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Original Paper

Climate Risk Exposure and Firm Risk-Taking: Evidence from Chinese Listed Firms

Shengzhen Ding[1] & Zhe Zhang[1*]

[1] School of Mathematics and Statistics, Zhaoqing University, Zhaoqing, Guangdong, 526061, China

[*] Corresponding Author, Email Address: zhangzhe@zqu.edu.cn

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Abstract

This paper uses data from more than 2,400 Chinese non-financial A-share listed companies from 2007 to 2022, to investigate the impact of firm-level climate risk exposure on corporate risk-taking. The main conclusions are as follows: (1)First,corporate climate risk exposure has a significant inhibitory effect on the level of risk-taking, and this conclusion remains valid under a series of robustness tests, including instrumental variable regression, propensity score matching regression, and placebo tests.(2)Second, the positive impact of climate risk exposure on risk-taking is more pronounced for heavily polluting enterprises, small enterprises, and state-owned enterprises. Moreover, when enterprises already have a relatively high level of risk-taking, the negative impact of climate risk exposure on them is further strengthened. (3)Finally, climate risk exerts a negative influence on corporate risk-taking mainly through the principal-agent channel and the resource-based channel. Because enterprise managers are concerned about their reputation and future career development, they tend to make short-sighted and cautious decisions, thereby intensifying the negative impact of climate risk exposure on risk-taking. In addition, climate risk exposure prompts enterprises to increase their investments in green environmental protection, which in turn crowds out traditional venture investments and reduces their risk-taking levels.

Keywords

climate risk exposure, risk-taking, ESG, venture investment

Data availability

The data can be available on request

Declarations

Ethical approval and consent to participate. The authors declare that they have no known competing

financial interests or personal relationships that seem to affect the work reported in this article. We declare that we have no human participants, human data or human tissues.

Competing interests The authors declare no competing interests.

1. Introduction

The greenhouse effect and climate warming are important challenges that all countries in the world are currently facing. On November 20th, 2023, the United Nations Environment Programme released a report indicating that the global temperature is projected to ascend by 2.5 to 2.9°C in 2030. Climate warming could potentially trigger a series of severe consequences, including extreme weather conditions, diminished food production, and a rise in sea levels. The severity and consequences of climate warming are profound and multifaceted, posing a significant threat to global ecosystems, human societies, and economies.

Climate risks, such as extreme weather events, rising sea levels, and shifts in climate policies, can have significant negative impacts on business operations. These risks may disrupt supply chains, increase operational costs, cause asset damage, and produce fluctuations in market demand, ultimately threatening the long-term sustainability of businesses (Lei et al., 2023). Concurrently, climate risks often prompt governments to implement stricter environmental regulations to mitigate their impact, which can negatively affect businesses. Such regulations may include higher emissions standards, carbon taxes, or mandatory investments in sustainable infrastructure, increasing compliance costs for companies. In addition, businesses that fail to adapt quickly may face penalties, reputational damage, or a loss of competitive advantage in the market. As a result, stricter environmental policies driven by climate risks can pose significant financial and operational challenges for organizations. Therefore, investigating the influence of climate risk exposure on enterprises holds significant reference value for enhancing their adaptability to climate change, achieving climate risk management, and promoting sustainable development.

Corporate risk-taking capacity reflects the risk that an enterprise is willing to bear in pursuit of profits, reflecting the degree of risk appetite shown by the enterprise when making investment decisions (Yu et al., 2024). A certain level of risk-taking helps enterprises engage in high-risk, high-return projects; enhances innovation; boosts core competitiveness; and fosters long-term competitive advantages, thereby achieving higher profit levels and corporate value (John et al., 2008). However, existing literature has found that the overall risk-taking level of enterprises is often less than the risk-taking coefficient of their owners, which may lead to inadequate investment in high-risk, high-return projects (Wang & Xu, 2024).

