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## Climate Change Effects and Stock Market Returns

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### ABSTRACT

*To capture climate change risk at the business level, use records of performance briefings from different enterprises. This examination discovers that chances of worst climate change, the negative impact of business environment risk on market stock returns. Study also conducts a broad assessment of the empirical and theoretical literature on the influence of climate change related risks on financial market. The main aim of this analysis is to enhance our knowledge of the estimation significances of climate change risk in financial markets. It is initiated by discussing the theoretical connections between market asset pricing and climate change related risks, and then propose a hypothesis of how climate change risk drivers convey costs to enterprises and cause stock returns variations. It studies the historical climate change related events, which indicate that both climate physical effects and transition dynamics can cause a stock return volatility. Finally, the results imply that disclosures of climate change related information can support the stock market in more efficiently as pricing climate risk.*

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### 1. Introduction

Climate change, triggered by human activities, cause danger to several issues for all around the world (Abbas et al., 2023). Climate change and financial systems are inter-associated and highlighting the significance of sustainable practises (Azam et al., 2023). Climate change has far-influential effects, affecting not just natural ecosystems but also the sensitive balance of financial markets in terms of stock returns (Zhang et al., 2023). According to the studies, as climate change get worse, its effects are ever more noticeable across various areas in the world (He et al., 2018, Yu et al., 2023). During the last few decades, economic performance and climate changes are closely examined by scientists and researchers equally concluded financial marketplaces, as they represent

as an important channel (Hansen et al., 2005, Storelvmo et al., 2016, Phillips et al., 2020, He and Shi 2023). The scientific data and diplomatic records like the Paris Agreement (PA) that belief as climate change is really have more concerns about its world-wide effects (Pham et al., 2019, Birindelli et al., 2021, Daumas, 2023). The effects of climate change are markedly visible in the stock returns, even though ecologists and elected official have mostly focused on preventing ecological deterioration (Santi, 2023, Carè and Weber, 2023). Its potential to upend established financial paradigms and alter investment landscapes is particularly intriguing, making a thorough examination of its effects on stock market returns necessary (Briere and Ramelli, 2022, Daumas, 2023).

Moreover, evidence studies from the last few years shows that many climate-related events, from extreme weather to changes in regulatory policies, have affected evident changes in stock prices and market indexes (Venturini, 2022, Shen, 2023). These changes present significant problems regarding the relationship between climate change and the success of a businesses, specific sectors, and the whole market (Acharya et al., 2023, Cevik, and Miryugin, 2023). Both stockholders and businessmen are looking to improve their portfolios and policymakers hoping to promote resilient economies in the face of changing climatic must understand how these issues are connected (He et al., 2018, Song et al., 2023). In addition, various connections between climate change and stock market performance are examined by Antoniuk and Leirvik (2021) and Santi (2023). The climate-change impact on a company extends immediate operations beyond its policies, affecting supply chains and assets (Kleindorfer and Saad, 2005, Castillo, 2023, Skipworth, Bastl, Cerruti, and Mena, 2023).

For example, Zhengzhou, the capital of China's Province Henan, faced record-breaking heavy rainfall on July 20, 2021. Many widely traded businesses stock market performance was additionally crushed by the terrible floods that followed, such as Zhengzhou Coal Industry and Electric Power, whose stock value fell off to 13.25 % within initial 7 days of the failure. Climate change exposes businesses to a lot of new risks and effect on a large financial disorder (Giglio, 2021). In a climate change economy, risks include asset devaluation, stock returns, regulatory adjustments, and altered consumer concerns (Semieniuk, Campiglio, Mercure, Volz, and Edwards, 2021, Rehman Khan, Yu, Ridwan, Irshad, Ponce, and Tanveer, 2023). The climate change risks directly affect any company's financial success.

