualitative results suggested that the transition of economies from unsustainable to green ones would reduce the threats posed by climate change to the financial sector and other industries. This result does not support the view of Van der Ploeg and Rezai (2020), who opined that the effectuation of green economic models would lead to loss-making for companies whose production processes depend on fossil fuel as a result of stranded assets. Such redundant capacities could, therefore, mean that the economic gains anticipated from transitioning to green economies are not translated and spread to other economic actors.

Comparative Analysis of Norway, UK and USA

Far from these academic databases, the researcher utilized online information databases to obtain quantitative data on climatic alterations and financial steadiness, particularly in Norway, the UK, and the US, as evidence-based illustrations of the adverse consequences of weather-related changes on the countries' economic indicators. The World Bank Group, Bank of England, Norges Bank, and the Financial Supervisory Authority of Norway are examples of such online sources from which numerical data was obtained to facilitate a comparative analysis of Norway, the UK, and the UK on the studied phenomenon.

This section uses evidence of climate risks from Norway, the US, and the UK and possible impacts on the health of the country's financial system to understand the challenges posed by climate change on economic output and how this translates to shortcomings in financial stability.

The Manifold Exposures of Climate Change and Their Implications on the Monetary System's Efficiency. The findings of this study revealed that climate risks are usually associated with two forms of risk that affect the steadiness of the financial system. The first risk component emanates from physical causes, which include exposures accruing from natural occurrences such as floods and cyclones and long-term changes in climatic conditions. Views from the quantitative outcomes indicated that such long-term alterations of climatic conditions can lead to heightened temperature

changes, as well as changes in rainfall patterns. These risks affect the steadiness of the financial system by inducing a loss of value of financial assets coupled with the deterioration of the economic system, which now requires funding from financial institutions to regain from the destructive nature of such calamities. This result concurs with the views of Stolbova, Monasterolo, and Battiston (2018) and Battiston et al. (2017), who explained that such physical risk poses significant financing challenges because enormous financial resources are committed to recovering the value wiped by natural occurrences like floods and creating adaptive systems that are resilient to changes within the external business environment. The second source of exposure is the transition of economic systems from unsustainable to sustainable ones with net-zero carbon to counter the adverse effects of non-green production processes. This result corroborates the arguments of Brunetti et al. (2021), who suggested that the transition risks of climate change affect the financial system through the enormous funds required to create resilient economic systems by transitioning to a low-carbon economy. In this case, financial institutions play a crucial role in funding the acquisition of relevant technologies and technical capacities to generate renewable energy and embed green production processes within an economic system.

1.3 The Perceived Nexus of Climate Risk and Financial Stability

Changes to climatic conditions have become a substantial risk associated with financial systems. Chabot and Bertrand (2023) argue that central banks across the globe and other financial supervisors have commended various financial institutions and other investors for assessing the interplay between climate alterations and related financial risks. In concurrence, Oguntuase (2020) insists that these financial advisors have been designing various mechanisms to evaluate the susceptibility of the financial establishment to climate alterations. However, contrastive notations by Sanderson and Stridsland (2022) indicate that the financial community lacks adequate measures to enable effective analysis of various risks that are associated with climatic alterations and their implications on the steadiness of the financial establishment. Fabris (2020) asserts that features of climate change make up the setbacks that underpin the analysis of the macroeconomic and financial status using ancient techniques. In contrast, Oguntuase (2020) reiterates that there is a need to incorporate climate change in this analysis to guarantee an innovative perspective that simplifies the interplay between climate alterations and financial stability. In alignment,

perspectives from Fabris (2020) reiterate that climate and other weather patterns have a lasting impact on the GDP. In occurrence, perspectives from Oguntuase (2020) suggest that this impact is attributed to the loss of properties and the capital that is set aside to generate goods. Hoffart et al. (2022) argue that climatic hazards can also affect agricultural productivity, leading to reduced labor. In addition, similar perspectives from Battiston, Dafermos, and Monasterolo (2021) suggest that the logistical functions of firms are likely to be weakened, thereby necessitating a shift in economic activities. Indeed, in their studies, Brunetti et al. (2021) align with the views of Hoffart et al. (2022) and Fabris (2020) by explaining that physical hazards have the ability to affect GDP, thereby forming the basis for reduced production. Fabris (2020) contends that climate change results in a surge of physical hazards within the environment, thereby exposing it to more physical and financial risks. As such, the loss of production results necessitates the channeling of investment capital to various replacements and reconstruction activities.

The consequences of climate alterations have multifaceted implications due to the nature of their intersectoral disruptions and ability to spread the severity of risks to manifold economies and financial systems. According to Chabot and Bertrand (2023), risks linked to climate alterations are global in nature and tend to affect various economies, sectors, and other entities. Hoffart et al. (2022) agree with this view by contending that the intensity of climate events coupled with poor sustainable measures that promote low-carbon activities within the economy impact the financial system severely. As such, the adverse implications of climate alterations are disruptive to economic activities as they deteriorate the ability of sectors, entities, and economies to run efficiently.

Physical climate risks affect banks in different ways, as they often lead to the destruction of physical assets. For instance, in their inquiries, Nieto (2019) and Roncoroni et al. (2021) explain that the destruction of these assets causes high levels of depreciation of various capital assets. In alignment, Oguntuase (2020) asserts that the depreciation of these assets is connected to effects on weather patterns and events that include floods, wildfires, and other storms. Indeed, Hoffart et al. (2022) support Oguntuase's (2020) assertion by explaining that such an impact is usually balanced by insurance covers since they are the results of patterns that are unpredictable. In addition, returns on capital assets are likely to reduce drastically as a result of these climate patterns. These climate losses decrease the ability of borrowers to repay loans. Brunetti et al. (2021) agree with this view by explaining that such a decline has a direct effect on the decline of the quality of loans, thereby resulting in an increase in the credit risks of banks in the economy. In concurrence, Fabris (2020)

argues that such credit risks associated with harsh climatic conditions affect the financial stability of individuals and states in general. The lack of efficient actions for mitigation of climate change results in adverse effects on the economy. In concurrence, Oguntuase (2020) explains that in light of the susceptibility of the financial establishment to climatic exposures, there is a need for collaborative approaches to transform the economies of all developing and industrialized countries across the globe. Such a measure is likely to affect certain economic activities that have financial importance while generating new opportunities that can be vested in for financial viability.

One of the most crucial mitigative efforts is fostering the flow of information relating to climate change among global actors to help with the designing of suitable policies and measures for combating adverse consequences of related calamities on the global financial system. Fabris (2020) contends that the impact of climate change and its mitigation approaches serve as integral sources of information that have been developed by the scientific and global policy players that have been vested in the research around climate change. In support, Chabot and Bertrand (2023) assert that financial markets that are doing well allow emerging climate effects to be realized in the adaptation of the utility of financial assets that are associated with corporate and effective entities. Roncoroni et al. (2021) agree with the argument above by underscoring that this utility further stretches to include liabilities for various insurance companies. Indeed, perspectives from Brunetti et al. (2021) suggest that the degree of adaptation and the selection of the sectors that take part depict the application of climatic exposures to the financial steadiness of various institutions. According to Chabot and Bertrand (2023), the substantial consequence of changing climatic conditions on various economies and institutions showcases the severe effects that global economies can anticipate from such unprecedented occurrences since financial systems are susceptible to such disturbances. As such, there is a need for a paradigm shift in efforts to deal with climate change, which calls for concerted efforts to mitigate the emerging sources of various financial risks effectively.

Theoretical Framework

The consequences of climate-related exposures to the stability of the financial establishment are examined by using the theoretical model based on the SFC model, post-Keynesian in this particular case, and enable the identification of the causal relations of the variables in the analysis. This theoretical exposition was presented by Campiglio, Godin, and Kinsella (2015) to unravel how climate policies integrate a triggering effect on the financial exposures of a given economic system.

Likewise, Liu, Sun, and Tang (2021) maintain that in the light of climatic change impact on the economy, which is analyzed based on the post-Keynesian SFC model, the incremental cost of addressing the physical and transition risks, as well as the disruptive effect of these risks on the financial infrastructure need to be considered. Comerford and Spiganti (2023) argue that the financial frictions that arise as a result of the climate policies cause investment in infrastructure for the development of alternative sources of energy to be hampered, hence resulting in depressions and financial crises. In the same vein, Dunz, Monasterolo, and Raberto (2018), on the background of the SFC model, assess the impact of the carbon tax and policies of green subsidies on the stability of the financial system and prove that climate change policies adversely affect the stability of the financial system. Therefore, the applicability of this theoretical model of the present study is to allow the evaluator to determine the impacts of the climate policies and the economic shocks originating from any transformational agenda squarely on the stability of the financial system. According to Battiston et al. (2017), the sectors most sensitive to such climate policies are hugely exposed to risk, meaning that the financial system is considered based on the vast consequences of climatic changes on specific segments of the economy. Notably, in their research, Stolbova, Monasterolo, and Battiston (2018) claim that a real economy/financial industry feedback loop could be essential in explaining the impact of climate policies on the financial industry. Therefore, the application of this theoretical model was appropriate to explain the different effects of climate policies on specific industries and the overall impact of these policies with respect to the steadiness of the financial establishment.

Chapter Summary and Literature Gaps

The synthesis of the research and publications in this line of research indicates that there is complexity in relation to the threats posed by climate change mitigation and their implication for financial establishment's steadiness. The chapter finds out that first-order exposures originate from physical and transition risks that affect investments in the financial sector and the value of financial assets in the market (Battiston, Dafermos, and Monasterolo, 2021; Monasterolo and Battiston, 2020; Semieniuk et al., 2021; Roncoroni et al., 2021). Yet, this further research is aimed to reveal the priorities of climate change risk management as well as the importance of this topic and the necessity of an urgent response to the threats defined by it and thus attempts to bridge the significant voids in this area of knowledge. For instance, though there is a dearth of literature in this particular area of research, an interesting concern is the need to have an understanding of the

consequences of financial risks that often originate from climate-related causes, more so with an emphasis on the United States case. Accordingly, this study fills the above research gap by using data from the United States to evaluate potential financial policies as well as tools that may help overcome financial risks related to climate change. This research also fills the gap in the literature in that it establishes the association between pertinent variables in this study area for the United States context by coming up with the most appropriate causality between climatic risks and financial stability.