Scholars have conducted a series of analyses on the factors influencing corporate risk-taking levels. Most existing literature focuses on the corporate risk-taking impacts deriving from corporate governance, CEOs' personal characteristics, and external factors (Faccio et al., 2011; Kim et al., 2017; He et al., 2023), while overlooking climate risk as a potential influencing factor. Climate risk

introduces considerable uncertainty into enterprises' future production and operation activities. Therefore, as enterprises' exposure to climate risk increases, their risk aversion levels may also rise. For example, enterprises may reduce investments in risky projects and increase cash holdings to cope with potential uncertainties (Heo, 2021). Consequently, corporate climate risk has numerous negative impacts on corporate risk-taking levels. Furthermore, if an enterprise's resources are relatively limited, when their exposure to climate risk increases, they may allocate more funds to climate-related investments, leaving insufficient capital for investments in other risky projects, which in turn lowers their risk-taking capacity (Zhu et al., 2022). Furthermore, enterprise managers are more inclined than enterprise owners to adopt conservative investment strategies. Thus, when the level of exposure to climate risk rises, the uncertainty of investment returns also increases. Managers may become more cautious in reducing risky investments due to concerns about the negative impacts of investment failures on their careers and external images (Wang & Xu, 2024).

Research on the impact of climate factors on corporate risk-taking has been relatively scarce. He et al. (2023) found that a firm's environmental, social, and governance (ESG) performance significantly inhibits its risk-taking; however, their research focused specifically on enterprises' performance in the environmental, social, and governance domains, rather than the climate risks they may face. To our knowledge, no research has examined the impact of micro-level corporate climate risk exposure on risk-taking.

To fill that research gap, this paper empirically tests the impact of micro-level corporate climate risk exposure on risk-taking levels. The main research questions addressed in this paper are as follows: First, does corporate climate risk exposure reduce a firm's risk-taking level? Second, through which channels does corporate climate risk exposure influence risk-taking? Third, does the impact of climate risk exposure on risk-taking exhibit structural effects? Fourth, among which types of enterprises is the negative effect of increased corporate climate risk exposure on risk-taking more pronounced?

Specifically, this paper employs panel data from more than 2,400 A-share listed companies in China's Shanghai and Shenzhen stock markets spanning from 2007 to 2022. Drawing inspiration from Lei et al. (2023), we construct a corporate-level indicator of climate risk exposure through text analysis, utilizing keywords such as "climate change." Next, a fixed-effects model is then utilized to analyze the impact of this indicator on risk-taking. The findings reveal a significant negative effect of climate risk exposure on risk-taking levels. Furthermore, this paper conducts mechanism tests from the perspectives of resource dependency and principal-agent theory. Finally, we conduct several heterogeneity analyses from aspects of firm size, ownership, and industry attribute to investigate the differential negative impacts of climate risk exposure on risk-taking across various types of enterprises.

The potential marginal contributions of this paper are as follows: Firstly, it reveals that, beyond internal and external factors such as corporate governance and CEOs' individual characteristics (Faccio et al., 2011), corporate climate risk exposure may also exert a significant negative influence on risk-taking levels, thereby enriching the research landscape in this field. Secondly, this paper complements the

literature on the economic consequences of corporate climate risk exposure. Prior studies have found that climate risk significantly promotes green transformation, innovation, and ESG performance among enterprises. However, there is a lack of literature examining the potential impact of climate risk on corporate investment decisions from the perspective of risk-taking; this paper fills that gap to some extent. Thirdly, this research delves into the mechanisms underlying the negative impact of climate risk exposure on risk-taking. The study finds that the negative effect of climate risk exposure is primarily driven by principal-agent issues between owners and controllers, as well as the fundamental effect of green investments crowding out risky investments. These findings not only contribute to a deeper understanding of how climate risk influences corporate investment decisions but also provide insights into strategies to mitigate the adverse effects of climate risk on businesses.

The remainder of this paper is structured as follows: Section 2 reviews the literature, Section 3 outlines the research hypotheses, Section 4 describes data selection and model specification, Section 5 presents the empirical results, and Section 6 concludes.

