

Relationship between Climate Change and Business Risk: Strategies for Adaptation and Mitigation: Evidence from a Mediterranean Country

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Abstract: - Global corporate operations are facing significant challenges as a result of climate change. Businesses are exposed to a variety of dangers because of their effects, which might include anything from changing regulations to excessive weather. The objective of this research is to examine the connection between business risk and climate change, with a particular emphasis on the success of different adaptation and mitigation tactics used by Greek companies. A cross-sectional study was carried out among 345 enterprises in Greece using a quantitative research methodology. To investigate the relationship involving company risk management, adaptation, and mitigation plans with climate change risks, descriptive, correlational, and regression analyses are employed. Businesses are most distressed about the financial risks associated with climate change, followed by supply chain disruptions and physical hazards. Moreover, developing climate-resilient infrastructure and enhancing catastrophe preparedness have evolved into vital adaptation tactics. Also, converting to renewable energy sources is the most preferred approach to mitigation initiatives. Furthermore, the study demonstrated a significant positive correlation between climate change mitigation strategies and effective business risk management. Nevertheless, as perceived climate change risks increased, business risk management effectiveness decreased. The study suggests that Greek businesses are actively engaging in climate change risk management strategies that embrace both adaptation and mitigation strategies. Yet, the study recommends a continued focus on developing resilient infrastructure and collaborative efforts with local communities, governments, and NGOs. Businesses should also prioritize the shift to renewable energy sources to better mitigate their carbon emissions. This research contributes significantly to understanding how companies can strategically address the challenges of climate change. Furthermore, the study provides valuable insights into the dynamics of climate change adaptation and mitigation in a specific geographical area, thereby enhancing the global dialogue on climate resilience and sustainable business practices.

Key-Words: - Climate Change, Business Risk Management, Adaptation Strategies, Mitigation Strategies, Renewable Energy, Greece.

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1 Introduction

1.1 Background to the Study

Human activities are the primary drivers of climate change, which has rapidly become one of the most urgent challenges for the global community [1], [2], [3]. The Intergovernmental Panel on Climate Change (IPCC) has consistently underscored the growing impacts of climate change, as detailed in its most recent report [4]. This issue has shifted from a distant threat to an immediate concern with widespread ecological, social, and economic implications [5]. According to the World Meteorological Organization (WMO), the decade from 2011 to 2020 was the hottest on record, with global temperatures about 1.2°C above pre-industrial levels. The rise in temperatures has led to more frequent and severe extreme weather events, such as hurricanes, droughts, floods, and wildfires [6]. For instance, the occurrence of Category 4 and 5 hurricanes has surged by approximately 25% since the 1980s. These events cause not only immediate destruction but also have long-term economic effects [7]. Thus, climate change extends beyond environmental concerns, bearing significant economic consequences. According to the Global Commission on the Economy and Climate the direct economic impacts of climate change, which include losses to agriculture, infrastructure, and public health may total \$360 billion and \$971 billion, respectively, between 2030 and 2050, [8]. In addition, the shift to a low-carbon economy, which is required to slow down global warming, will alter markets and sectors, providing both possibilities as well as hazards for companies. Also, businesses, as major economic engines, are both accountable for and susceptible to climate change. Yet, they are exposed to significant risks such as the effects of climate change, supply chain disruptions, modifications to regulations, and reputational harm resulting from carbon emissions, [9], [10]. Nevertheless, businesses perform a crucial role in climate change mitigation by implementing innovative ideas, sustainable practices, and carbon reduction initiatives. Therefore, integrating climate change into risk assessments and strategies is emerging as a priority in business operations worldwide, [11].

Greece's varied economy and landscape present a compelling case for examining business risk in the context of climate change [11], [12], [13]. The country grapples with climatic challenges including rising temperatures, decreased rainfall, and escalating wildfires [14], [15]. As a result, critical sectors such as infrastructure insurance, tourism, agriculture, and energy are expected to be adversely affected. Gaining insight into how Greek businesses perceive and manage climate risks is essential for

developing innovative adaptation and mitigation strategies that enhance resilience and promote the climate agenda [16], [17]. This study explores the interplay between climate change and economic risks in Greece, offering valuable contributions to the broader discussion on global climate resilience and sustainability.

1.1 Problem Statement

The increasing intensity and frequency of severe weather events underscore climate change as a major global commercial concern, significantly impacting various industries [18], [19]. The Intergovernmental Panel on Climate Change (IPCC) predicts that global mean temperatures will rise by 1.2 degrees Celsius above pre-industrial levels by 2020, establishing a clear link between rising temperatures and the intensification of extreme weather phenomena such as hurricanes, droughts, floods, and wildfires [4]. The business sector is acutely aware of these climatic disruptions. A report by the Carbon Disclosure Project (CDP) indicates that over 85% of Global 500 companies recognize climate change as a substantial risk to their operations, supply chains, and financial stability [20], [21], [22]. Moreover, the World Economic Forum's Global Risks Report identifies environmental hazards related to climate change as the top global risks in terms of both likelihood and impact [23]. Despite heightened awareness of climate change as a critical business risk, there remains a considerable knowledge gap regarding its effects on different businesses and the strategies that can be employed to manage and mitigate these threats effectively. Climate change impacts are not uniform; they vary by industry, region, and a company's adaptive capacity [24]. Consequently, businesses often lack a comprehensive understanding of the types and scope of climate change risks relevant to their activities. Greece serves as a pertinent example of this information gap due to its susceptibility to heat waves, sea level rise, and other extreme weather events. Recent studies reveal that Greece's average annual temperature increased by 1.5 degrees Celsius between 1901 and 2018, significantly higher than the global average [12]. This temperature rise has adversely affected the Greek economy, especially in the energy, tourism, and agriculture sectors. Addressing this knowledge gap is crucial to equip Greek enterprises with effective climate change risk management capabilities. Therefore, Greek businesses must develop robust adaptation and mitigation strategies to tackle climate change risks and foster sustainable economic development [25], [26], [27].