Similarly, several approaches are considered as researchers work to discover the main links between climate change effects and stock market returns (Pankratz, Bauer, and Derwall, 2023). The connections between climatic situations and stock market concerns are being well understood by the empirical research using econometric tools, event studies, and machine learning algorithms (Pham, Huy, Van, Ramiah, Saleem, and Nisreen, 2019, Birindelli, Giuliana, and Chiappini, 2021, Maranzano and Pelagatti, 2023). In addition, the accessibility of high-frequency stock market data and expansions in big data analytics have made it successful for researchers to highlight new trends and techniques, which has enhanced our understanding of these complex interactions (Chen, Zhang, and Weng, 2023). Many theoretical frameworks and mechanisms are discussed by different researchers in different time. A few of them are discussed as follows.

Incorporating perspectives from multiple disciplines, theoretical frameworks are constructed to examine the effect of climate change on stock market returns. By shedding light on the methods involved, these frameworks try to explain how climate change events and risks can impact stock market returns. Here are some key theoretical perspectives and mechanisms:

EMH suggests that stock prices fully reflect all available information, including information about climate-related risks and events. Climate-related information, such as the potential impacts of extreme weather events on a company's operations, could lead to changes in investor perceptions and stock prices (Brouty and Garcin, 2023). In last four decades, the worldwide concern for climate change has significantly highlighted in various industries, strategies, and markets (Ullah and Asghar, 2023). For example, Carbon Pricing and Market Efficiency (Chai, Zhang, Zhang, and Wang, 2023), Green Investing and EMH (Yang, Mehdi, Hafeez, Kaium, and Salahodjaev, 2023), Climate-Related Disclosures and Transparency (Hsu and Schletz, 2023) and Technology and Innovation (Rej, Bandy Hossain, Islam, and Yeediballi, 2023).

Behavioural finance theories emphasize that investor sentiment and behavioural biases can lead to market inefficiencies. Climate change events can trigger emotional responses or attitude, affecting investors to react excessively or underreact, resulting in short-term stock price rise and fall (Bennett, Mekelburg, and Williams, 2023). Positive sentiment has favourable feeling that has a potential to encourage investments in new energy businesses, electric car makers, and other nature friendly companies. Similarly, negative sentiments can discourage the investments.

CAPM suggests that systematic risk, often measured by beta, affects expected stock returns. Climate risks, especially those affecting whole businesses (e.g., energy, agriculture), can be considered systematic risks that impact company's financials and stock returns (Pham Thuy, 2023, Dewi and Natsir, 2023). The impact of climate change on stock returns is due to Physical Risks, Transition Risks, Liability Risks, and many more.

Event study approaches evaluate stock price advances around special climate-related events in a specific time period, such as regulatory announcements or ultimate weather incidents. Abnormal returns, deviations from expected price movements, can reveal how markets perceive and react to climate-related news (El Ghoul, Guedhami, Mansi, and Sy, 2023).

Portfolio theory underscores the importance of diversification to reduce risk. Investors concerned about climate risks might seek to diversify across industries less susceptible to these risks, impacting sectoral stock prices (Viviani, Komura, and Suzuki, 2023).

These theoretical frameworks and methods highlighted the multidimensional nature of the relationship between climate change effects and stock market returns. As researchers examine these concepts, they revealed that how climate risks, corporate behaviours, investor sentiments, and market dynamics interact to financial market in growth and loss.

Numerous empirical studies and event analyses have investigated the relationship between climate change effects (e.g., natural disasters, regulatory changes) and stock market returns. These studies use various methodologies to measure how specific climate change risks impact on stock prices. Below are a few significant examples.

Hurricanes have been studied in relation to their impact on local and regional stock markets. These two hurricanes serve as reference points for examining the stock market's reactions to extreme weather events (Schuh and Jaeckle, 2023). The disruptions had a significant impact on regional economies, leading to swift adjustments in stock prices for companies in the insurance, energy, and construction industries (Ai, 2023).