2. Literature Review

2.1 Drivers of Corporate Risk-Taking

When making investment decisions, corporations face a trade-off between high risks and high returns. Taking a certain level of risk is crucial for achieving higher corporate profits and enhancing company valuation (Faccio et al., 2011; John et al., 2008). Currently, scholars have identified that external factors, corporate governance. and managerial characteristics significantly influence corporate risk-taking (Bernile et al., 2017; Faccio et al., 2011).

The impact of corporate governance on risk-taking stems from the principal-agent problem. The separation between company owners and actual manager, a characteristic of modern corporations, result in principal-agent costs. Due to concerns about the negative impact of investment failures on their careers and external reputations, CEOs often prioritize lower-risk projects when making investment decisions from their self-interest perspectives(Koirala et al., 2020). The level of corporate risk-taking often depends on the risk appetite of corporate managers, resulting in the actual risk-taking level being lower than that preferred by corporate owners (Yu et al., 2024). Corporate governance measures the level of principal-agent costs to a certain extent, will affect corporate risk-taking level. Existing literature indicates that incentive policies aimed at corporate managers help align the interests of company owners and managers, making managers more willing to take risks for higher returns, therefore has a positive impact on corporate risk-taking (Kim et al., 2017; Koirala et al., 2020). In addition, corporate risk-taking levels are also influenced by other corporate governance factors, such as ownership concentration and board size.

Because corporate risk attitudes depend on managerial risk preferences, executives' personal characteristics may also affect enterprises' risk-taking levels. Existing literature indicates that corporate executives' gender, age, and past experiences (Bernile et al., 2017; Faccio et al., 2011) significantly

impact corporate risk-taking levels. Furthermore, external factors affect corporate operating conditions and future investment prospects, which may also significantly influence corporate risk-taking. Prior research has found that external corporate attention (Yu et al., 2024) and information disclosure policies (Liu et al., 2024) have negative effects on corporate risk-taking.

2.2 Economic Effects of Climate Risk

Climate risk exposure can affect operations or enterprises in multiple ways. To examine the potential impact of climate risk on corporations, most prior research has constructed corporate-level climate risk indicators based on listed companies' annual reports by calculating word frequencies and conducting empirical research (Yu et al., 2024). At present, scholars have found that climate risk also increases financing costs and default risks and inhibits corporate total factor productivity (Cang & Li, 2024).

Meanwhile, to deal with climate risk effectively, companies' business strategies will also change. On the one hand, corporations may be more cautious in managing their cash flow statements, increasing cash holdings to buffer potential losses from climate change (Heo, 2021). On the other hand, climate risk may force corporations to allocate more resources to environmental protection projects, actively enhance green innovation levels (Tian et al., 2024), and improve ESG performance (Li et al., 2024) to effectively alleviate the negative impacts from climate risk.

2.3 Green Transformation and Corporate Risk-Taking

As climate issues have garnered widespread attention across society, numerous studies have begun to explore the impact of climate factors on corporate risk-taking. He et al. (2023) found that corporate ESG performance significantly inhibits risk-taking. Wang and Xu (2024) discovered that the implementation of environmental tax policies has a significant negative impact on the risk-taking of heavily polluting corporations. Zivin et al. (2020) and Zhou et al. (2022) found that high temperatures and air pollution have negative effects on corporate risk-taking. However, no scholars have yet studied the impact of enterprises' level of climate risk exposure on corporate risk-taking.

Analysis of the above reports reveals that that current research has investigated the influencing factors of corporate risk-taking and the economic effects of climate risk, and that it has drawn certain conclusions. However, there remains a lack of research on the connection between the two variables. From a micro perspective of companies, this paper constructs indicators of climate risk exposure levels from the annual reports of listed companies, and then studies the mechanisms of how firms' climate risk exposure impacts their risk-taking. This contributes to a deeper understanding of the impact of climate change on corporate investment decisions and provides references for corporations to reasonably address climate risks and achieve sustainable development.