This study utilized the pragmatism research philosophy to determine the impact of climate risks on various business operations and the financial aspect of the economy at large. According to Kaushik and Walsh (2019), pragmatism underpins the utilization of diversely suitable research methods to construct truth and knowledge in a manner that advances the understanding of the world using evidence-based perspectives. In this context, research can be actualized by selecting methods that give a rigorous comprehension of the topic under study. This study was conducted within the understanding of the pragmatism research pattern to enable the researcher to gain from employing various research methods to understand the theoretical and practical context of climatic exposures and financial stability better. Accordingly, the selection of the pragmatism research pattern was efficient since it enables the research to discuss the impact of climate risk on financial stability using many research methods to guarantee that data supports various conclusions devised from this study.

This paper incorporated mixed-methods research to investigate the association between climatic alterations and the financial stability of countries. According to Almeida (2018), the mixed methods approach of research underpins combining both numerical and non-numerical evidence to generate a viable conclusion regarding the topic under study. In concurrence with this view, the study by McKim (2017) and Schoonenboom and Johnson (2017) argues that the viability of the mixed-methods research approach is determined by utilizing the evidence generated from the non-numerical and quantitative data sources to enable strong conclusions regarding the research phenomenon. In this regard, mixed-methods research was suitable in this investigation to provide adequate evidence from both non-numerical and quantitative sources to enrich the general comprehension of how climate risks impact the financial stability of a country. Indeed, studies by Timans, Wouters, and Heilbron (2019) and Plano Clark (2017) recognize the importance of mixed-methods research in balancing the pros and cons associated with qualitative and quantitative

research methods, thereby facilitating equilibria in evidence integration. In other words, using mixed-methods research helped complement and enrich the study findings by overcoming the limitations associated with qualitative and quantitative methodologies when adopted singlehandedly.

Data Collection and Search Strategy

This research study utilized secondary data gathered from academic publications gained from various scholarly databases, industry reports, and other policy documents. Both qualitative and quantitative data were obtained from secondary sources to address the underlying research objectives. The research utilized the Google Scholar search engine and other academic databases, including Emerald Insight, Sage Open, and Scopus, to acquire information relevant to climate risks and financial stability. These databases were utilized in this study due to their reputation of containing peer-reviewed publications, which normally undergo a rigorous process of approval, thus ensuring that they contain credible and high-quality information, as asserted by Gusenbauer and Haddaway (2020). Moreover, the use of the Google Scholar search engine to identify other relevant sources broadened the researcher's access to relevant materials for review since the platform gives access to unindexed publications, as explained by Halevi, Moed, and Bar-Ilan (2017) and Martín-Martín et al. (2021). Sources obtained from the academic databases and the Google Scholar search engine provided the study's qualitative findings. Each theme in the qualitative findings section lists the sources supporting it.

Qualitative Analysis of climate change and financial stability

The qualitative data generated from secondary data sources such as government documents, industry reports, and other published articles on this area of study were presented through thematic analysis and synthesis. According to Nowell et al. (2017), thematic analysis is more attached to the qualitative research component since it encompasses the use of text data to generate codes and patterns on select themes, while the methodological context is quite adaptive and versatile in changing analysis situations. This reason underscores the justification for adopting the six-phase design proposed by Nowell et al. (2017) to analyze the non-numerical data in this inquiry. For example, the first phase of thematic analysis was data familiarization, in which the raw data generated were thoroughly reviewed to obtain various perceptions regarding the effect of climate risks on financial stability. The second process involved the generation of new initial codes and ideas from the data. The third and fourth processes involved various thematic searches and reviews.

These themes were defined and presented in the fifth process, and the final manuscript was generated in the final phase.

The analysis of findings from secondary data sources indicated that severe weather patterns coupled with enduring environmental difficulties were responsible for the physical risks of climate change that usually distort the equilibrium state of economic systems. The qualitative findings reiterated that these weather patterns typically encompass intense floods, droughts, and fires from natural sources that lead to significant losses of financial value for financial institutions like insurance companies and other global actors in the finance industry. This result aligns with the outcomes of Battiston, Dafermos, and Monasterolo (2021), NGFS (2019), and Roncoroni et al. (2021), which indicated that the physical consequences of the climate change risks include the destruction of the productive capacity of affected firms coupled with the rise in credit risks for the financial sector. In this regard, the physical risks of climate change pose significant threats to the financial system's stability due to the unprecedented loss of financial value when such events occur. Moreover, the results from the analysis of secondary data revealed that the encroaching sea level has been rising rapidly and, in the process, generating physical risks of climate change. This finding agrees with Sun et al. (2022), who underscored that the financial risks of climate change have adverse physical effects on businesses due to the severity of impacts caused by natural calamities. The effects of these climatic conditions are felt directly and indirectly by industries and financial assets that are in constant contact with climate mitigation financing. In this regard, these exposures create a systemic financial burden affecting all firms. Notably, the outcomes from the analysis of secondary data underscored that the systematic financial burden generated by these natural and unprecedented occurrences spreads across the financial system and significantly impacts small firms. This result is not consistent with Mandel et al. (2021), and Pagnottoni et al. (2022), who opined that low-carbon transition is akin to substantial economic disruptions which can have adverse impacts on businesses on the one side and generate new opportunities for other sectors and economies on the other side. For instance, once these risks occur, insurance companies must indemnify companies to regain their financial assets and reestablish their financial positions for covered risks. This finding concurs with the outcomes of Nieto (2019), which confirmed that the risks of unprecedented climate change could adversely impact the financial ability of various economic actors, thus causing the insurance industry to incur significant financial losses as it funds the recovery processes of companies seeking to regain their business operations and financial

strength. This aspect means that the insurance sector bears the overall costs of indemnifying the assets destroyed by climatic alterations for all risks the affected companies had insured. Indeed, the views from the analysis of secondary data disclosed that the current policymaking environment emphasizes the need for insurance companies to adjust their underwriting exercises and loss models to accommodate the ever-changing weather and climatic patterns. This aspect means that the insurance sector is increasingly being encouraged to include their underwriting on losses accruing from unprecedented natural occurrences like floods, drought, and fires. In this regard, physical risks emanating from the calamities of climate change can pose significant and adverse impacts on financial sector actors and players.

The Possible Consequences of Various Climate-Change Containment Strategies on the Soundness of the Financial Establishment

The outcomes established from the analysis of secondary data revealed that transition risks emanating from regulatory and technological changes in response to the need to promote the transition to green economies and curb the adversities of climate change. This finding is consistent with Sun et al. (2022), who explained that the financial risks produced from changes in climatic patterns have physical implications, as reflected by how the different hazards of climate change affect people's social and economic imperatives. Perspectives from the qualitative findings revealed that transitioning to a green economy is akin to the loss of carbon-intensive assets, thus generating adverse financial consequences on the financial system's stability. This result concurs with the post-Keynesian SFC model, which suggests that the incremental cost of mitigating the physical and transition risks of climate change, as well as their disruptive effect on the financial infrastructure, should be considered because of the financial frictions that ensue from investment into developing alternative sources of energy (Comerford and Spiganti, 2023; Liu, Sun, and Tang, 2021). In this regard, the financial frictions of funding such transitions can lead to economic depressions and financial crises. As such, the actions undertaken by policymakers on climate change in economic decarbonization and ensuring the financial appeal of the green transition processes lead to the commitment of enormous financial resources to acquire the most robust and appropriate innovation for the job. This result agrees with Dafermos, Nikolaidi, and Galanis (2018), whose study revealed that the establishment of appropriate climate policies could impactfully foster a transition to an economic regime with a low carbon footprint. Essentially, the impacts of such transition processes affect diverse industries pertinent to the green economy

transformation, like energy and transportation sectors, alongside other utility carbon assets. While such an initiative is crucial in enhancing carbon prices and grounding fossil fuel assets, it requires vast financial resources, which might destabilize the financial sector. Indeed, the qualitative results indicated that a reduction in carbon-sensitive assets translates to a loss in value of the holdings of financial mediators and investors. Such losses would lead to some firms losing creditors, making it arduous for them to settle their credit obligations.

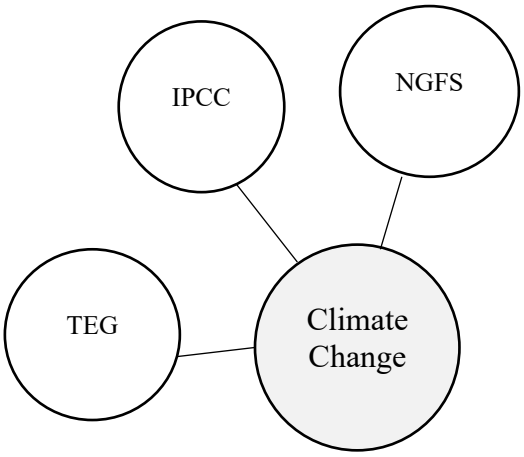
In this regard, the outcomes from the qualitative analysis suggested a need to mitigate the adverse financial consequences of transitioning to green economies or low-carbon regimes by effectuating gradual processes that do not tamper with financial markets. Such gradual transition processes would ensure that the models and frameworks are handled smoothly to realize the green transition. This finding is inconsistent with IPCC (2018), which indicated that much of the knowledge of climatic changes fails to map adequate mitigative measures and practical climate adaptation practices. Moreover, the qualitative results suggested the need to identify new financing opportunities for green transition to lower the adverse effects of climate change mitigative efforts on the steadiness of the financial sector. This result contrasts the findings by Carney (2015), which suggested that deterring the catastrophic consequences of climate change calls for substantial paradigm shifts in both industrialized markets and developing economies, as enormous resources and responsive policies are needed rather than focusing on one element alone. This intervention would put regulators and policymakers in vantage positions to mitigate the risks associated with funding green innovations using current financial assets, thereby safeguarding investors and actors from unrealistic financial losses. These findings contrast the arguments of Monasterolo and Battiston (2020), who argued that in scenarios where green economy transitions are executed poorly, investors fail to foresee the adverse impacts of embracing climate policies on their individual business models. In this regard, ensuring that the green economic transitioning processes are executed effectively to leverage gains for all actors and stakeholders involved in economic activities and climate change mitigation is crucial.