Studies have explored how climate change risks like droughts and heatwaves impact agriculture-related stocks. Crop failures due to adverse weather conditions can lead to decreased revenue for agriculture companies, affecting stock prices (Saura, Ribeiro-Navarrete, Palacios-Marqués, and Mardani, 2023).

Research has explored the relationship between policy support for renewable energy and the stock performance of companies in the renewable energy and clean technology sectors. Positive policy signals can lead to increased investor interest and improved stock performance for these companies (Fang, 2023).

Research has discovered how innovations in clean technologies impact the stock performance of companies in multiple areas. Innovations in renewable energy, energy storage, and efficiency technologies can drive positive stock returns (Qing, Chun, Dagestani, and Li, 2022).

Studies have investigated the relationship between companies' commitments to emissions reduction targets and their stock price volatility. Companies that demonstrate strong sustainability practices might experience reduced volatility during periods of environmental uncertainty (Fan, Wei, Xu, Chen, and Liang, 2023).

It is important to note that empirical findings can vary based on the context, data availability, methodologies used, and the specific climate events being studied. These examples demonstrate the diverse ways in which climate change effects can effect stock market returns and highlight the need for rigorous analysis to understand the distinctions of these relationships.

Long-term resilience and adaptation are some fundamental approaches that companies may use to balance the effects of climate change on their financial market performance and, as a result of stock market returns (Wardekker, 2023). These methods include practical steps to forecast, direct, and adapt to the risks presented by changing weather analytics. An overview of long-term resilience and adaptation is given in the context of the effects of climate change on stock market returns.

According to Xiong, Lam, Hu, Yee, and Blome (2021) and Wang, Xiong, Cheng, and Lam (2023) diversifying suppliers and sourcing supplies from different regions can decrease the vulnerability of supply chains to climate-related risks, helping to maintain production and reduce stock return risks.

Attractive insurance policies against climate change risks can help financial security in case of sudden consequences (Collier, Elliott, and Lehtonen, 2021). Moreover, using risk-transfer mechanisms like catastrophe bonds can mitigate financial losses from risky weather incidents (Xiang, Chang, and Jiang, 2023).

Adaptation strategies worked on practical variations to business procedures, processes, and plans to connect with climatic conditions and regulatory environments. By predicting and focusing on climate impacts, stakeholders can improve their position, handle risks, and enhance their financial outcomes, which can have a profiting effect on stock market returns (Sargani, Jiang, Chandio, Shen, Ding, and Ali, 2023).

Companies can provide helping products and assistance that can be adaptable in climate changes, such as energy-efficient technologies (Nguyen, Nguyen, Bhatti, and Vuong, 2023). This approach gives a clear understanding of investments to the investors and stakeholders that how many new as well as existing products should be launched into the market in different time zones.

Companies with different businesses might be better to manage climate risks. By operating in multiple marketplaces, company can compensate losses in one area with profits in others (Bai, Wei, Zhang, Wang, and Lucey, 2023). By analysing the climate changes in different times stakeholders can have a clear view about their investments and profits.

Companies that participate in research and development related to climate change technologies can gain a reasonable profit by launching innovative products and solutions to climate-related challenges (He, Ma, Nasir Malik, Shinwari, Wang, Qing, and Ageli, 2023).

Collaborating with different stakeholders, such as concerned government officials and communities can lead to shared knowledge, capital, and visions that can improve the knowledge of climate change effects on stock returns (Bouguerra, Hughes, Cakir, and Tatoglu, 2023).

Climate change can create a complicated environment for different industries (e.g., energy, agriculture, insurance, tourism, and hospitality). The impacts of climate change vary based on factors such as the degree of exposure, adaptability, regulatory environment, and consumer behaviour leading to a combination of challenges and growth opportunities. Some industries that may experience both losses and growth due to climate change are highlighted below.

**Losses:** Industries, like coal, oil, and gas, face challenges as climate policies and the transition to renewable energy sources reduce demand for carbon-intensive fuels.