1.2 Research Questions

The main aim of this study is to investigate the link between climate change and business risk, specifically emphasizing the identification of actionable adaptation and mitigation strategies.

1.3 Study Objectives

- To explore a range of climate change adaptation strategies and analyze their effects on managing business risks.
- To assess the influence of different climate change mitigation strategies on business risk management.
- To investigate the various climate change risks that businesses face and determine their impact on business risk management.

1.4 Research Questions

1. What climate change adaptation strategies are available to businesses, and how do they impact business risk management?

2. What are the different climate change mitigation strategies that businesses can implement, and how do these strategies influence business risk management?

3. What are the specific climate change risks associated with businesses, and how do these risks affect business risk management?

1.5 Research Hypotheses

Hypothesis 1. (H1). Implementation of climate change adaptation strategies significantly reduces business risk across various sectors in Greece.

Hypothesis 2. (H2). The adoption of climate change mitigation strategies leads to a notable decrease in business risk in different industries in Greece.

Hypothesis 3. (H3). The severity and frequency of climate change-related risks have a direct and significant impact on business risk management practices in Greece.

1.6 Significance of the Study

This study is significant as it provides actionable insights for businesses to strategically plan for and adapt to the realities of a changing climate, ensuring long-term sustainability and resilience.

2 Literature Review

2.1 Climate Change and Business Risk

Climate change has ushered in a new era of risks and uncertainties for businesses worldwide [6], [28].

Scientific consensus indicates that climate change is a real phenomenon, evidenced by a continuous rise in global temperatures. It is estimated that since the late 19th century, the average global temperature has increased by approximately 1.2 degrees Celsius [29]. Human activities, particularly deforestation and the use of fossil fuels, are the primary drivers of this upward trend. Extreme weather events such as hurricanes, droughts, wildfires, and floods are not only becoming more frequent but also more destructive. According to data from the United Nations Office for Disaster Risk Reduction (UNDRR), there were 7,348 large catastrophe occurrences worldwide between 2000 and 2019, resulting in 1.23 million fatalities and economic damages surpassing \$2.97 trillion, [30]. A considerable amount of these losses is attributable to climate-related calamities. These climate-related disasters have a significant budgetary impact, particularly on businesses. There are significant effects on operations, infrastructure, and supply networks. According to World Economic Forum research, natural catastrophes, severe weather events, and the inability to mitigate and adapt to climate change were predicted to be the top five global hazards in terms of likelihood in 2020, [23]. Businesses are also realizing the hazards that transition risks present. Further, governments globally focus their interest on addressing climate change with an emphasis on decarbonization and green policies, [31]. In this context, businesses that do not comply confront regulatory penalties, harm their reputation, and decrease their market value. As a result, comprehension and regulation of climate change-related physical and transitional risks have emerged as critical issues, [8], [32].

According to another study, [33], although the amount of climate threats differs among regions, businesses can gain significant insights into geographical aspects of climate change risk. For instance, increasing sea levels and the possibility of more frequent and powerful storms might put coastal places at greater risk, while inland locations would face a variety of challenges like changed precipitation patterns that could have an impact on agriculture. Therefore, businesses that operate in many areas may find these insights especially helpful since they must customize their risk management plans to the unique circumstances of each location, [34], [35], [36].

A study [37], examines the complicated link between a nation's environmental performance, credit risk, and climate change commitment, focusing on international banks. The study, [37], also note that environmental and climatic issues

may severely affect the finance business. However, IPCC, [38] used real data to demonstrate how environmental performance in a country might affect foreign banks' credit risk. The report states that foreign banks' credit risk exposure varies according to host nation's environmental laws and regulations, which has major implications for financial institutions operating in areas with different environmental regulations because they must assess their climate-related credit risk, [38].

The researchers, [2], also emphasize the growing importance of environmental and climate risk assessments in banking and finance. As worldwide awareness of climate change and environmental sustainability grows, investors, regulators, and consumers examine financial institutions' environmental policies and risk management techniques. The authors, [6], also discuss partnerships and collaborations with banks that prioritize climate change mitigation and show environmental responsibility for businesses in renewable energy, sustainable agriculture, and green technology. Partnerships may increase financial resources and lower borrowing costs, providing members with a competitive advantage, [39].

The study, [28], examines how UK firms are reacting to climate change business risk and carbon disclosure. Businesses disclose their greenhouse gas emissions, climate change risks, and sustainability actions via "carbon disclosure". This method is becoming more common as investors and stakeholders demand climate transparency. The research found that carbon disclosure significantly affects firm risk, [40]. The investigation, [41], found that clear carbon data disclosure reduces risk. Therefore, transparent carbon disclosure implies investors, analysts, and stakeholders to better comprehend a company's exposure to climate-related risks. As a consequence, it becomes possible to make better-informed investment decisions, [40], [42], [43]. As a result, investors' confidence and credibility are increased when businesses provide complete and accurate information about their carbon emissions, climate strategy, and risk management initiatives, [18], [44], [45].

Furthermore, the study [11], emphasizes the significance of acknowledging climate change as an immediate and potentially catastrophic hazard, as well as a long-term commercial concern. Companies may be unprepared for the disruptive and catastrophic effects of climate change if their risk assessments and planning do not consider these severe scenarios. Moreover, the research emphasizes how climate hazards are interrelated across industries and geographical areas, [18].

Concretely, a catastrophic climatic catastrophe that occurs in one region of the world could have a significant impact on financial markets, corporate operations, and international supply networks. The interconnection emphasizes the importance of corporations adopting a global perspective and collaborating across borders to successfully address climate change, [46].

Businesses are subject to transition risks because of the change to a low-carbon economy, claims -the analysis, [29]. Policies and initiatives to reduce greenhouse gas emissions are being implemented by governments, regulatory agencies, and financial institutions more often, [47], [48], [49]. These regulations include clean technology subsidies, emission reduction goals, and carbon pricing schemes. In contrast, businesses that fail to adapt to these new rules risk their assets and suffer financial losses, [8], [32]. Yet, transition risks are exacerbated by evolving consumer preferences requiring sustainable products and services. In this line, The investigation, [46], noticed that 81% of global consumers believe that businesses should help improve the environment. On the other hand, failure to adapt to these market dynamics can lead to reputational damage and market share loss.