In this regard, the quantitative findings demonstrated that physical and transition risks emanating from climate change can have significant and adverse financial impacts. This result aligns with Battiston, Dafermos, and Monasterolo (2021), Sun et al. (2022), and Pagnottoni et al. (2022), who indicated climatic risks can potentially lead to modifications on how financial endowments of companies and sovereign entities are valued and adversely affect insurance companies' liabilities.

The quantitative results suggested that the risks of climate change can have disruptive consequences on financial markets, leading to increased asset volatilities that affect the general economy. This finding is inconsistent with the views of the SFC model, which was this study's theoretical model, explaining that the policies adopted to combat climate change usually trigger financial risks that affect the overall economy (Campiglio, Godin, and Kinsella, 2015). The outcomes of this study's quantitative analysis disclosed that there is a need to establish coordination between actors in the financial markets and players from financial institutions to intensify how they address the loss-making effects of climate change. Likewise, the qualitative results indicated that while financial institutions play a crucial role in dispensing financial options for dealing with the adversities of climate change, finance markets are integral in providing insights into how loss-making from such risks can be combated to stabilize the overall financial system. As such, the coordinative efforts of the financial markets and financial institutions can provide a profound pathway to mitigating the adverse consequences of climate change.

Figure 1

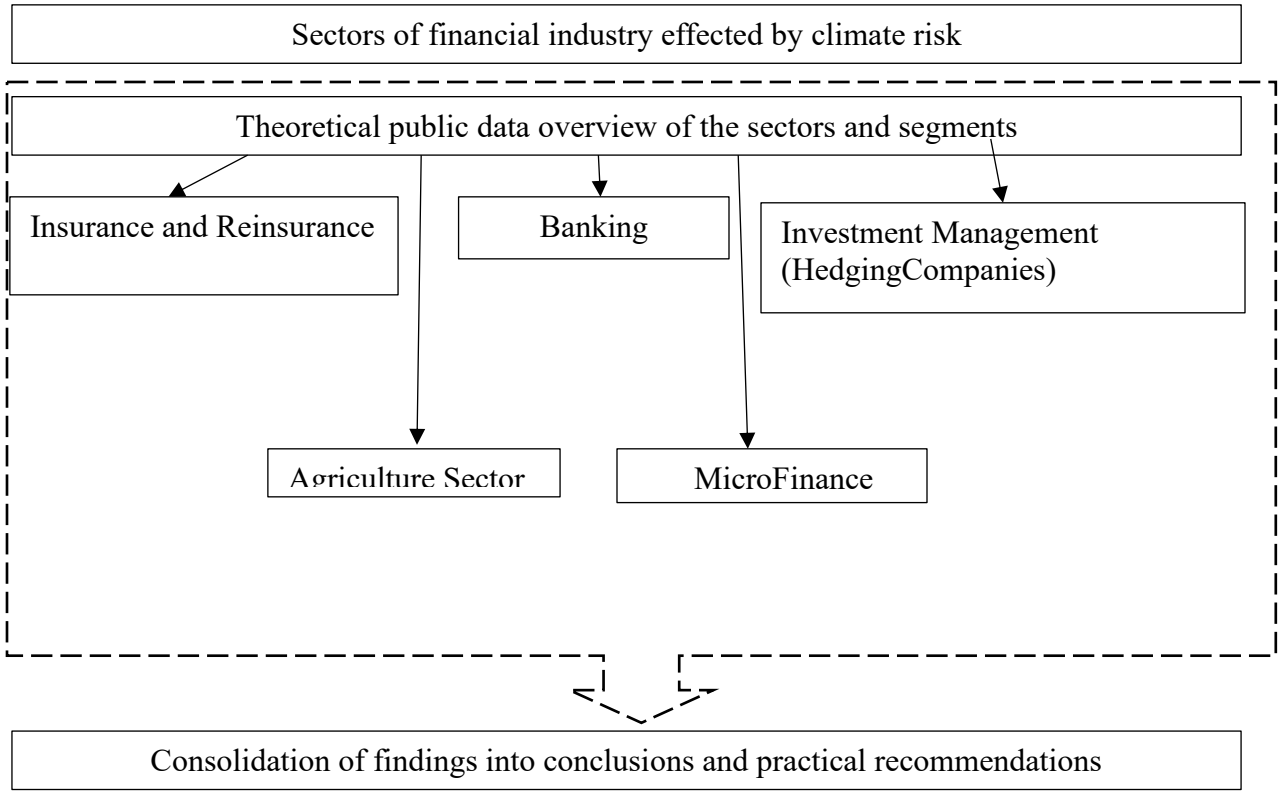
Key bodies specified in Literature which plays important role in climate change and financial stability.



Source: created by the author based on the analysis of scientific literature.

Figure 2

Key sectors specified in Literature which plays important role in climate change and financial stability.



Source: created by the author

The key points of these sectors are explained in my literature review especially the insurance sector. By using mixed methodology both qualitative and quantitative aspects can be determined.

Table 1

Search Combinations for This Research

Keyword	Boolean operator	Search term
Climate, carbon, change, footprint, risk, effect, financial stability, transition, physical, United Kingdom, United States, Norway, global, society	**AND**	-Climate change-related risks AND financial stability in the United States. - Climate change-related risks AND financial stability in the United Kingdom - Climate change-related risks AND financial stability in Norway -Climatic risks AND challenges of transitioning to a low-carbon society -Physical risks of climate change AND financial stability. -Effect of climate change on level of carbon footprint AND financial stability. -Global climate change AND financial stability.
Effect, impact, climate, consequence, change, risk, policy, low, carbon, footprint, transition, financial, system, stability, United States, United Kingdom, Norway	**OR**	-Effect of climate change policy OR low carbon transition on the financial system in the United States. - Effect of climate change policy OR low carbon transition on the financial system in the United Kingdom. - Effect of climate change policy OR low carbon transition on the financial system in Norway. -The impact of low-carbon transition on induced financial risks OR its consequence on the financial system's stability in Norway. -climate risk OR policy on financial stability in the United States.

Source: McCrae, Blackstock, and Purssell (2015)

These keywords were widely utilized across the databases indicated above and the Google Scholar search engine altogether. Besides the process of forming the keywords, the researcher had to choose data sources with specific characteristics to address the set research questions. According to McCrae, Blackstock, and Purssell (2015), the application of suitable criteria to choose data sources in secondary research is crucial in ensuring that the studies chosen meet the set thresholds of quality and produce findings relevant to a given scope. In this regard, the researcher qualified studies with specific attributes to make the findings relevant within a given scope of time and

pertinent to understanding how climate change affects financial stability. As such, the search outcomes were then passed through the eligibility criteria presented in Table 2 below to guarantee that only effective and appropriate data sources were considered for this research study.

Table 2:

Conditions Applied to Qualify Studies Included in This Study

Included	Disqualified
Information sources that were published from 2014 onwards were qualified for inclusion in this inquiry to ensure that the findings established were up-to-date and relevant to understanding the contemporary consequences of climatic exposures on financial steadiness.	Data sources that were published in non-English languages were excluded to deter possible issues of language barrier.
Data sources with information on the policies, consequences, climate change-related discussions, and the perceived impacts of climate risks on financial stability were utilized in this study.	The researcher excluded non-credible sources of data, such as blogs, to ensure that the outcomes of this study were based on credible sources.
Journal articles, policy documents, industry reports, and webpages of credible organizations with information about climate change risks and climate stability were used to provide useful information for comprehending the studied phenomenon.	Sources that required a subscription to access information

Source : Stolbova, Monasterolo, and Battiston, 2018, created by author

There was no geographical limitation applied to the studies included because the effects of climate change have system-wide effects, but the resilience of individual economies determines how their financial systems are affected (Stolbova, Monasterolo, and Battiston, 2018). For this reason, the qualitative analysis of the evidence was more general and not restricted to any specific context to provide an overview of the aspects of climate risk that affect the stability of the financial system. Nevertheless, the researcher compared Norway's scenario of climate risk and its implications on financial stability with those of the US and the UK as more precise examples to provide specific quantitative results for understanding the causal impacts generated. The US's and UK's scenarios were chosen to compare with Norway's because these countries have strong economies with more robust climate change resilience measures (Stolbova,,Monasterolo, and Battiston, 2018). Therefore, the quantitative results obtained from this comparison offered a comprehensive understanding of the causal effects of climate risks on the financial stability of more advanced global economies far from the measures of the dependent variable indicated in Table 3 above,

climate risk was the independent variable as measured by average annual temperature changes over the examined period of 2014-2024.

Table 3:

Dimensions and Indicators of Financial Stability Metrics

Dimension	**Indicators**
Financial growth metrics	-Ratio of loans to GDP -Market values of bonds to GDP ratio -Insurance revenues from premiums to GDP ratio
Macroeconomic situation	-prevailing rates of GDP growth
Financial markets' functioning	- Ratio of loans to deposits in financial institutions -Fluctuations in exchange rates

Source: Stolbova, Monasterolo, and Battiston, 2018, created by author

Qualitative Results

The analysis of data from the chosen information sources to aid in the comprehension of the various ways in which exposure to climate risks impacts financial stability generated two themes. The themes are the financial costs of climate risks and their perceived effect on the stability of the financial system and economy, as well as how the physical and other transitional climate change risks impact financial stability. Precisely, the US Department of Treasury (2023), Biden (2021), Miller (2021), Curcio et al. (2023), Gelzinis and Steele (2019), and Martinez-Diaz and Keenan (2020), Colgan et al. (2021), and Schellhorn (2020) provided insights utilized in the qualitative analysis section. Likewise, the quantitative findings were derived from the following sources: Zhang, Zhang, and Fang (2023), the World Bank Group (2021), the US Department of Treasury (2023), Bank of England (2018), Norges Bank (2021), Martinez-Diaz and Keenan (2020), Financial Supervisory Authority of Norway (2021) and Colgan et al. (2021). In this regard, evidence from Colgan et al. (2021), the US Department of Treasury (2023), and Martinez-Diaz and Keenan (2020) was used in both quantitative and qualitative analyses.