**Growth:** Industries, such as solar, wind, and hydropower, experience growth because the world shifts unconditionally toward low-carbon energy consumptions. In last few years, high investments in clean energy technologies and infrastructure presents growth opportunities (Dutta, Bouri, Rothovius, and Uddin, 2023).

**Losses:** Agriculture faces challenges due to changing precipitation patterns, increased pests, and extreme weather events affecting crop yields. Food security may be compromised in vulnerable regions (Sandberg, Alnoor, and Tiberius, 2023).

**Growth:** The adoption of climate-resilient crops, precision agriculture technologies, and sustainable farming practices presents opportunities for innovation. There is growing demand for climate-resilient seeds and technologies (Abeysekara, Siriwardana, and Meng, 2023).

**Losses:** Extreme weather events and natural disasters can lead to higher insurance claims, increasing financial risk for insurers. Predicting and pricing climate-related risks accurately becomes more challenging (Toumi, Najaf, Dhiaf, Li, and Kanagasabapathy, 2023).

**Growth:** There's potential for growth in climate risk assessment and modelling services. Additionally, offering specialized insurance products for climate-related risks could become a profitable niche (Boungou and Urom, 2023).

**Losses:** Coastal tourism and destinations susceptible to extreme weather events may experience reduced demand due to safety concerns. Changes in ecosystems can impact wildlife-based tourism (Mun and Park, 2023).

**Growth:** There's potential for growth in ecotourism and sustainable travel as consumers seek destinations and experiences that align with their environmental values (Lee, and Wu, 2023). These examples underscore the complexity of climate change effects on industries. While some sectors face challenges, others could thrive by embracing climate resilience, sustainability, and innovation. Adaptation strategies are crucial for businesses to navigate the changing landscape and harness growth opportunities while addressing challenges.

## 2. Literature Review

Climate change is currently getting attention from all over the world. While the interferences of climate change do not occur in over nights, companies and stakeholders are getting more interest in understanding how the conversion to a greener and cleaner economy affects business markets (He, Xubiao, and Liu, 2018, Alsaifi, Khaled, and Salama, 2020, He and Shi, 2023). As the most recent Intergovernmental Panel on Climate Change (IPCC) report (2022), decarbonization is becoming ever more crucial for survival of many nations. According to Nordhaus and Yang (1996), climate changing risks are universal risks that are not only affecting just one branch of business but the entire economy. Moreover, climate change risks are categorised as: physical risk and transition risk by Clapp, Christa, Lund, Borgar, and Elisabeth in 2017.

In addition, the effects of long-term drought charts on cross-country food stock returns is studied by Hong et al. (2019). They claim that the stock markets are incapable to completely understand statistics on climate risk, which reasons a large suspension in stock price regulation. According to Murfin and Spiegel (2020) investigate how rising sea levels due to climate change may disturb home economical finances. They determined that there are a limited pricing effects and market is incapable to identify these risks. Most of the studies pay their devotion to one or a few climate risk issues, such as unfamiliar temperature, carbon emissions, floods, and ESG ratings. However, there exist many measures that can change the whole climate risks that businesses faced.

### 2.1. Climate Change Effects on a Company Financial Status

According Barrot and Sauvagnat (2016), the effects of natural disasters due to climate change have a damaging effect on both the sales-growth of companies and their greatest clients. Similarly, Dessaint and Matray (2017) stated that storms minimise the market value of companies in the United States. Odongo, Misati, Kageha, and Wamalwa (2023) investigates that serious cold provides a shock return and cause of reduction of cash balances. Furthermore, Zhou, Endendijk, and Wouter Botzen, (2023) explained that climate change risks often reduce guarantor profits and risk-sharing capability, bank stability and credit supply chain, stock market return, and international financing. The research conducted by Odongo, Misati, Kageha, and Wamalwa in 2023 finds a clear alarming situation in Kenya, an unpredictable rainfall pattern due to climate change, and an increase in greenhouse gas emissions, particularly in the agricultural and transportation sectors is a cause of losses of company's finances. Further, the banking sectors are also affected by the climate change by significantly increase of banks systemic risks (Wu, Bai, Qi, Lu, Yang, and Taghizadeh-Hesary, 2023). The Bank of England and the European Central Bank have expressed concern about the risks that climate change establishes to financial stability of businesses (Skinner, 2021).