2.2 Adaptation Strategies in Response to Climate Change

Climate change is a global challenge that poses significant risks to businesses across industries, [4], and adopting adaptation and mitigation strategies tailored to their unique circumstances is required to navigate hazards and ensure long-term sustainability, [50].

The researchers, [51], say resilient infrastructure is one of the most essential climate change adaptation measures. The design, development, and management of resilient infrastructure allows physical assets and systems to endure and recover from climate-related shocks and stressors. The rising frequency and intensity of severe weather events and their dangers to companies and communities globally underline the need for infrastructure, [21], [22], [52]. Climate resilience is emphasized, followed by climate impact forecasts using climate data and future scenarios. According to the publication, [12], engineers and architects may use improved wind load regulations to ensure constructions can resist stronger storms and typhoons.

Resilient infrastructure requires public-private collaboration. The authors, [16], believe that governments set resilience criteria, enforce legislation, and invest in key infrastructure. Public-

private partnerships are growing as private companies fund and advise infrastructure initiatives, [8], [53]. However, investment in solid infrastructure pays off. In 2020, the Task Force on Climate-related Financial Disclosures (TCFD) estimated that investing \$1.8 trillion in resilient infrastructure over 10 years might yield \$7.1 trillion [24]. These benefits include greater public health, increased economic production, and reduced climate-related damage, [54], [55], [56].

According to the study, [51], a growing number of companies are diversifying their supply chains to reduce their vulnerability to the effects of climate change. Nonetheless, more businesses are implementing redundancy and diversification plans in their supply chains to boost resilience and mitigate the effects of climate-related disruptions. According to researchers, [7], businesses have become less dependent on a particular source or region, making diversifying suppliers and sourcing areas a critical strategy. As a result, the risk associated with climate-related catastrophes can be distributed by finding substitute providers in other geographic locations following the authors, [16], an automobile manufacturer might potentially reduce the risk of production disruptions caused by climate-related disasters in a single site by procuring components from various suppliers located in different nations.

Furthermore, the investigation, [37], highlighted that disaster preparedness is essential to businesses' climate change adaptation strategies. As the frequency and severity of extreme weather events increase, businesses recognize the critical importance of being well-prepared to mitigate their potential impacts on operations and assets. Effective disaster preparedness requires comprehensive planning and proactive steps to reduce vulnerabilities and increase resilience, [31]. Hence, companies that prioritize disaster preparedness are better able to reduce interruptions, safeguard staff, continue operations, and recover from climate-related disasters faster. Planning for business continuity is part of being prepared for emergencies. To ensure that the company can continue to run, this entails creating plans to preserve critical operations both during and after a crisis. It can work remotely, backup data, and alternate workspaces, [11], [34], [40].

According to the International Monetary Fund - IMF, [57], businesses are realizing that they need to work together with different stakeholders to improve their resilience and adaptation capacity as the effects of climate change intensify. Working together to address climate-related issues and create

sustainable solutions, this cooperative strategy entails interacting with local governments, NGOs, and communities, [58], [59]. Businesses must work in tandem with local communities to comprehend the unique climate risks and vulnerabilities that exist in the locations where they operate. From a strictly corporate perspective, it might not be possible to see the whole impact of climate change, but local expertise and community involvement can offer insightful information, [60], [61].

Evaluate community vulnerability, collect input on disaster preparation plans, and include local people in resource management and infrastructure development choices. By actively integrating local stakeholders, firms may develop confidence and ensure their adaption strategies meet community needs and goals, [11]. Figure 1 concludes with the four-climate change adaptation strategy topics.



Fig. 1: Common adaptation strategies in response to climate change

2.3 Mitigation Strategies

The study, [18], reports that corporations worldwide are switching to renewable energy sources to reduce carbon emissions and combat climate change. This move away from fossil fuels, the main source of greenhouse gas emissions, to cleaner, more sustainable alternatives is crucial. Recently, renewable energy has become more cost-competitive, [62]. Businesses are attracted to solar and wind electricity due to their lower generating costs [30]. Growing environmental and corporate social responsibility awareness has led corporations to minimize their carbon footprints, [63], [64], [65]. Transitioning to renewables shows a commitment to sustainability. Renewable energy sources are often domestic, lowering fossil fuel imports and improving energy security, [41], [66].

Energy efficiency stands as a central pillar of mitigation efforts for businesses and industries

worldwide in the face of climate change, [67]. It involves the systematic reduction of energy consumption while maintaining or enhancing the quality and quantity of goods and services produced, [2]. This strategy not only reduces greenhouse gas emissions but also offers several economic and environmental benefits. Improving energy efficiency can lead to significant cost savings for businesses. According to FAO, [50], investments in energy efficiency measures typically yield a return on investment of 20% or more. By optimizing processes, upgrading equipment, and adopting energy-efficient technologies, businesses can lower their energy bills, which can have a substantial positive impact on their bottom line. Rapid advancements in technology have made it increasingly feasible for businesses to improve energy efficiency, [28]. Smart building systems, energy-efficient appliances, and industrial automation, teleworking are just a few examples of technologies that enable businesses to optimize energy use. In many cases, the upfront investments in these technologies can be offset by long-term energy savings, [6],[68].

According to the analysis, [28], carbon pricing has emerged as a pivotal mitigation strategy for businesses seeking to reduce their greenhouse gas emissions and contribute to the global effort to combat climate change. This strategy involves assigning a monetary value to carbon emissions, either through taxes or cap-and-trade systems, which incentivizes companies to limit their emissions and transition to cleaner, more sustainable practices [18]. Carbon taxes impose a fee on each unit of carbon dioxide (CO₂) or equivalent greenhouse gas emissions produced. The cost per metric ton of CO₂ released varies according to the jurisdiction's environmental objectives. Businesses subject to carbon taxes have a financial incentive to reduce emissions, as higher emissions result in higher taxes. This mechanism encourages companies to invest in low-carbon and energy-efficient technology to reduce their tax liability [42], [45].