Research Ethics

This research study was conducted by adhering to the ethical considerations for doing secondary research. The researcher followed the identification of the original authors to refer to various issues attached to secondary research ethics. According to Tripathy (2013), data acquired from easily accessible information databases includes implied permission for use by various secondary

researchers so long as the original author of the data is recognized. This assertion implies that the referencing of the secondary data sources used in this research study is to satisfy the obligation of the researcher to attain prevailing necessary ethical considerations to enhance ethical research practices. Please refer to Annex 1 to understand the questions used in preparing the literature review.

Methodological Limitations

A key limitation associated with this study is the quality of the secondary data sources used to inform the conclusions made. Studies by Wickham (2019) and Pederson et al. (2020) acknowledge the flaws associated with secondary data, including a possible transfer of errors, biases, and omissions from original sources, which might influence secondary research outcomes. The researcher mitigated this limitation by relying on high-quality sources to establish credible results connecting climatic risks with financial stability disruptions. The other possible limitation is the inability of secondary data to address the specific objectives of this inquiry effectively. In their studies, Pederson et al. (2020) and Cheng and Phillips (2014) contend that secondary data faces this flaw because it was originally collected in alignment with the initial researchers' objectives, which makes them misaligned or less tailored to addressing the research outcomes of secondary researchers. The researcher overcame this limitation by picking sources that topically aligned with the scope of this inquiry.

3.ANALYSIS OF MICRO AND MACRO LEVEL FACTORS OF CLIMATE EFFECTING FINANCIAL STABILITY

3.1 Formulas and indices used to understand the climate change and financial stability

This chapter presents an analysis of the data collected from the chosen fourteen secondary sources to facilitate an in-depth comprehension of how climate risks affect financial stability. In the descriptive analysis major metrics like CRI and Standard Deviation is used to determine relationship between climate risk and financial stability of 37 countries to understand how CRI index effects the average growth percentage.

$$CRI = Fatalities + Economic\ Loss(\%GDP)/2 \quad (1)$$

CRI – Climate Risk Index

The most important part is standard deviation which is used in determining factors like temperature variability, economic loss variability and asset price volatility. As it is used in measuring the climate risk index and average growth the sophisticated equation is applied in the equation to get results.

$$3.\sigma GDP = \sqrt{\varepsilon(Growth - \mu Growth)2}/N \quad (2)$$

For better understanding of the Hedging of Climate Risk in Norway Debt to Service Ratio and Debt Income ratio were some of the metrics used for a complete understanding of how hedging instruments such as revolver and so can be used in order to understand the impact of hedging on climate change. Basically, we are getting the hedging impact on a country with which we can make a model to determine the effect globally.

$$Debt\ Ratio = \frac{Total\ Liability}{Total\ Assets}$$

$$Debt\ Service\ Ratio = \frac{Net\ Operating\ Income}{Total\ Debt\ Service} \quad (3)$$

$$Debt\ Income\ Ratio = \frac{Total\ Monthly\ Debt\ Payments}{Gross\ Monthly\ Income} * 100 \quad (4)$$

To determine significant correlations between climate change with metrics such as ROA, CFO and debt the formula below was used in the hypothesis testing to determine whether the correlations were weak or strong

$$7. r = \frac{\sum(xi - x) - (\sum yi - y)}{\sqrt{\sum(xi - x)\text{^}2 - (\sum yi - y)\text{^}2}} \quad (5)$$

The regression data in the research was obtained from Macrotrends and forecasting. The ANOVA model was used by the secondary source to forecast and understand some variables. However taking into consideration the complexity of system extension of data is required.

$$8. r_t = \mu + \sum_{l=1}^{p} \emptyset_l \, r_{t-l} + \sum_{l=1}^{q} \theta_l \, e_{t-l} + e_t \quad (6)$$

Where: Setting p = 0, reduces the model to a moving average model MA(q)

Setting q = 0, reduces the model to an autoregressive model AR(p)

Slope is used in secondary research to determine the relationship between dependent and independent variable. It shows how much Y changes when X increases by 1 unit. It is assumed that Y is independent and X is dependent and b represents slope.

$$9. b = \frac{\sum(X - \overline{X})(Y - \overline{Y})}{\sum(X - \overline{X})^2} \quad (7)$$

Intercept it assumes that the value of Y when X is 0. It indicates where the line crosses the Y Axis. It is used in secondary research to determine the point the regression line crosses Y Axis where a is intercept, b = slope, $\overline{Y}$ – dependent variable mean and, $\overline{X}$ is independent mean variable

$$10. a = \overline{Y} - b\overline{X} \quad (8)$$

3.1 Exploring Pearsons correlation with Climate Risk Index

Pearson's correlation helps in measuring the strength of relationship between two continuous variables and used to determine statistical significance. In the Pearson's Correlation certain assumptions are made such as the variables are linear and homoscedasticity to make sure that the one variable will be consistent across range of other variables. A systematic approach is considered while evaluating significance of correlation between two variables.

Table 4

Pearsons Correlation

Variable	Pearson correlation values of CRI
ROA	-0.049
CFO	0.034
Short-term debt	-0.039
Long-term debt	0.082
Short-term and long-term debt combined	0.048
Overall assets	0.019
Overall intangible assets	0.001
Growth in sales	0.110

Source: Zhang, Zhang, and Fang (2023).

According to the findings shown in Table above, it is apparent that Return on Assets (ROA), Cash from Operations and long-term debts, short-term debts, and corporate sales do not have statistically significant correlations with the indicators of climate risk because their values are negative or lean towards zero, which means weak Pearson correlations. Notably, the results from Table suggest that short-term debt (-0.039) and ROA (-0.049) had weak negative Pearson correlations with CRI. This result could be attributable to the small sample size involved. Nonetheless, the findings from Table suggest positive weak Pearson correlations between CRI and long-term debt (0.082), an aggregate of short-term and long-term debt (0.048), and sales growth (0.110). These findings lead to the acceptance of the alternate hypothesis, Ha, and rejection of the null hypothesis, Ha0, because a rise in climatic risks contributes to the destabilization of the financial system by lowering returns on investments (ROA), long-term and short-term loans, and CFO. An analysis of the regression coefficients is illustrated in Table 2 below based on the dataset by Zhang, Zhang, and Fang (2023).

Table 5

Coefficients of the Correlations Between Climate Risk and Financial Outcomes

	Return on Assets (ROA)	**Cash for Operations**
Annual CRI	-0.017	18.411
Overall assets	-3,284,000	0.027
Total intangible assets	-2,060,000	0.178
Sales Growth	0.281	0.212
F-value	2.839	28.186

Source: Zhang, Zhang, and Fang (2023).

Findings from Table 2 below indicate that the coefficients of the impact of climate risk on ROA as well as CFO are both negative, with 0.263 and 0.606 as their confidence levels, respectively. Since these figures are more than the permitted significance level of 0.05, this finding suggests that even though relationships between climate risk and these outcome measures exist, they are

not statistically significant. In addition, Table 6 shows that the adjusted R-squares for ROA and CFO were 0.281 and 0.212, respectively. These results imply that 28.1% changes in ROA and 21.1% changes in CFO could be explained by climatic risk, total assets, sales growth, and overall value intangible assets. Therefore, while climate risk is one of the variables that influence financial stability, its interaction with the other economic variables mentioned above determines the extent of impact generated. More specifically ROA shows a weak negative relationship showing negative impact and cash flow has a substantial value including positive influence or variability. ROA has a negative value which shows decline in returns concerning overall assets. Cash for operations show a minor positive association. A large negative relationship with ROA (-2060.000) shows a significant adverse impact. Cash for operation reflects a modern positive correlation (0.178).

F Value: Considering ROA the F Value 2,839 suggest weaker explanatory power to significance. The results demonstrate a diverse relationship between operational outcomes and financial metrics

that emphasize the role of sales growth and highlights potential challenges posed by intangible assets and assets in ROA. The F Value was used to assess whether variable is significant across various regions or timeframes. Various datasets were compared to get a deep insight of certain data. Please refer to Annex 2,3 and 4 to understand the model used and what parameters are considered while doing the calculations.

Table 6 below illustrates the descriptive results of the relationship between climate risk and financial stability based on a Bloomberg dataset of 37 countries analyzed by Zhang, Zhang, and Fang (2023).

Table 6

Descriptive Results

	Observations (n)	**Minimum**	**Maximum**	**Mean**	**Standard deviation**
Return on Assets	431	-38.3188	41.4595	5.4253	8.2454
Cash From Operations	435	-115,970.098	207,459	9651.8475	23,138.7162
Short-Term Debt	435	0	163,397.407	8711.0124	19,611.2785
Long-Term Debt	435	0	405,217.489	30,436. 1432	65,019.9861
Short- Term and Long-Term Merged	435	1.516	940,682. 427	49,382.7403	118058.9699
Overall Assets	435	31.426	1,899,340. 511	159,275.949 5	320,122.631
Overall Tangible Assets	435	0	142,742.613	14,616.8071	26,018.1541
5-Year Mean Growth Rate	435	-13.1864	111.6382	6.6071	10.9375
Annual CRI	435	-125	-5.5	-61.8998	28.90067

Source: Zhang, Zhang, and Fang (2023).