## 2.2. Climate Change Regulations Policies on Carbon Emissions

Climate change regulations policies aims to reduce carbon emissions, so that carbon release risk should also be incorporated in business strategies. Most recent studies show that stockholders have acknowledge of climate-change risks and demand better profits from companies with raising emissions levels (Krueger, Sautner, and Starks, 2020, Bolton, Patrick, and Marcin Kacperczyk, 2021, Atz, Van Holt, Liu, and Bruno, 2023). In addition, the cost of loans for climate-aware companies are cheaper than for companies that do not reveal carbon emissions. According to the literature, realising different techniques is necessary by which the stock market responds to climate-change initiatives.

However, the climate change risks cannot be avoided but the loss can be reduced by applying the following strategies suggested by different researchers. Reducing the risks of climate change events on stock market returns includes a mixture of practical method adapted by companies, investors, policymakers, and regulators. Here are several strategies that can help mitigate these risks.

## 2.3. Enhanced Risk Assessment and Disclosure

A broad climate risk assessment can be done by businesses to recognise liabilities and guess possible effects on their operations and finances (Walenta, 2020). Main exposure of climate-related risks can help a company official with more precise information for their decision-making.

## 2.4. Integration of ESG Factors

Companies should include Environmental, Social, and Governance (ESG) factors into their business strategies (Marczis, Mihálovits, and Sebestyén, 2023). ESG integration helps identify and address climate-related risks and opportunities, improving long-term sustainability (Ferreira, 2023). Investors can consider ESG criteria in their investment decisions, favouring companies that demonstrate responsible environmental practices and preparedness for climate challenges (Delgado, Ortiz, Antolín, and Montiel, 2023).

For case in point, Wong and Zhang (2022) realize that stock price surprises may be taken on by a company's ESG presentation through different social media channels. They provide suggestion that more unfavourable ESG media reporting predicts a high drop in the stock returns. We focus on the climate risk identified briefings, which are similar to this study on a business's ESG performance. As was already highlighted, when a specified business environmental risks are released, market anxieties about the business's future commercial operations are often intensified. Therefore, we assume that business disclosure about climate risks may have an effect on how stockholders observe a business's value through increasing (positive) or decreasing (negative) social media attention.

## 2.5. Scenario Analysis and Stress Testing

Companies and financial institutions can perform scenario analyses and stress tests to model the possible impact of different climate change scenarios on their portfolios, strategies, and financials. By suggesting the potential impacts of physical risks (flood, storm, extreme weathers, and climate change), industries and financial organizations can recognize vulnerable assets, supply chains, and regions (Schneider, Strahan, and Yang, 2023). Furthermore, market and economic impacts can also be calculated by using stress testing.

## 2.6. Diversification and Portfolio Resilience

Investors can diversify their portfolios across industries and sectors to reduce exposure to concentrated climate-related risks. Allocating to sectors with growth potential in the context of climate adaptation (e.g., renewable energy, clean technology) can provide long-term resilience (Caballero, Salgueiro-Otero, and Ojea, 2023).

## 2.7. Engagement and Advocacy

Investors can engage with companies to encourage improved climate risk management, disclosure, and integration of sustainability practices. Institutional investors can advocate for stronger climate policies and regulations that align with the global transition to a low-carbon economy. For example, the decreasing risk of climate change for some investors since 2015 can be endorsed to Pedersen, Fitzgibbons, and Pomorski's (2020) ESG-CAPM framework and stockholders growing understanding of climate change issues. The positive unconditional risk premium offers credence to models classified as having uncertainty regarding the climate change by Giglio, Kelly, and Stroebel (2020). However, a lowering conditional risk premium as a result of the attribution of more possibilities to companies with greater exposure implies that these models require an additional dynamic component relating climate change exposure to development prospects.