3. Theoretical Analysis and Research Hypotheses

3.1 The Direct Effect of Firm Climate Risk Exposure and Corporate Risk-Taking

The risks posed by climate change can impose a series of adverse consequences on a company's production and operations. For instance, extreme weather events erode not only the actual value of a

company's fixed assets (Ren et al., 2022), but also its human capital and labor productivity (Zivin et al., 2020), which has an inhibiting effect on the company's industrial output (Chen & Yang, 2019). Furthermore, climate risks introduce considerable uncertainties into a company's future production and operations, significantly increasing the volatility of its future profits (Heo, 2021). Meanwhile, to effectively alleviating negative consequence of climate risks, policymakers may implement stricter environmental regulations that further pressure corporate production and operations (Wang & Xu, 2024).

From the above analysis, it is evident that climate risks increase the additional risks associated with corporate risk investments. Therefore, when a company's climate risk exposure increases, based on the adverse impacts of climate change, it will adjust its investment and operating strategies, exhibiting a more conservative stance; this involves holding more cash flow and reducing the frequency of investments in risky projects to cope with potential uncertainties (Heo, 2021). This strategic shift manifests as a decline in the company's risk-taking level. Consequently, this paper proposes the following hypothesis:

H1: An increase in a company's climate risk exposure has a negative impact on its risk-taking level.

Channels of Climate Risk Exposure on Corporate Risk-Taking

3.2 Resource Crowding-out Effect

An increase in climate risk exposure may prompt companies to increase their investments in environmental protection and green transformation, thereby creating a crowding-out effect on traditional venture capital activities and reducing corporate risk-taking. Specifically, when climate risks are perceived to increase, to effectively address the various adverse impacts that climate risks may bring, company owners will increase their resource on investment in environmental protection and place greater emphasis on green transition topics within their development strategies. Examples include increasing green innovation investments or accelerating the green transformation process. Meanwhile, according to the resource allocation theory, a company's total investment in project investment is relatively fixed. Therefore, when a company increases its investments in the climate issues, it will have a crowding-out effect on other business activities (He et al., 2023). This means that the funds and resources available to a company for venture capital activities will correspondingly decrease (Zhu et al., 2022), thereby adversely affecting the company's risk-taking capacity. Consequently, this paper proposes the following hypothesis:

H2: A company's perception of climate risks will reduce its risk-taking level by increasing its investments in the environmental protection sector.

3.3 Principal-agent Channel

The actual risk-taking level of a company is often lower than that of its owners. Within the framework of separation between corporate owners and managers, different roles exhibit distinct risk appetites in investment decisions. Benefiting from a diversified investment strategy that can effectively hedge some

risks, corporate shareholders tend to demonstrate higher risk tolerance than managers when evaluating investment proposals. However, as the actual administrators and controllers of a business, managers are often short-sighted in decision-making due to concerns about the negative impacts of investment failures on their performance evaluations and future career prospects. In addition, they prefer the pursuit of a quiet life and tend to choose projects with higher likelihoods of positive returns, resulting in lower risk-taking levels .

From the perspective of short-sightedness, as the level of companies' climate risk exposure increases, public media will focus more on companies' specific actions in regard to climate issues , thereby significantly increasing the external scrutiny companies receive (Yin et al., 2024) and exerting external pressure on company management as their mistakes are more likely to be observed. Under closer public scrutiny, managers may become still more short-sighted and concerned about the potential negative personal impacts of investment failures (Yu et al., 2024) and increasingly reluctant to engage in high-risk investment activities, thereby further reducing corporate risk-taking (Wang & Xu, 2024).

From the perspective of manager's pursuit of a stable life for, an increase in the degree of climate risk exposure faced by companies also leads to a decline in their willingness to take risks. The greater the climate risks facing a company, the greater the uncertainty of investment returns. Managers become more cautious of making decision due to concerns about the negative impacts of investment failures on their careers and external reputation, resulting in a reduce in venture capital activities. Meanwhile, based on society's continuous focus on sustainable development, a better investment direction for corporate managers is to make green and environmentally friendly investments. This allows companies to save time and effort in screening investment options and also helps them win positive societal evaluations. Therefore, climate risk exposure has a negative overall impact on corporate risk-taking.