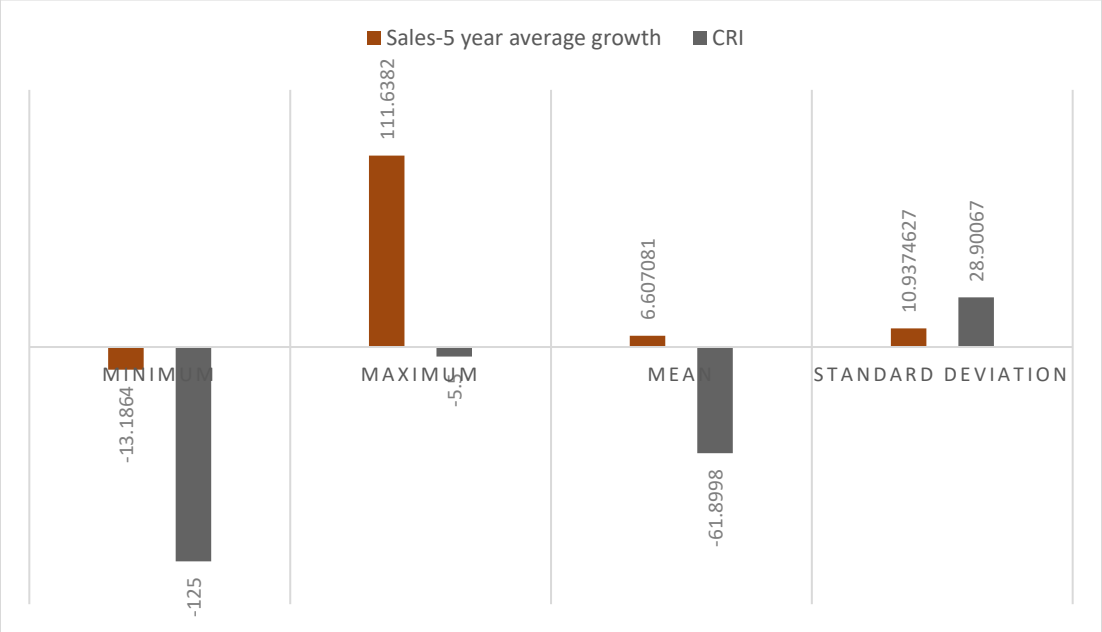
Climate Risk Index Analysis

From the dataset of 37 countries, there were n=431 observations of return on assets realized by firms whose operations were exposed to climatic risks across the 37 countries whose data was analyzed (Table 4). All the other variables had n=435 observations over the 20 years analyzed by Zhang, Zhang, and Fang (2023).

The country-level results of the 2021 Global Climate Risk Index (CRI) of the analyzed countries were collected over the preceding 20 years, representing how firms performed under different CRI scores (Zhang, Zhang, and Fang, 2023). The minimum CRI value was -125, and the maximum value was -5.5 (Table 4). The analyzed firms had a mean annual CRI of -61.8998 and a standard deviation of 28.90067 (Table 4). This result implies that the data was widely dispersed from the average CRI value. The findings also suggest that, on average, companies exposed to varied climatic exposures realized a 5-year growth rate of 6.607081% and a standard deviation of 10.9374627%

Figure 3

Effect of CRI on Average Growth Averages - Climate Risk Index Versus 5 Year Growth Averages



Source: Zhang, Zhang, and Fang (2023), Colgan et al. (2021), and Martinez-Diaz and Keenan (2020)

The findings from Figure 3 above suggest that a negative minimum value of CRI (-125) is associated with negative 5-year averages (-13.1864%). This finding implies that a high risk of CRI corresponds with increased economic destabilization, which affects the earning capacity of the financial sector. On the other hand, a negative CRI mean value of -61.8998 is associated with a mean growth of 6.607081 (Figure 1), which means that a reduction in climatic risks leads to improvements in the financial performance of an economic entity, as evidenced by the generation of positive growth on a 5-year average. A scenario-based analysis of climate risks in Norway, the US, and the UK is presented below to provide specific insights into how the stability of the financial system is affected by unprecedented climatic changes.

Data Analysis of Pearson Correlation and Descriptive Analysis

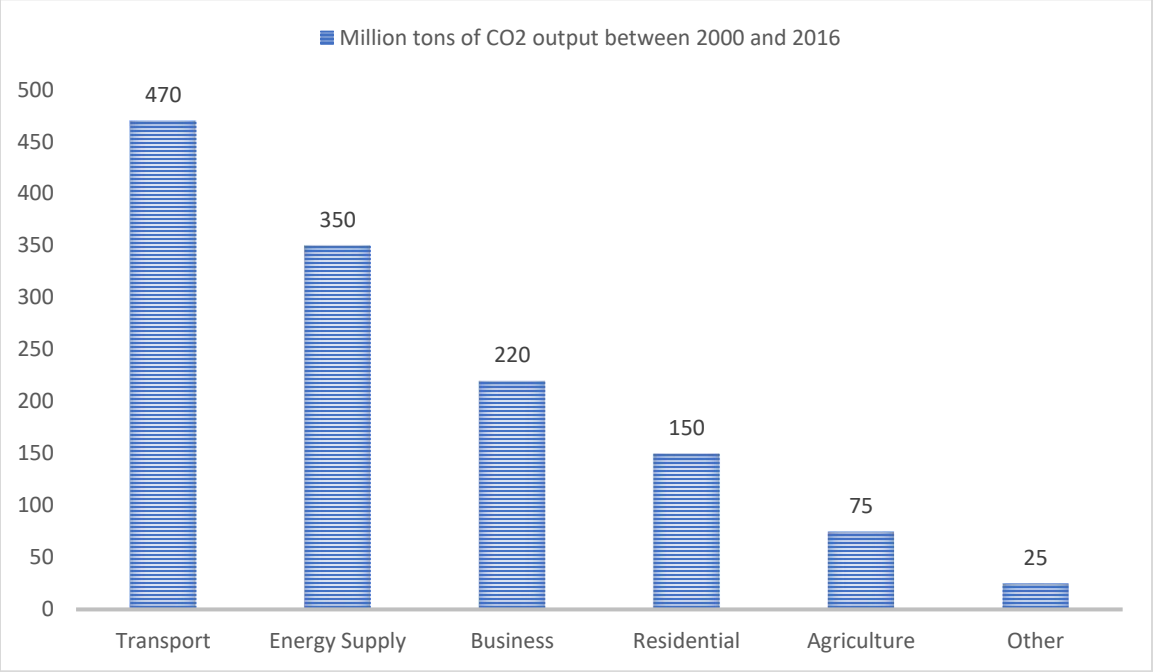
Conversely, descriptive and inferential analysis techniques were used to present the numerical data. The findings were written descriptively in the form of mean, standard deviations, as well as minimum and maximum values of data distribution. In addition, the descriptive findings included the frequency distributions, scenario-based tests of the implications of reducing carbon-intensive processes on financial stability, and annual growth averages for an orderly and disorderly transition to a low-carbon economy. On the other hand, the researcher presented the inferential results through Pearson correlations and R-squared values of the correlation coefficients, which helped test the underlying hypotheses. The findings were visualized through charts, tabulations, and other graphical illustrations. Zhang, Zhang, and Fang (2023), Colgan et al. (2021), and Martinez-Diaz and Keenan (2020) used SPSS software to analyze data, while the rest of the quantitative sources used the Excel software. The various variables utilized in this study are presented below.

Financial stability became the dependent variable whose dimensions and indicators are presented below.

3.2 Impact of Climate Hazards on Financial Stability and Challenges in modelling risk

Figure 4

Greenhouse Gas Emission in the UK by Category



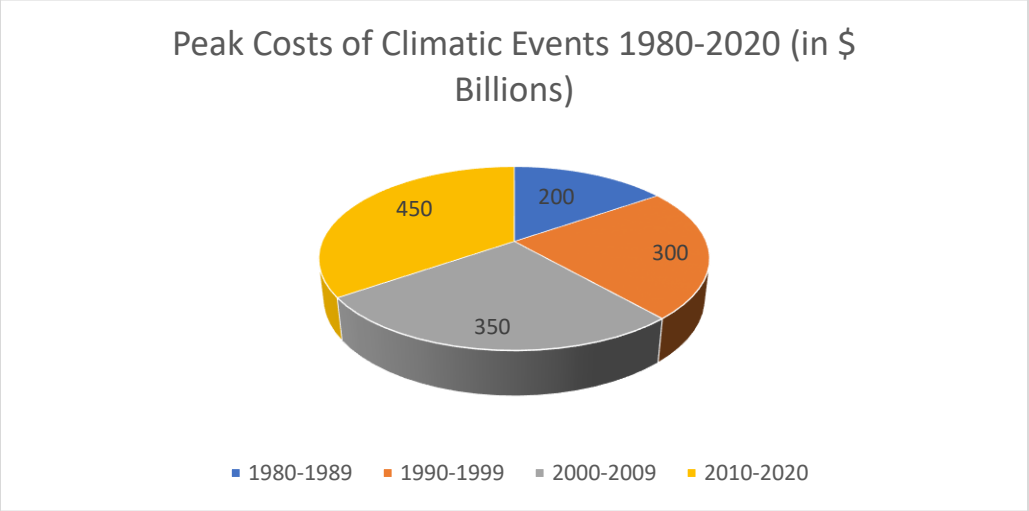
Source: Bank of England, 2018

According to Figure 4 above, the transport sector of the UK is the largest contributor of greenhouse gases, as it is responsible for about 470 million tons of CO2 emitted by 2016, followed by the energy sector with about 350 million tons of CO2 and businesses that produce about 220 million tons of CO2, among others. These values represent a significant reduction in CO2 emission when compared to the emission levels in 2016, where transport accounted for about 700 million tons of greenhouse gas emitted (Bank of England, 2018). In order to avert the financial effects associated with these emissions, transformative actions must be instituted in the UK, with key sectoral reforms focusing on meeting emission targets. The World Bank Group

(2021) notes that climate change affects various systems, communities, and other economies at large. The Industrial Revolution in Norway resulted in the heightening burning of fossil fuels and the changing landscapes (Norges Bank, 2021). An example of changing landscapes is the conversion of forest lands into agricultural farmland, thereby impacting the concentration of greenhouse gases globally. These human activities are the basis for the changing climatic patterns today. Burning fossil fuels results in the generation of carbon dioxide, a greenhouse gas responsible for the greenhouse effect (Norges Bank, 2021). The greenhouse effect denotes a warming process where emerging solar energy released as heat by the surface of the Earth gets absorbed into the atmosphere. Carbon dioxide makes up the main human effect of climate change.

Figure 5

Billion Dollar Climatic Events Reported in the US from 1980 to 2020.



Source: Martinez-Diaz and Keenan (2020).

According to Figure 5 above, the economic expenses of tragic climatic events in the US have been enormous, claiming billion-dollar investment value from the private and public sectors. Compared to 1980, these events cost the US significantly in the post-2010 era, with peak losses in value being $450 billion per year recorded in 2012 and 2017 (Figure 3). Such extreme climatic events can, therefore, have serious economic ramifications that affect countries' fiscal costs and hinder economic productivity.