## 2.8. Innovation and Adaptation Strategies

Companies should invest in innovation to develop adaptive strategies that address climate-related challenges. R&D efforts can lead to new products, services, and business models that align with changing consumer preferences for sustainability (Zhang, Mohsin and Taghizadeh-Hesary, 2022).

## 2.9. Supply Chain Management

Companies can assess the climate resilience of their supply chains, diversify suppliers, and collaborate with partners to enhance supply chain sustainability. Strengthening supply chain resilience can mitigate disruptions caused by climate-related events (Zhang, Tay, Alvi, Wang, and Gong, 2023).

## 2.10. Government Policies and Regulations

Governments can play a crucial role by implementing robust climate policies and regulations that incentivize emissions reduction, sustainable practices, and climate adaptation. Clear regulatory frameworks provide a level playing field and encourage businesses to adopt climate-resilient strategies. For instance, Xu et al. (2012) gave experimental proof that stock prices in China respond negatively to public releases about company's environmental violations. According to Guo et al. (2020), the Chinese government's overview of environmental regulations reasons the stock market to react negatively. The Chinese stock market productivity issue is also surveyed in studies like Chong (2012) and Li (2022), which find that market productivity increases as market liberalization and deregulation progress.

## 3. Methodology

### 3.1 Variable Measurement and Sample Selection

In this article, our focus is on risks on a business faced by climate change, which is examined by a company's experience to climate change. Particularly, we use data of Chinese company operation updates to measure certain companies time-variable climate change risks. Several findings use weather-related or topographical variables, such as heat surprises and sea level rise, to assess



the risks related with climate change in financial stock return markets (Bernstein, 2019, Hong, 2019, Choi, 2020). Nevertheless, due to a lack of interoperability at the business level, these procedures are not very essential in our context. Likewise, while climate change may insist physical risks or transition risks on company's economic processes (Giglio, 2021), it is non-applicable to employ a single geographical proxy to show the global climate change risks achieved by organisations. For instance, by following the current writings that kets business release transcripts (Li, 2020, Sautner, 2021).

Climate-change related problems are less likely to "greenwashing" or window dressing by the executive team of management, as stated by Price et al. (2012). Study use the subsequent technique for acquiring our business climate risk variable. First, by creating a list of words linked to ultimate weather or sudden meteorological incidents. According to Henry and Leone (2016), while a more multiplex machine learning technique may be effective, word-count metrics are as operative and more susceptible to replication when analysing business disclosure descriptions. As a result, Li (2020) lists of the most often used phrases to quantify business climate change risks and adjust climate change related words in the Chinese language setting. Count the number of climate change related words in each transcript of the business's twelve-month report performance updates and create the Corporate Climate Risk (*CCR*) index as a proportion of the total number of climate change related words in the transcripts. As a replacement, extent of corporate climate change risk, computation of the percentage of sentences that include climate terms for robustness.

Regardless from the business climate change risk measure, the accumulative abnormal return through a two-day incident window is the dependent variable for the stock market effect tests. According to Price (2012), the daily abnormal return is determined as the size regulated return:

$$AR_{i,t} = Ret_{i,t} - Ret_{p,t}.$$

Here, for business  $i$  on day  $t$ ,  $AR_{i,t}$  is the daily abnormal return. Whereas  $Ret_{i,t}$  is the daily stock return for company  $i$  on day  $t$ . For all businesses in the same size decile as firm  $i$  on day  $t$ ,  $Ret_{p,t}$  is the equally weighted average return. Then the cumulative abnormal return is calculated as:

$$CAR(t, t + k) = \sum_t^{t+k} AR_{i,t},$$

where  $t = 0$  on the firm's performance briefing date.