As part of their sustainability objectives, several companies are voluntarily implementing internal carbon pricing mechanisms, [69]. This method entails putting a price on carbon emissions that occur during business activities, even in the absence of laws. According to the authors, [5], the internal carbon price acts as an internal financial incentive for decision-makers to support low-carbon projects and technologies. Businesses establish an internal price per metric ton of CO₂ released, which is taken into account when making investment choices and

assessing projects. This aids companies in determining the true cost of emissions and helps them rank the most financially sound carbon reduction projects. For instance, in 2012 Microsoft implemented an internal carbon fee, charging various business divisions for their emissions and allocating the proceeds to the financing of renewable energy initiatives, [46].

Figure 2 summarizes the four themes developed regarding mitigation strategies in response to climate change.

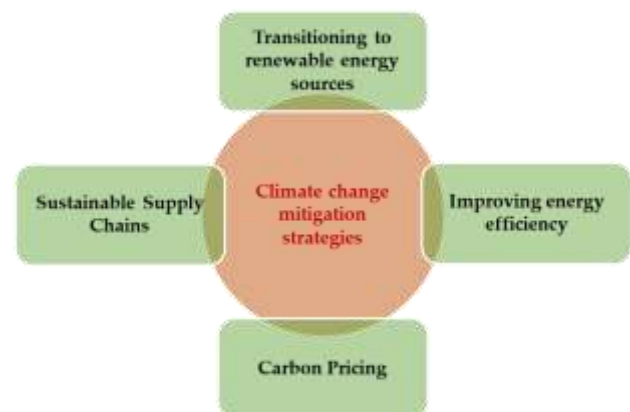


Fig. 2: Common mitigation strategies in response to climate change.

2.4 Climate Change in Greece: Statistics and Vulnerability

Greece's climate has experienced significant changes over the past century, with rising temperatures, changing precipitation patterns, and more frequent extreme weather events. Also, Greece's average temperature has risen by around 1.5°C over the past century, and the investigation, [6] expect this trend to continue. Yet, Greece's economy is directly affected in several sectors, including energy, tourism, and agriculture, [12]. According to statistics, Greece is increasingly vulnerable to the effects of climate change. For example, the country has experienced an increase in heatwaves and wildfires in recent years, causing damage to the ecosystem and nearby communities, [41]. About 70% of Greeks reside in coastal zones, making them vulnerable to sea level rise. These numbers demonstrate the urgency of climate change adaptation and mitigation in Greece, according to the researchers, [70].

Greece's adaptation strategies also attempt to lessen climate change sensitivity and increase resilience, [58]. Farmers use climate-resilient irrigation and crop kinds to adapt to changing rainfall, [71], [72]. Terracing and reforestation are also regulated by the Greek government to minimize

soil erosion and land degradation, [73], [74], [75]. Although Greece's economy depends heavily on tourism, according to statistics, significant tourist arrivals have increased the country's GDP, [11], [76]. Nevertheless, climate change poses risks to the tourism sector, such as higher temperatures that may jeopardize tourist comfort and altered precipitation patterns that may have an impact on water supplies for tourism-related activities, [45].

Greece's mitigation strategies center on cutting greenhouse gas emissions and moving toward a low-carbon economy. Data show that Greece's energy industry, which heavily depends on fossil fuels, contributes significantly to emissions, [18]. Greece has established aggressive goals to produce renewable energy, mostly from solar and wind power, to address this, [5]. Government programs and incentives to encourage energy-efficient buildings and transportation systems bolster these efforts. Moreover, Greece actively participates in the EU's efforts to reduce emissions. Greece's policy landscape and its role in mitigating climate change are impacted by the European Green Deal, which intends to make the EU climate-neutral by 2050, [11].

3 Materials and Methods

3.1 Research Design

The study used a quantitative research approach based on the cross-sectional survey research design. The goal of the quantitative approach is to quantify data, and it usually makes use of standardized data collection tools like questionnaires and surveys. Objective measurements and statistical or numerical analysis of the gathered data are prioritized. This method enables the methodical examination of how firms understand and react to climate change concerns within the framework of your study. A cross-sectional survey gathers information at one specific moment in time. Its purpose is to draw conclusions about the population at a given moment by analyzing data from a population, or a representative subset of the population, at that point in time. The present trends, events, and connections between climate change and business risks in Greece were evaluated with the aid of this design.

3.2 Target Population

The study targeted the different companies or businesses in Greece. The population served as the foundation for selecting the study's ideal sample. The study's target population in Greece comprised

both public and private businesses. This technique was comprehensive and can explain how different businesses are reacting to climate change.

3.3 Sample Size

Greece's corporate enterprises provided 345 research participants. A typical sample size calculation method, the Krejcie and Morgan table, was used to pick a representative sample of Europe. Robert V. Krejcie and Daryle W. Morgan developed a simple approach for population sample size determination in 1970. It assumes a 5% margin of error and 95% confidence. The table lists population numbers and sample sizes needed for representative findings, [77].

Stratified random sampling was employed to carefully select a highly desirable sample for the study. Although there is an alternative method available for sample selection, which typically yields a smaller sample size, it was not utilized in this research due to the substantial response received from the respondents, [78],[79].

3.4 Sampling Technique

The study employed probability sampling techniques, specifically stratified and simple random sample methods. Using stratified sampling, the target population is split up into groups or strata according to specific traits that are pertinent to the study's goals. A more homogeneous and compact subset of the population makes up each stratum. This approach guarantees that every subgroup is represented in the sample, which is helpful when you wish to examine various population segments independently. It contributes to lowering sampling error and raising estimate precision within each stratum. Simple random sampling involves randomly selecting individuals or entities from the entire population without any systematic bias. Each element in the population has an equal chance of being selected.