The US has experienced significant climatic risks that have had devastating effects on the financial sector through losses in billions worth of economic value. Figure 3 below provides a visual illustration of some of the climatic events reported in the US between 1980 and 2020 based on data from Martinez-Diaz and Keenan (2020).

Comparatively, a better part of Norway experiences a maritime climate coupled with mild winters and some cool summers. There is usually a warmer climate in Norway, as opposed to its position at the latitude due to the interference of the North Atlantic Ocean (Norges Bank, 2021). Periodically, the country experiences normal annual air temperatures as high as 7.7°C along its coastline to the south-western (The World Bank Group, 2021). Table 6 below illustrates the monthly climatology data for Norway based on data obtained from the World Bank Group (2021).

Table 7

Norway's Monthly Climatology Data

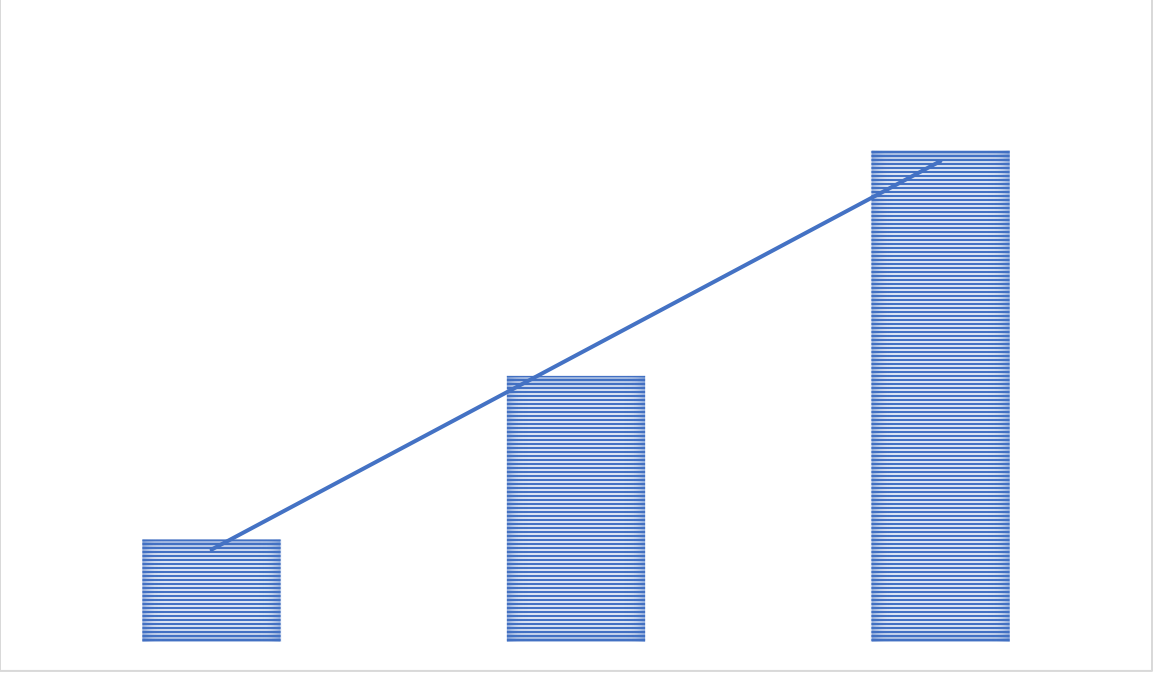
	Average minimum surface air temperature (°C)	Average surface air temperature (°C)	Average maximum surface air temperature (°C)	Precipitation (mm)
January	-9	-6	3	110
February	-9	-6	-3	80
March	-7.5	-5	0	78
April	-3	0	4	62.5
May	0	9	9	67.5
June	3	9	12.5	78
July	9	12	15	90
August	7.5	11.75	15	112
September	4.5	7.2	10	113
October	0	3	4.5	120
November	-7	-3	0	105
December	-9	-5	-2	117

Source: Norges Bank, 2021

Table 7 above shows the country experiences variations in climatic conditions across the year, with the lowest mean temperatures recorded at the beginning and end of the year. The precipitation levels are high in October (120 mm), December (117 mm), September (113 mm), August (112 mm), and January (110 mm) (Table 5). The exterior of mountain regions records the minimal annual mean temperatures as low as -3.1°C along the Finnmark Plateau. The mainland records its lowest and highest temperatures on the weather stations at -51.4°C and +35.6°C, respectively (The World Bank Group, 2021). The present westerly winds propel continuous moist air inflow from the ocean, generating enough precipitation across Norway (Norges Bank, 2021). Western Norway, across the coastline, experiences high levels of precipitation (The World Bank Group, 2021). The optimum precipitation zone is usually the wettest across Europe, making many sites along that region experience normal annual precipitation north of 3,500mm (The World Bank Group, 2021). These climatic changes pose vulnerabilities and risks to the stability of Norway's financial system. The hedging risks of rising debt levels relative to income as a result of climatic risks in the country are shown in Figure 4 below based on data from Norges Bank (2021).

Figure 6

An Illustration of the Household Hedging Risk Patterns in Norway. Effect of Hedging Climatic Risk on Rising Financial Crisis for 2010-2020 Period



Source: Norges Bank 2021

Evidence from Figure 6 above indicates that in Norway, there has been a slowdown in debt growth in recent years, with its peak debt-to-income ratio becoming 24% for the 2010-2020 evaluation period. The country has an interest burden of 5% and a debt service ratio of 13%, which is a discrepancy emanating from hedging the risks of climate change (Figure 4).

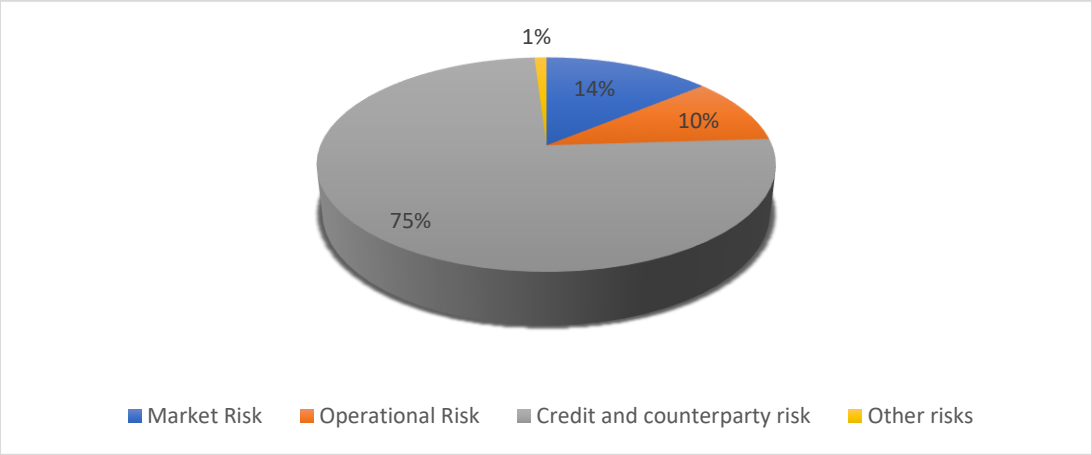
However, compared to growth in income, debt growth has been faster, illustrating the financial burden that households have to incur as a consequence of the insurance sector hedging the risks associated with climate change (Norges Bank, 2021). The report by Norges Bank (2021) explains that since the country charges low interest rates, households have an interest burden, which is the proportion of revenues spent on repaying loan interests. On average, the county has high debt service ratios, which entail both interest payments and estimated principal. As a consequence of this aspect, Norges Bank (2021) reports that interest payments were anticipated to increase from 14.0% reported in the second quarter of 2022 to 15.3% by the end of 2024. In this regard, climatic risks in Norway induce economic shocks that stimulate a rise in lending rates, whose impacts are felt by households.

Financial implications of the orderly and disorderly transitions to a low-carbon economy

Transitioning to a low-carbon economy has different scenario-based implications for the financial system's stability in Norway. One scenario encompasses an orderly transition and gives a baseline alternative, while the other entails a disorderly form of transition (Financial Supervisory Authority of Norway, 2021).

Figure 7

Weighted Banking Assets' Aggregate Risks of Climate Change in the UK.



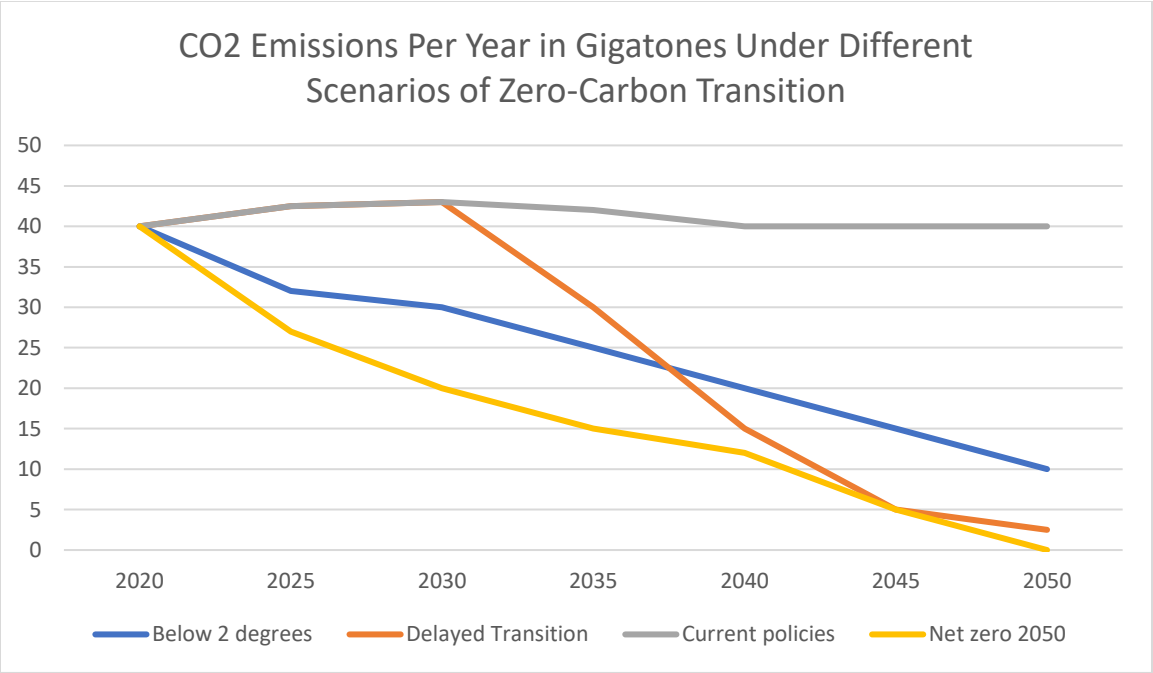
Source: Bank of England, 2018

As shown in Figure 7 above, climate change induces a rise in credit and counterparty risks by 75%, market risk by 14%, and operational risk by 10% for the UK's banking sector. This result implies that a change in climatic patterns and the occurrence of disaster events significantly increases banks' credit risk, meaning that borrowers might not be able to meet their credit obligations within the scheduled repayment period. As a consequence, banks have to renegotiate loaning terms with their clients and reschedule payments, which hinders their consistent growth.