The two-day  $CAR(0,1)$  was considered to calculate the immediate stock market reaction to corporate climate change risk described by organizations performance briefing. We utilize unusual daily abnormal return metrics, for example, size and market-to-book adjusted return, and size, market-to-book, market adjusted return, and momentum adjusted return, to ensure the strengthen of the empirical findings. The results are unchanged by the bench mark we decide on. Additionally, we devote a thirty-day window of (2,31) to examine if there is a postponed price effect following the briefing.

### 3.1.2 Control variables

We decide to select the following set of controls. Firstly, we employ a set of business attributes based on the work of Price et al. (2012). VOLATILITY, the standard deviation of daily

returns across the timeframe (-90, -10), is the lagging stock price volatility before the briefing. CAR (-60, -2), or lag stock return, is termed as the cumulative stock return on the interval (-60, -20). LEV is determined by dividing total debts by whole assets at the finale of the prior financial year. Profitability is defined as net income divided by total assets at the finale of the previous financial year. SIZE is the natural log of a company's total assets at the end of the earlier financial year. The book-to-market ratio at the end of the prior financial year is denoted by BM. The change in profits per share between the preceding two financial years is used to calculate unexpected earnings (UE). Secondly, we establish a set of limitations depending on the business's attributes. The global word-count of the opening section is WC\_INRO. WC\_QA is the conversation measure. LAG is the number of days that intervene between the end of the preceding financial year and the day that the business's yearly report. INTER is the time pass by between the date of the annual report and the date of the briefing for the same financial year. Adding together, we limit for the time fixed effects and business fixed effects to mitigate the omitted bias problem.

### 3.1.3 Data and Sample Construction

This research data is collected from a range of sources. To assess business environmental risk, we investigate transcripts of performance given by Chinese registered companies. The textual data may be accessed from the Win Go Textual Analytics database. The data for the characteristics are taken from the website of Chinese National Research Data Services (CNRDS). Similarly, accounting and stock trading data for businesses are obtained from the database of China Stock Market and Accounting Research (CSMAR). The experiment interval time runs from 2009 to 2022, with the start date chosen by the accessibility of performance briefing. On request corporations include any climate change related conditions in their transcripts. Further, we remove businesses that have deficient financial and market trading data.

### 3.2 Regression model

We retreat the cumulative return on corporate climate change risks released through performance briefings and a set of control variables to examine the stock market outcomes to corporate climate change risk:

$$CAR_{i,t} = \beta_0 + \beta_1 CCR_{i,t} + \beta_z Z_{i,t} + IND_j + \mu_t + \varepsilon_{i,t}$$

While the subscript  $i$  denotes businesses,  $t$  represents the financial year.

## 4. Analysis

The main aim of this research is to observe the impact of firm-specific climate change risks on stock return market response. The univariate relationship between  $CCR$  and  $CAR$  is examined. Supporting that, regression models to estimate the total effect of business climate change risk on stock return effect are also used. Several checks to strengthen the finding's reliability are also performed. Lastly, examine the effects of climate change risk on stock market reaction to a business's performance reports. Table 1 summarises the main aspects throughout all firm-year data in our sample.  $It$  reflects the turbulent nature of the Chinese stock market.

**Table 1: Descriptive statistics**

Variable	Mean	Std. Dev	Min	Max
VOLATILITY	0.0308	0.0123	0.0079	0.0804
LEV	0.3108	0.3022	0.0014	0.9108
ROA	0.034	0.062	-0.2455	0.2142
SIZE	21.678	1.011	19.992	26.994
BM	0.3976	0.2692	0.0605	2.4505
UE	-0.0591	0.4056	-2.0743	2.2074