3.5 Data Collection

The study employed an online questionnaire to collect data from the selected managers, directors, or employees of different businesses in Greece. Online surveys are cost-effective compared to other data collection methods such as in-person interviews or phone surveys. This questionnaire method helped to reach many respondents efficiently and was particularly useful when collecting data from owners or employees of multiple businesses across Greece. The digital nature of online surveys made data collection and management more efficient.

Responses were automatically recorded and analyzed, reducing the potential for errors associated with manual data entry. A nominal measurement scale was used in measuring the study variables and constructing questions on the relationship between climate change and business risk while highlighting the strategies for adaptation and mitigation. Different ethical considerations such as privacy and confidentiality were observed during the process of the study, [80], [81].

3.6 Data Analysis

After collecting all surveys, data was analyzed according to study goals. To conduct a more thorough statistical analysis, SPSS V21.0 was used to analyze the data. The first component of the questionnaire, which included respondents' profiles, was evaluated first. The data was displayed in a frequency table, and some mean and standard deviation were calculated to reveal more. The researcher also used Pearson's rank correlation test to examine study variables' correlations. A statistical strategy was used to establish and quantify correlations between different areas under consideration. Regression analysis was also used to examine climate change and company risk and identify adaptation and mitigation solutions. A multiple regression model (Equation (1)) was used to identify and quantify the predictive values of different factors to better understand how climate change affects company risk and how different tactics affect this dynamic, [78], [82].

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon \quad (1)$$

Where:

Y = Business risk management

β_0 = Constant (coefficient of intercept)

X_1 = Climate change risks in business

X_2 = Climate change adaptation strategies

X_3 = Climate change mitigation strategies

ε = Represents the error term in the multiple regression model

$\beta_1 \dots \beta_3$ = demonstrates how the regression coefficient for the independent factors may be used to forecast the extent of climate change-related business risk management, as well as adaptation, and mitigation strategies.

Finally, regression findings at 0.05 significance were used to assess and interpret the study's hypotheses.

4 Results

The following section interprets the various results obtained after analyzing data collected from the selected study participants.

4.1 Demographic Characteristics

Table 1 shows the demographic characteristics of the selected respondents who participated in the study.

Table 1. Participants' demographic characteristics.

Characteristics	Frequency	Percentage (%)
Gender		
Male	237	68.7
Female	108	31.3
Age bracket in years		
Below 25 years	4	1.1
26–40 years	192	55.7
41–50 years	97	28.1
Above 50 years	52	15.1
Experience in managing business risks		
Below 5 years	63	18.3
5-10	197	57.1
Above 10 years	85	24.6
Total	345	100

Source: Authors' own work (2023)

The majority of respondents (68.7%) were male, with 31.3% female. Such demographic information is crucial for understanding the gender representation of study participants and can be used to assess potential gender-related differences in responses and perceptions. In terms of age distribution, the majority of respondents—(55.7%) are between the age of 26 and 40. The second largest group (28.1%) of the total are those aged 41 to 50. However, individuals under the age of 25 (1.1%) and those over the age of 50 (15.1%) represent a smaller proportion of the sample. Yet, a summary of the participants' age distribution is provided, which is useful when examining how different age groups perceive and react to climate change-related business hazards. Out of the total, 57.1% of respondents said they had five to ten years of experience, while 24.6% said they had more than ten years. Using this information makes it easier to determine the level of knowledge and skill that research participants bring. The participants with more expertise may have different perspectives and approaches to managing business risks related to climate change.

4.2 Descriptive Analysis

Table 2 displays the results of the study which highlighted different climate change risks associated with businesses.

Table 2. Key climate change risks for businesses.

	Frequency	Percentage (%)
Market risks	13	3.8
Regulatory and policy risks	8	2.3
Physical risks	83	24.1
Supply chain disruptions	41	11.9
Reputation and brand risks	10	2.9
Financial risks	185	53.6
Others specify ...	5	1.4
Total	345	100

Source: Authors' own work (2023)

Most research participants (53.6%) mentioned financial hazards as the biggest climate change worry for firms. This shows that climate change has serious financial consequences for corporations globally. Next was 24.1% who cited physical dangers as their main worry. Climate change directly affects a business's property, infrastructure, and equipment. The significant number of respondents who identified physical hazards shows that climate change threatens corporate physical integrity immediately. With 11.9% and 3.8% of replies, supply chain disruptions and market risks were also worries. 2.3% of respondents worried about climate-related rules and policies affecting company operations and compliance costs. At 2.9%, reputation and brand risks show how public opinion and customer trust are becoming more important in a business's climate change strategy. Finally, at 1.4%, "other" hazards include legal liability and the possible effect of increasing temperatures on worker health and productivity. Table 3 lists corporate climate change adaptation techniques.

Table 3 reveals that 30.1% of respondents listed "Enhanced disaster preparedness" as a company climate change adaptation strategy. This shows that companies understand the necessity of climate-related crisis preparation and response. Next, 28.1% named "Building climate-resilient infrastructure" as an adaptation method. This highlights the need to invest in climate-resistant infrastructure. "Collaboration with local communities, governments, and NGOs" was noted by 26.4%. This suggests an increasing understanding of climate change adaptation collaboration. Businesses realize they cannot solve climate concerns alone. People also suggested "Diversifying supply chains to reduce vulnerability to climate change" (8.1%).

Table 3. Key climate change adaptation strategies in business.

	Frequency	Percentage (%)
Diversifying supply chains to reduce vulnerability to climate change	28	8.1
Enhanced disaster preparedness	104	30.1
adopting climate risk disclosure and reporting	14	4.1
Collaboration with local communities, governments, and NGOs	91	26.4
Conducting comprehensive climate risk assessments	8	2.3
Building climate-resilient infrastructure	97	28.1
Others specify...	3	0.9
Total	345	100

Source: Authors' own work (2023)

Climate disturbances make supply networks susceptible, thus this method acknowledges this. Businesses diversify suppliers and get materials and components from several places to mitigate climate risks that might disrupt supply chains. Diversification is a feasible solution to global supply chain network weaknesses. Only 4.1% of respondents mentioned "adopting climate risk disclosure and reporting" as an adaptation approach. This indicates a rise in climate risk management openness and accountability. Few responders (2.3%) cited "Conducting comprehensive climate risk assessments". This suggests that risk assessments are essential for adaptation, but corporate practices may need to be more conscious and adopt them. Finally, 0.9% of respondents listed "implementing water management and conservation strategies, such as rainwater harvesting" as an adaptation approach.