In the UK, the adverse effects of climate change pose significant risks to the banking industry. Climate change increases the risk of default on credit facilities that banks advance to diverse economic players (Bank of England, 2018). Increasing credit risk as a result of climate-related antecedents means that the banking sector's solvency risks increase. The aggregate risk-weighted assets relating to the UK's banking sector and their proportionate vulnerability rates are illustrated in Figure 5 below based on data from the Bank of England (2018).

Figure 8

Authority of Norway (2021)

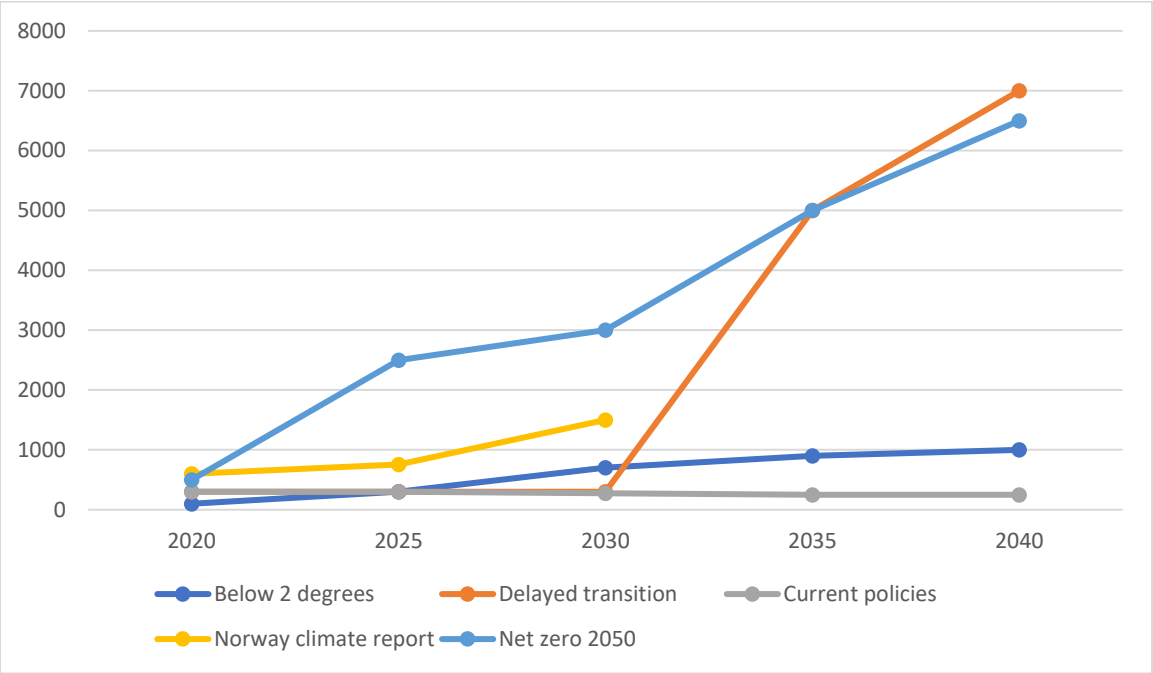


Source: Financial Supervisory Authority of Norway, 2021

Figure 8: Scenario-Based Tests on the Impacts of Carbon Emissions vis-à-vis the Net Zero Agenda Based on the data shown in Figure 6 above, the different scenarios of climate risks offer a common analytical perspective on evaluating climate risks through stress tests. The chart above illustrates that current policies of climate change are retained throughout a set period, as shown by the line for "current policies." In this scenario, therefore, it is predicted that global warming of over 3°C will prevail, leading to substantial changes in the climate coupled with heightened economic expenses throughout the period (Figure 8). The discrepant climate change scenarios underpin varied ways of modeling the physical variables of climatic alterations like atmospheric concentration of climate change as well as temperatures. These physical climatic variables are interconnected with variables of financial stability, particularly due to their influence on the design of climate change mitigation and policies aimed at enhancing disaster preparedness (Financial Supervisory Authority of Norway, 2021). These interrelationships are vital in the computation of carbon prices that are concomitant with specific climate targets, as stipulated by the Paris Agreement 2015 (Financial Supervisory Authority of Norway, 2021).

Figure 9

The Influence of Emission Targets on Carbon Prices (Source: Financial Supervisory Authority of Norway, 2021)



Source : Norges Bank (2021), Financial Supervisory Authority of Norway, 2021, Martinez-Diaz and Keenan, 2020

Based on Figure 9 above, different climate scenarios will generate different implications for the transition to a low-carbon economy in Norway. These scenarios are founded on the assumption that low-carbon transition is initiated immediately, leading to an effective reduction of greenhouse gaseous emissions and global warming lowered to below 2°C (Financial Supervisory Authority of Norway, 2021). These scenarios associated moderate financial costs with low-carbon transition and the mitigation of climate change. The other two scenarios depicted by the lines with the "Net zero 2050" and "Below 2°C" labels suggest the transition exposures connected with transitioning to a low-carbon economy (Figure 7). However, these scenarios can only commence in 2030. Meanwhile, Figure 7 suggests that by 2030, much of the carbon budget will be spent, which underscores the need for the transition to occur quickly to reach the global warming target of less than 2°C, as illustrated by the line labeled "delayed transition." In this regard, a sudden and disorderly transition to a low carbon economy would increase the exposure of unviable investment and induce a reduction in the value of production equipment that will exist post-2030.

As a result of the discrepant climate scenarios and their economic implications, central banks and other financial and climatic supervisory authorities have carried out stress tests to project potential disruptions of the financial system. One of the sectors mostly affected by these climate scenarios is insurance, which bears the burden of indemnifying insured businesses to their original productive capacity when climate-related risks occur (Financial Supervisory Authority of Norway, 2021). The report by Norges Bank (2021) emphasizes that stress tests help policymakers and actors undertaking climate mitigation and financial modeling to gain insights into the various climatic risks that financial institutions are facing, their consequences on the stability of the financial system, and how such exposures challenge the effectiveness of prevailing business strategies. Indeed, climate stress tests provide insight into how regulatory provisions are well-suited to provide effective mitigation to businesses when financial risks disrupt the financial system (Martinez-Diaz and Keenan, 2020). On the basis of climate stress tests conducted in Norway by the Financial Supervisory Authority of Norway (2021), it was established that sudden and disorderly transitions to a low-carbon economy would lead to modifications that accentuate adverse economic consequences. For instance, such transitions would lead to heightened uncertainty coupled with increased risk premiums in financial markets (Norges Bank, 2021). Such frictions in the financial market might also constrict the labor market, thus causing transitional delays. This scenario would amplify and extend the economic downturn, which, according to the Financial Supervisory Authority of Norway (2021), is akin to increased financial losses during the restructuring process. The overall impact of financial system distortions emanating from transition risks in Norway will, therefore, have adverse consequences on the general economy.

Understanding the analyzing aspect of climate change with financial stability

Concerning the research for this inquiry, the results obtained from the analysis of qualitative and quantitative data addressed it by suggesting that climate change induces various risks that impact the steadiness of the financial system through the transition costs and physical expenses that insurance and financial institutions incur in order to overcome the losses suffered from natural disasters and other events. The findings underscored that the long-term cost of transitioning the economy into a low-carbon or zero-carbon one is borne by financial institutions as the world readies itself to mitigate the adverse effects of unpredictable climatic patterns and natural hazards on the health of economic institutions operating within a given country. Insurance companies also

bear the costs of indemnifying economic entities that are directly affected by natural disasters, thus having a significant adverse effect on their capital reserves. The results of this study also revealed that the transition and physical consequences of adopting new technologies for renewable energy and compensating economic entities affected by climate change-induced risks have an indirect effect on other sectors of the economy as a result of spillover of such contagion impacts to related service and product sector. As such, the alternate hypothesis, Ha, was approved while the null hypothesis, Ha0, was declined because climate risks have a significant destabilizing effect on the financial system.

Concerning the first research objective, the study revealed that the leading risks associated with climate change are the transition and physical exposures, which have diverse implications on the steadiness of the monetary system. For instance, the physical risks of climate change affect the financial system through the funds that the financial system and the insurance sector have to incur to restore economic operations to their initial capacity. In other words, financial institutions bear the risk of climate change through the proportion of funds committed to reimburse and return businesses affected by natural events and unpredictable weather patterns to the prevailing operating capacities before these events occurred. As such, climatic changes distort the stability of the financial system because such funds could have been used to bolster productive and regenerative activities within an economic system. Likewise, the findings indicated that the financial system is also affected by climate change mitigation schemes because it is expected to fund the development and acquisition of technological innovations that facilitate the transition to low-carbon economic regimes. In other words, the enormous funds needed to facilitate an effective transition of an economy from an unsustainable to a sustainable one that uses renewable sources of energy and methods of environmental conservation, preservation, and adaptation require significant input from the financial sector.