In summary, the discrepancy between corporate owners' and managers' respective interests—which arises from principal-agent problems—makes managers more inclined to choose low-risk investment projects from a personal interest perspective in the context of intensifying climate risks, thereby reducing the company's overall risk-taking. Poor corporate governance increases principal-agent costs, making managers more short-sighted and their stronger preference for a quiet life more pronounced. This trend further exacerbates the adverse impact of climate risks on corporate risk-taking due to managers' concern for their own personal reputations. Consequently, this paper proposes the following hypothesis:

H3: The weaker a company's corporate governance capabilities are, and the higher the principal-agent costs, the greater the negative impact of climate risk disclosure on corporate risk-taking.

4. Variable Selection and Data Source

4.1 Data Source

This paper selected data from more than 2,400 Chinese A-share listed non-financial companies between

2007 and 2022 as the research sample. Next, the following data processing steps were taken: (1) samples of companies that are not normally listed were excluded; (2) samples of companies that have been established for less than one year were excluded; and (3) data samples with missing values in variables were excluded. After these screenings, a total of 23,027 observations were retained. To avoid the influence of outliers, all variables were winsorized at the 1% and 99% quantiles. All indicators were sourced from the CSMAR and Wind databases.

4.2 Variable Selection

The explained variable in this paper is the level of corporate risk-taking (Risk). Referring to Yu et al. (2024), this paper measures Risk using the volatility of the company's realized profit rate over a certain period. The higher this indicator, the higher the potential cash flow volatility of the company in the future, leading to a higher willingness to invest in risky ventures. Specifically, this paper uses the volatility of ROA (return on assets, roa_{it}) and adjusted ROA (after removing industry and year mean adjustments, adj_roa_{it}) to measure the risk-taking level of each company.

$$risk1_{i,t}=\frac{1}{T}\sum_{t=1}^{T}\left(roa_{it}-\frac{1}{T}\sum_{t=1}^{T}roa_{it}\right)^2, T=3 \quad (1)$$

$$risk2_{i,t}=\frac{1}{T}\sum_{t=1}^{T}\left(adj\_roa_{it}-\frac{1}{T}\sum_{t=1}^{T}adj\_roa_{it}\right)^2, T=3 \quad (2)$$

The main explanatory variable in this paper is the degree of exposure to climate risks (clinot) for each company. In selecting specific indicators, this paper follows the method of Lei et al. (2023 and uses the disclosure level of climate risks in corporate annual reports to characterize the climate risk exposure level of listed companies. This indicator employs text analysis to collect keywords such as "air quality" and "carbon dioxide" from corporate annual reports,and it also measures the attention paid by corporate management to climate issues over different periods based on the frequency of these keywords.Specific keyword indicators can be seen in Lei et al. (2023). A higher value of this indicator represents a higher degree of exposure to climate risks for a given company.

In addition, this research controls for financial indicators at the corporate level, including company size (Lnsale), corporate leverage ratio (Lev), asset liquidity (Liquidity), ownership nature (SOE), market value of the company (Tq), and earnings growth rate (growth). Variable selection and construction are described in Table 1, and description analysis of variables appears in Table 2.

Table 1. Variable Selection

Variable type	Variable name	concept	measurement
Dependent variable	risk1	Firm risk taking	Volatility of ROA calculated according to Formula (1)
	risk2	Firm risk taking	Volatility of adj_ROA calculated according to Formula (2)

	risk3	Firm risk taking	Volatility of corporate cash flow
Independent variable	CAI	Company risk exposure	Obtained through text analysis based on annual reports of listed companies
	Lnsale	firm size	Logarithm of corporate sales
	Lev	firm leverage	Total liabilities / Total assets
	Liquidity	Asset liquidity	Current assets / Total assets
Control variables	Soe	ownership	1 for state-owned enterprises, 0 for non-state-owned enterprises
	Tq	Market value	Shareholding ratio of the largest shareholder
	growth	Revenue growth rate	Growth rate of operating revenue