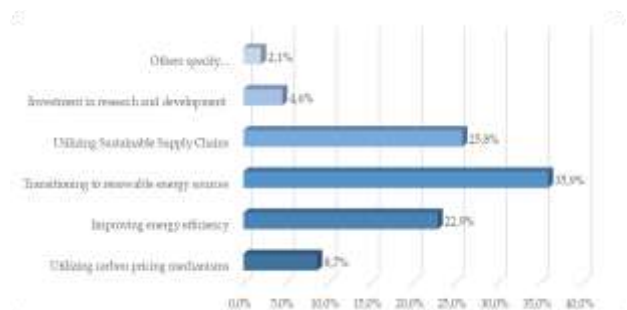


Fig. 3: Key climate change mitigation strategies in business. Source: Authors' own work (2023)

Although less prevalent, this method emphasizes the significance of effective water

resource management, particularly in the face of changing precipitation patterns and water shortages. Figure 3 shows the study's findings on company climate change mitigation methods.

Most research respondents—35.9%—preferred switching to renewable energy sources as a company climate change mitigation option. This shows that renewable energy is increasingly recognized as crucial to decreasing greenhouse gas emissions and climate change. Sustainable supply networks were the second most favored method, with 25.8% of respondents. Emissions and environmental consequences must be addressed throughout the supply chain. Companies are becoming more cognizant of climate threats in their transportation, manufacturing, and material supply chains. 22.9% of respondents supported energy efficiency, demonstrating that many firms understand its relevance. Energy efficiency cuts expenses and helps meet emissions objectives. To reduce energy waste, use LED lighting, energy-efficient HVAC systems, and smart building management systems. Carbon pricing was used by 8.7% of respondents. Carbon taxes and emissions trading internalize carbon emissions costs and encourage enterprises to decrease their carbon footprint. Only 4.6% of respondents stressed low-carbon technology R&D. This technique shows how some companies use innovation to reduce emissions. Only 2.1% of respondents mentioned additional climate change mitigation methods in business, such as researching specialized or alternative techniques customized to their sectors or situations. This varied category might include carbon offsetting, circular economy methods, and climate action collaborations. The research also identified company risk management outcomes, shown in Figure 4.

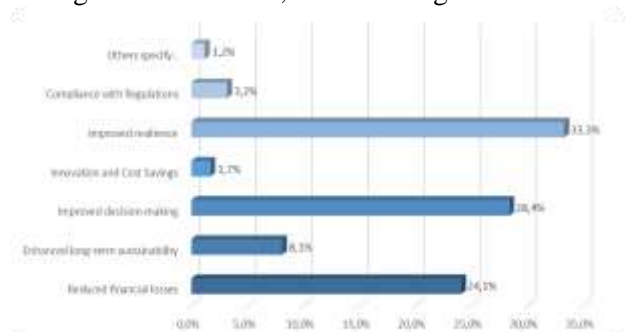


Fig. 4: Results on the key outcomes of business risk management. Source: Authors' own work (2023)

Figure 4 show that 33.3% of respondents ranked "Improved Resilience" as the most important corporate risk management result. This shows that firms recognize that risk management may help

them overcome issues, including climate change. At 28.4%, "Improved Decision-Making" was the second-most common business risk management result.

This supports the premise that a well-structured risk management approach helps businesses make strategic choices. 24.1% of respondents listed "Reduced Financial Losses" as an important consequence. This shows how good risk management pays off. Manage risks to limit the financial effect of bad occurrences and provide financial stability and sustainability. 8.1% of respondents said company risk management led to "Enhanced Long-Term Sustainability". This suggests that some companies understand the need for risk management for long-term success and sustainability. Fewer respondents identified "Compliance with Regulations" (3.2%) and "Innovation and Cost Savings" (1.7%) as major results. Since climate rules spur innovation and cost-saving, these results are linked. Only 1.2% of respondents listed "Adaptation to Regulatory Changes", "Increased Investor Confidence", and "Enhanced Supply Chain Resilience". These findings show that business risk management in climate change has several linked advantages that boost resilience and sustainability, [83].

4.3 Correlation Analysis

The following section explains the relationship between the study's different variables.

Table 4 shows that "Climate Change adaptation strategies" and "Climate Change mitigation strategies" are positively correlated. According to the Pearson correlation value of 0.592** (significant at the 0.05 level, 2-tailed), firms that adopt more climate change adaptation methods also execute more climate change mitigation initiatives. This positive relationship suggests that organizations that are actively engaged in adapting to the impacts of climate change are also more likely to take steps to mitigate their contributions to climate change. Secondly, the negative correlation between "Climate Change Risks in business" and "Business Risk Management" is worth discussing. The Pearson correlation coefficient of -0.248** (significant at the 0.05 level, 2-tailed) indicates an inverse relationship between the extent of perceived climate change risks in business and the effectiveness of business risk management. In other words, as the perceived climate change risks increase, businesses tend to have lower levels of risk management effectiveness. Lastly, the strong positive correlation between "Climate Change mitigation strategies" and "Business Risk Management" is a significant

finding. The Pearson correlation coefficient of 0.853** (significant at the 0.05 level, 2-tailed) indicates a highly positive relationship between the extent of climate change mitigation strategies adopted by businesses and the effectiveness of their business risk management practices. This suggests that businesses that are proactive in mitigating their carbon emissions and environmental impact are more likely to have robust risk management mechanisms in place.