Concerning the second research objective, this study found that various strategies for containing the consequences of climate change have varied impacts and implications on the stability of the financial sector. For instance, the results of this inquiry revealed that the transformation to a green economy in a bid to counter the adverse effects of climate change results in the loss of carbon-intensive assets. This loss generates negative financial effects that destabilize the financial system. In addition, the results of this study revealed that such transformations yield disruptive effects on the financial infrastructure due to financial frictions of investments committed

to developing alternative sources of energy. The findings also revealed that climate-change containment measures affect the ability of businesses to continue meeting their debt obligations, thus undermining the capacity of banks to create credit and advance to others intending to seize any emerging business opportunities.

Lastly, concerning the third study objective, this study established the adverse effects of climate change spillover on other sectors. In other words, the adverse impacts of climate change affect not only sectors that are directly connected to the finance industry, like the insurance and banking industry but also others that are affected by the high default rates on borrowed funds. Therefore, the occurrence of natural events means that the banking industry's loaning capacity to small and medium enterprises cannot be operationalized at full scale since most borrowers usually face challenges repaying their current loans, thus limiting credit creation. Further, the results underscored that the enormous resources committed to fund climate change mitigation and low-carbon transition imply that other sectors and businesses have little funds they can access from the banking and financial sectors for economic expansion.

CONCLUSIONS AND RECOMMENDATIONS

After in depth analysis of the literature, scientific literature, methodology research and findings the following conclusions are made with certain recommendations and flaws to give a concrete idea of the model.

This study has examined the connection between climate risk and the stability of the financial system by focusing on three precise objectives, which included determining the manifold exposures of climate change and their implications on the monetary system's efficiency, establishing the possible consequences of various climate-change containment strategies on the soundness of the financial establishment, and identifying the spillover effects of the climate-related disruptions of the financial establishment on other sectors of the economy. To mitigate the risks and enhance the resilience of financial systems, policymakers and stakeholders concentrate on climate change mitigation and sustainable economic practices.

This research has used both macro and micro level analysis of countries to understand the pattern of how climate change can affect financial stability, Provided sophisticated equations and regression figures were scrutinized to prove that the mitigation of climate risk can help in achieving financial stability. Both the levels of study helped us in figuring out how it can help us in bringing solution to a wider problem.

The qualitative analysis was performed using certain journals and sources. In order to narrow the research Boolean operators were used to get relevant information in order to give a precise answer to questions which are challenging. Equations like CRI are used in order to see how climate change effects financial stability. The equations like CRI can only be derived from secondary source combining it with standard deviation and mean, provided we were possible to assess the results and get a clear view on the relationship between climate risk and growth. To solve successfully the spillover effects in depth analysis of countries such as USA, Norway and UK was used to get a pattern of how climate change can be tackled in terns of it effecting the financial stability on both short term and long run.

The quantitative analysis was performed using the ANOVA which gave us valuable insights and statistically significant differences were addressed during the research hypothesis. The use of the model effectively helped in isolating key factors and reducing error variance with actionable insights and underscoring the importance of statistical modelling and guiding us in the path of evidence based decision.

Recommendations for Practice

1.There is a need to have contingency plans and the creation of a hedge fund to take care of significant consequences of climate change, particularly the impacts resulting from natural

2.It is also important to create a pathway for transitioning to zero-carbon regimes to enable stakeholders and actors to understand the technological innovations and capital required to fund such a transformation. Committing huge capital outflows to fund an innovative transformation to low-carbon economies would leverage substantial and long-term benefits to economic systems because of the reduced impact and severity of adverse climatic events.

3.It is also important for climate change actors and policymakers to prioritize economic decarbonization through green transition processes and explore suitable sources of funding for such changes to avert the adverse impacts of climate change.

Suggestions for Further Research

Future research should explore the exact financial cost of transitioning economic systems to have the capacity to mitigate the risks posed by climate change. Such a study could provide a comprehensive understanding of the depth of impact generated by the mitigation strategies developed to combat climate change whilst maintaining the steadiness of the financial system.

Moreover, future research should quantify the indirect effects of climate risks on the financial system and how these exposures spill over to adjacent sectors and industries. Such a study could reveal the operational realities of climate change and the obstacles created by the smooth operation of businesses in other industries, such as the service and product sectors.

Study Implications

1. The first implication of this study is that in order to contain the risks of climate change on financial stability, concerted efforts should be directed toward lowering the physical risks of such unpredictable and unfavorable events.
2. Secondly, the findings of this study also imply that the process of low carbon transition is costly, with far-reaching consequences for actors within the financial environment. Financing the acquisition of relevant technology for low-carbon transition can impact financial institutions and banks' operational and liquidity positions.
3. Thirdly, the study implies that higher severity of climatic events is also unfavorable for the insurance industry's operations because it increases expenses as it tries to restore affected sectors to their usual operating capacity. Lastly, the result implies that climatic risks create an unfavorable business environment that limits borrowers from being able to meet their debt obligations, leading to underwhelming banking performance.

Limitations

1. The first limitation of this study is attributed to the inclusion of secondary data, which is associated with various flaws that might have impacted the validity and reliability of the conclusions drawn from the analysis of such information. For instance, the secondary data were originally collected to address the specific needs of their primary researchers, which might have undermined it from being tailored towards effectively answering the current study’s research question.
2. The research question was answered by mitigating this limitation whereby the researcher stuck with the inclusion criteria to ensure that the data collected was relevant to the understanding of the connection between climate risk and financial stability.
3. Another possible constraint of using secondary data as part of the evidence base of this study was a possible transfer of errors, omissions, and biases from original sources to this study. The evaluator overcame this shortcoming by using only

credible sources and relying on reputable information databases to obtain insights into how climate risk affects financial stability.

4. A key limitation associated with this study is the quality of the secondary data sources used to inform the conclusions made. Studies by Wickham (2019) and Pederson et al. (2020) acknowledge the flaws associated with secondary data, including a possible transfer of errors, biases, and omissions from original sources, which might influence secondary research outcomes. The researcher mitigated this limitation by relying on high-quality sources to establish credible results connecting climatic risks with financial stability disruptions.
5. The other possible limitation is the inability of secondary data to address the specific objectives of this inquiry effectively. In their studies, Pederson et al. (2020) and Cheng and Phillips (2014) contend that secondary data faces this flaw because it was originally collected in alignment with the initial researchers' objectives, which makes them misaligned or less tailored to addressing the research outcomes of secondary researchers. The researcher overcame this limitation by picking sources that topically aligned with the scope of this inquiry.
6. The last limitation associated with this study is the inability to make the results generalizable to other geographical contexts. This study predominantly relied on evidence from the US, which means that the results cannot be interpolated to understand the nexus between climatic risk and the steadiness of other countries' financial establishments. This shortcoming was not mitigable because it was beyond this investigation's scope to focus on contexts other than the US. There is, therefore, a need for b between climate risk and financial stability.

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Annexes

Annex 1: Semi-Structured Questions

1. How do climate change risks affect the financial stability of the economy in the long term and short-term?
2. Which sectors or segments of the financial industry are most affected by natural disasters? Please, elaborate
3. How does a low-carbon transition affect the stability of the financial system?
4. How do unpredictable weather patterns affect bank credit risk?
5. How can climate risks be mitigated and controlled in the long term to ensure that financial systems are sustainable?

Annex 2: Results of the Pearson Correlation

Correlations							
		Climate change-induced risks present operational challenges for financial institutions	The rise in global temperatures exacerbates the adverse effects of climate change hazards on the efficient functioning of the financial system.	The severity of natural disasters and unfavorable weather events affect the default rates of borrowers, thereby hampering financial institutions from functioning efficiently.	Climate policies cause significant market volatilities that endanger the financial system.	Frequent and severe climate disasters are akin to increased damage to the economic system.	Transitioning to a low-carbon economy in order to combat climate change presents substantial risks that can destabilize financial stability.
Pearson Correlation	Climate change-induced risks present operational challenges for financial institutions	1.000	-.080	-.256	-.142	-.049	-.021
	The rise in global temperatures exacerbates the adverse effects of climate change hazards on the efficient functioning of the financial system	-.080	1.000	-.125	.358	.188	.015
	The severity of natural disasters and unfavorable weather events	-.256	-.125	1.000	.271	.038	.226

	affect the default rates of borrowers, thereby hampering financial institutions from functioning efficiently						
	Climate policies cause significant market volatilities that endanger the financial system	-.142	.358	.271	1.000	.349	.189
	Frequent and severe climate disasters are akin to increased damage to the economic system.	-.049	.188	.038	.349	1.000	-.034
	Transitioning to a low-carbon economy in order to combat climate change presents substantial risks that can destabilize financial stability.	-.021	.015	.226	.189	-.034	1.000

Annex 3: Outcomes of ANOVA

ANOVA						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	3.120	5	.624	.569	.723b
	Residual	35.090	32	1.097		
	Total	38.211	37			

a. Dependent Variable: Climate change-induced risks present operational challenges for financial institutions

b. Predictors: (Constant) Transitioning to a low-carbon economy in order to combat climate change presents substantial risks that can destabilize the financial stability, The rise in global temperatures exacerbates the adverse effects of climate change hazards on the efficient functioning of the financial system, Frequent and severe climate disasters are akin to increased damage of the economic system, The severity of natural disasters and unfavorable weather events affect the default rates of borrowers, thereby hampering financial institutions from functioning efficiently, Climate policies cause significant market volatilities that endanger the financial system

Annex 4: Summary Results of the Regression Model

Model Summary									
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**Change Statistics**				
					R Square Change	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.286	.082	-.062	1.047	.082	.569	5	32	.723
a. Predictors: (Constant), Transitioning to a low-carbon economy in order to combat climate change presents substantial risks that can destabilize the financial stability, The rise in global temperatures exacerbates the adverse effects of climate change hazards on the efficient functioning of the financial system, Frequent and severe climate disasters are akin to increased damage of the economic system, The severity of natural disasters and unfavorable weather events affect the default rates of borrowers, thereby hampering financial institutions from functioning efficiently, Climate policies cause significant market volatilities that endanger the financial system									
b. Dependent Variable: Climate change-induced risks present operational challenges for financial institutions									