#### 4.1 Regression Analysis

Following section indicates the regression findings of the impact of corporate climate change risk on the stock price consequence of businesses to offer more realistic data. Regression findings for the initial reaction period time frame with time fixed effects and business fixed effects included. It gives the solution without controlling factors, determining that the *CCR* coefficient is outstandingly negative at the 5% level. Firm-level stock trading and accountancy control factors are added to assure that company characteristics do not affect the results. Study use a set of variables to control a business's performance briefing attributes such as all control variables as well as fixed effects of time and business are included. The coefficients of *CCR* stay negative and statistically significant after adding control variables. These results imply that the stock return market replies negatively to the climate change risk instantly after the firm's performance briefing, which authorizes our conjecture that the climate change risks statistics quickly impact into stock returns and prices.

**Table 2: Regression Analysis**

	(1) CAR	(2) CAR	(3) CAR	(4) CAR	(5) CAR
CCR	-0.212**	-0.301**	-0.421*	-0.123*	-0.123
VOLATILITY		24.002		24.990	1.8440
LEV		0.2044		0.3871	1.5255
ROA		-1.106		-0.330	15.101
SIZE		-0.307		-0.302	-1.701*
BM		0.601		0.639	1.916
UE		-0.325		-0.031	-2.346
Constant	0.202**	5.343	0.230*	5.493	9.2**
R-Square	0.089	0.109	0.112	0.120	0.211

#### 4.2 Two stage least Square

The endogenetic variable *CCR* using the variable *IND CCR* are instrumented. It shows the initial results of the connection between *IND CCR* and *CCR*. Businesses that face more climate change risks on industry-level are more likely to experience greater firm-specific climate change risks. The strong F-statistics imply that the model is not affected by the weak instrument problem. It exhibits the expected coefficients from the second-stage regression using *CAR* as the dependent variable. Coherent with the baseline findings, corporate climate change risk has a considerably negative influence on the first reaction of businesses' stock prices. It also instruments the endogenous variable *CCR* "SENT" using *IND CCR* "SENT". As noticed, the coefficient of *CCR SENT* remains notably negative after re-estimating the 2SLS regression.

**Table 3: Two stage least Square**

	CCR 1st stage	CAR (0,1) 2nd stage	CCR SENT 1st stage	CAR 2nd stage	CAR	CAR
CCR		-0.344***			-0.234**	
IND CCR SENT			0.678***			
CCR SENT				-0.0347***		-0.015***
REGULATION					-0.347	-0.128
DISASTER					0.167	0.126
INNOVATION					-0.257*	-0.319*
F-Statistic	11.807***		87.07***			
R-sq	0.347	0.206	0.325	0.016	0.213	0.312

## 5. Conclusion

Mitigating the risks of climate change incidents on stock market returns forces a broad approach that incorporates strategic planning, transparency, innovation, and teamwork. Businesses and investors have a chance to influence to a more ecological and flexible financial landscape as knowledge of climate-related risks rises. In addition, this article examines the body of previously published material in order to outline the key conclusions and insights gathered from several investigations. It expects that by doing so, it would further scholarly debate on the issue and give policymakers, asset managers, and investors with helpful implications. Through a detailed review and analysis, this article tries to provide a better understanding of the dangers and opportunities that climate change effects provide within the framework of stock market returns. Finally, we hope that our findings will upgrade a better knowledge of the financial risks linked with climate change and spark discussions trained at supporting long-term economic growth in the face of climatic insecurity. This paper carefully examines the complex connections between climate change and stock market dynamic contrasts. Because of the complex chemistry between environmental businesses, company performance, shareholder mood, and market changing aspects, climate change consequences can have a significant effect on stock market returns. These results can vary from difficult weather tragedies (such as hurricanes, floods, or wildfires) to steady changes in climatic patterns and regulatory frameworks. Resources scarcity and input costs, global economic effects, long-term viability and adaptation strategies, regulatory changes and compliance, physical risks and business operations, long-term modelling, international collaboration, and cross-disciplinary studies are some potential future research topics in this field.

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