Table 4. Correlation results

		Climate change risks in business	Climate change adaptation strategies	Climate change mitigation strategies	Business risk management
Climate change risks in business	Pearson Correlation	1			
	Sig. (2-tailed)				
Climate change adaptation strategies	Pearson Correlation	0.453**	1		
	Sig. (2-tailed)	0.002			
Climate change mitigation strategies	Pearson Correlation	0.651	0.592**	1	
	Sig. (2-tailed)	0.064	0.010		
Business risk management	Pearson Correlation	-0.248**	0.626**	0.853**	1
	Sig. (2-tailed)	0.009	0.025	0.000	

** Correlation is significant at the 0.05 level (2-tailed).

4.4 Results of Regression Analysis

Regression analysis was also conducted to establish the level to which Business Risk Management is predicted based by the distinct aspects of climate change adaptation strategies, climate change mitigation strategies, and climate change risks, and the results are presented in Table 5. In this analysis, the R-value is 0.702, indicating a positive correlation. This means that as the levels of climate change adaptation strategies, climate change mitigation strategies, and climate change risks increase, business risk management tends to improve positively. The R-Square value, which is 0.561 in this analysis, represents the proportion of the variance in the dependent variable (Business risk management) that can be explained by the independent variables (climate change adaptation strategies, climate change mitigation strategies, and climate change risks). In this case, the R-squared value of 0.561 suggests that these three independent

variables collectively account for approximately 56.1% of the variability observed in business risk management. However, it's essential to note that there may be other factors or variables not considered in this analysis that also influence business risk management. The remaining 43.9% of unexplained variability could be attributed to these unaccounted factors. The adjusted R-Square value, which is 0.539, considers the number of independent variables in the model. It is slightly lower than the R-Square value, which is typical when adding more predictors to the model. This suggests that while the three independent variables collectively explain a sizable portion of the variability in business risk management, there may be some degree of multicollinearity or interdependence among the predictors.

Table 5. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
	0.631 ^a	0.561	0.539	0.216

^a Predictors: (constant): climate change adaptation strategies, climate change mitigation strategies, climate change risks

The ANOVA analysis in Table 6 shows that the regression model is statistically significant, as evidenced by a significant F-statistic of 352.413 ($p < 0.001$). This suggests that at least one of the predictors (climate change adaptation strategies, climate change mitigation strategies, or climate change risks) has a considerable influence on business risk management.

Table 6. ANOVA analysis

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	36.040	3	18.361	352.413	0.016
Residual	30.108	342	0.027		
Total	66.148	345			

Dependent variable: business risk management. Predictors (constant): climate change adaptation strategies, climate change mitigation strategies, climate change risks.

Table 7 presents the regression coefficients for the model predicting business risk management based on the predictors, which include climate change adaptation strategies, climate change mitigation strategies, and climate change risks. The constant, with a coefficient of 0.518, represents the expected value of business risk management when all predictor variables (climate change adaptation strategies, climate change mitigation strategies, and climate change risks) are zero. In this context, it indicates the baseline level of business risk management. The coefficient is statistically

significant with a p-value of 0.026, suggesting that even in the absence of the predictors, there is a non-zero level of BRM. The coefficient for climate change adaptation strategies is 0.291. This positive coefficient indicates that an increase in the level of climate change adaptation strategies is associated with an increase in business risk management. The standardized coefficient (Beta) of 0.397 indicates that this predictor has a relatively strong positive impact on business risk management. This relationship is statistically significant with a p-value of 0.000, suggesting that businesses that implement more adaptation strategies tend to have higher levels of BRM. The coefficient for climate change mitigation strategies is 0.414. This positive coefficient suggests that an increase in the level of climate change mitigation strategies is associated with an increase in business risk management. However, the standardized coefficient (Beta) of 0.213 suggests that this predictor has a relatively weaker positive impact on business risk management compared to adaptation strategies. This relationship is statistically significant with a p-value of 0.021, indicating that businesses implementing more mitigation strategies tend to have higher levels of BRM. The coefficient for climate change risks is 0.092. Interestingly, this coefficient is negative, implying that an increase in perceived climate change risks is associated with a decrease in business risk management. The standardized coefficient (Beta) of -0.282 indicates a moderate negative impact. Despite the negative coefficient, the relationship is statistically significant with a p-value of 0.002. This suggests that while businesses may perceive more risks related to climate change, it doesn't necessarily translate into lower business risk management. Other factors may be influencing this relationship.

Table 7. Regression coefficients.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	0.518	0.236		2.438	0.026
Climate change adaptation strategies	0.291	0.057	0.397	3.736	0.000
Climate change mitigation strategies	0.414	0.067	0.213	3.195	0.021
Climate change risks	0.092	-0.079	-0.282	3.511	0.002

Dependent variable: Business risk management.

The coefficient for "Climate change adaptation strategies" is 0.291 (Beta = 0.397), and its

associated p-value is 0.000 ($p < 0.001$). This indicates that the implementation of climate change adaptation strategies has a statistically significant and positive effect on business risk management in Greece. Therefore, Hypothesis 1 is supported by the data, suggesting that the adoption of adaptation strategies does reduce business risk.

The coefficient for "Climate change mitigation strategies" is 0.414 (Beta = 0.213), and its associated p-value is 0.021 ($p < 0.05$). This indicates that the adoption of climate change mitigation strategies also has a statistically significant and positive effect on business risk management in Greece, although the effect is smaller compared to adaptation strategies. Hypothesis 2 is supported by the data, suggesting that the adoption of mitigation strategies contributes to a decrease in business risk.

The coefficient for climate change risks is 0.092 (Beta = -0.282), and its associated p-value is 0.002 ($p < 0.01$). Climate change-related hazards' intensity and frequency negatively affect Greek corporate risk management statistics. Thus, company risk management declines as climate change hazards increase. Thus, Hypothesis 3 was accepted, demonstrating a negative association between climate change and corporate risk management.

5 Discussion

The study's examination of climate change and business risk in Greece is crucial for adaptation and mitigation efforts. Current climate change and corporate risk management science and practice support the conclusions. The report shows that Greek firms are prioritizing climate change adaptation. According to the studies, [21], [51], catastrophe preparation and climate-resilient infrastructure are crucial initiatives. This focus on resilient infrastructure and catastrophe preparation highlights the necessity to build climate-resistant physical assets, [37], [45]. This strategy protects physical assets and ensures business continuity during climatic calamities. The responders highlight engagement with local communities, governments, and NGOs, which matches the analysis, [58], who stress collaboration to overcome climate hazards. Collaboration is essential for sharing resources, information, and efforts to accomplish objectives. Most respondents recognized a worldwide trend toward sustainable energy solutions, including the move to renewable energy sources. UNDRR, [30], and the Asian Development Bank - ADB, [62], agree that renewable energy is economically and environmentally beneficial. Businesses are more cognizant of their role in climate change mitigation

as they prioritize energy efficiency and sustainable supply chains. According to publication [64], corporations should be environmentally responsible. Climate change and corporate risk management: The study's conclusion that Greek firms' biggest climate change worry is financial concerns matches worldwide trends. According to the World Economic Forum [23], climate-related financial concerns are a worldwide priority. The identification of physical dangers and supply chain disruptions supports IPCC [84] and study [85] worries about climate change's direct and indirect effects on company operations. Policy and regulatory concerns are seldom highlighted, but the survey shows that corporations are nonetheless worried about them. The investigation [29] findings show that climate-related regulations are increasingly affecting corporate operations. Businesses must also monitor regulatory changes and adapt to new rules. It also stresses the need for governments to support companies and ensure they meet climate targets. The survey found that corporations are using various climate change mitigation strategies. Diversifying methods is essential in a fast-changing business atmosphere, [34], [41], [45]. Even though fewer respondents mentioned it, the focus on low-carbon technological innovation and R&D implies a forward-thinking plan for long-term sustainability. Collaboration with regional authorities and communities emphasizes stakeholder engagement in climate risk management. This method is necessary for effective local mitigation and adaptation initiatives, [7], [69]. It also aligns with corporate social responsibility, which requires firms to benefit their communities, [37], [86]. Sustainable supply chains and renewable energy generate economic opportunities and mitigate risk. As the globe moves toward a green economy, sustainability is becoming a competitive advantage. The study's results that perceived climate threats negatively affect risk management indicate how complex and dynamic climate risks are. According to the researchers, [64], firms may need to spend more in understanding these risks and regularly alter their strategies in response to new data and changing conditions.

The positive association between adaptation and mitigation suggests that businesses adapting to climate change are also proactive in mitigation. Addressing climate risks necessitates an integrated approach to climate risk management. Many climate experts support this holistic strategy. Nevertheless, the perception of climate change threats can negatively impact a company's risk management efforts. This gap between how climate risks are

perceived and the strategies employed to manage them can make it difficult for businesses to effectively understand and respond to climate challenges [2], [3]. The data suggests that adopting climate change adaptation and mitigation strategies improves enterprise risk management. This conclusion aligns with existing research on managing climate risks through such strategies [28]. However, the inverse relationship observed between business risk management practices and climate change concerns implies either an underestimation of these concerns or an inadequate response to them.

6 Conclusions

This research examined how climate change influences business risk in Greece, focusing on the difficulties and opportunities faced by companies. The results demonstrate that climate change has a considerable impact on business activities, underlining the urgent need for effective risk mitigation and adaptation strategies. Descriptive analysis revealed that businesses are primarily concerned with the financial repercussions of climate change, followed by disruptions in the supply chain and physical threats. This highlights the necessity for comprehensive risk management programs to effectively tackle these issues. The analysis further indicates that companies are increasingly acknowledging the importance of strong adaptation and mitigation efforts to maintain operational continuity and long-term sustainability. Essential adaptation strategies include disaster preparedness, development of climate-resilient infrastructure, and forming partnerships with local authorities, NGOs, and communities. These actions are crucial for enhancing resilience and reducing the severe impacts of climate change. Moreover, diversification of supply chains and proactive climate risk disclosure and reporting indicate a growing awareness of the challenges associated with climate adaptation. Businesses are also focusing on utilizing renewable energy sources to reduce emissions. Implementing sustainable supply chains and improving energy efficiency are the next steps. These methods demonstrate that lowering carbon emissions and supporting global climate change initiatives are proactive. According to replies, corporate risk management outcomes show the various benefits of effective risk management. Climate change considerations should be included in company risk management plans to enhance decision-making, reduce financial losses, and comply with regulations. Additionally, correlation and regression analysis show the connection of

business risk management, adaptation and mitigation measures, and climate change threats. According to their positive association, businesses that apply adaptation and mitigation strategies are more likely to implement the other, indicating a holistic climate change strategy. However, the negative link between risk management efficacy and perceived climate change threats shows how firms struggle to react to climate-related dangers.

6.1 Recommendations

Given the significant number of firms that value catastrophe preparation, risk assessments and emergency response plans should be prioritized. This involves educating staff, improving emergency communication, and giving resources for a quick recovery.

Businesses should find it simpler to obtain funding for projects aimed at mitigating and adapting to climate change, according to governments and financial institutions. This can include low-interest loans, grants, or subsidies for sustainable practices innovation, infrastructure improvements, and renewable energy projects.

It is the responsibility of policymakers to establish favorable conditions for the use of renewable energy. This can entail tax breaks, expedited permitting procedures, and funding for the advancement of green technology research and development.

6.2 Suggestions for Future Research

Future research could involve comparative case studies across various countries or regions. This would provide insights into how different geographic, socio-economic, and political contexts influence the effectiveness of climate change adaptation and mitigation strategies in businesses. For instance, comparing Greece with countries in similar climate zones or economic structures could reveal valuable patterns and unique challenges.

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Declaration of Generative AI and AI-assisted Technologies in the Writing Process

During the preparation of this work, the author used ChatGPT-4 to improve the readability and language of the manuscript. After utilizing this tool, the author reviewed and edited the content as needed and takes full responsibility for the content of the publication.

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