Table 2 Description analysis

Variable	Obs	Mean	Std. Dev.	Min	Max
risk1	23027	2.907	3.685	.05	27.836
risk2	23027	3.052	3.494	.104	27.031
clinot	23027	2.36	.629	.551	4.179
Lnsale	23027	21.605	1.396	18.186	25.959
Lev	23027	.433	.2	.035	.909
Liquidity	23027	.555	.196	.058	.957
Growth	23027	.298	.838	-.875	9.088
Tq1	23027	.625	.246	.087	1.234
Soe	23027	.159	.366	0	1

4.3 Model Setting

We investigate the impact of corporate climate risk exposure on the risk-taking level through the following model:

$$risk_{i,t}=\alpha_0+\alpha_1 CAI_{it}+\gamma X_{it}+\vartheta_i+\pi_t+\epsilon_{it} \quad (3)$$

Among them, represents the risk-taking level of enterprise in year t, and represents the climate risk exposure level of the enterprise. is an important parameter of concern in this paper, and the expected sign of is negative, indicating that corporate climate risk exposure has a inhibitory effect on corporate risk-taking. represents the control variables. ϑ_i and represent the firm and year fixed effects, respectively. is the random error term, and the standard error of the regression is clustered at the firm level.

5. Empirical Results

5.1 Baseline Regression Result

Table 3 reports the benchmark regression results of corporate climate risk exposure on corporate risk-taking. Columns (1) and (3) present the regression results with risk-taking measurements using formulas (1) and (2), respectively, as independent variables. Columns (2) and (4) show the regression results after including control variables on this basis. As the table shows, for both proxy variables of corporate risk-taking as the dependent variables, the regression coefficients for climate risk exposure are consistently and significantly negative. This indicates that an increase in the level of attention paid by corporate management to climate issues has a significant negative effect on corporate risk-taking. Taking the results in column (2) as an example, the regression coefficient for climate risk exposure is −0.505, suggesting that for every 1% increase in a firm's climate risk exposure, risk-taking decreases by an average of 0.505 units.This fully supports Hypothesis 1. Climate risk exposure introduces considerable uncertainties into corporate investment activities, making firms more cautious when making investment decisions and thus exerting a negative impact on risk-taking.

Table 3. Baseline Regression Result

	(1)	(2)	(3)	(4)
	risk1	risk1	risk2	risk2
clinot	-0.568***	-0.505***	-0.503***	-0.446***
	(-4.52)	(-4.14)	(-4.38)	(-3.98)
Lnsale		-0.859***		-0.821***
		(-8.31)		(-8.41)
Lev		4.073***		3.982***
		(8.18)		(8.55)
Liquidity		0.0247		-0.0228
		(0.06)		(-0.06)
Growth		-0.000159		0.000718
		(-0.00)		(0.02)
Tq1		-2.392***		-2.096***
		(-9.63)		(-8.86)
Soe		0.763***		0.748***
		(7.06)		(7.46)
Year FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
N	22828	22828	22828	22828
R^2	0.357	0.381	0.356	0.380

Note. ***, ** and *indicates statistical significance at the 10%,5% and 1% level, respectively. T-statistics are reported in parentheses and clustered at the firm level. The same below.

5.2 Endogeneity Test

5.2.1 Instrumental Variable (IV) Regression

In this paper, two instrumental variables (IVs) for corporate climate risk exposure are constructed, and an instrumental variable test is conducted accordingly. Firstly, the previous year's value is used as the first instrumental variable (IV1) for the current year's climate risk exposure level. Secondly, following Zhou et al. (2022), the average climate risk exposure level of other listed companies in the same province and year (IV2) is used as the second instrumental variable. Due to the peer-pressure effect, a higher overall climate risk exposure level among other firms within the same region can also positively influence a company's own climate risk exposure. Meanwhile, this indicator is unrelated to other indicators, thereby satisfying the exogenous condition.

Table 4 presents the results of the instrumental variable regression. Columns (1) and (3) show that for both instrumental variables, when climate risk exposure is the dependent variable, IV1 and IV2 as explanatory variables are both positively significant at the 1% level. The LM test values are 339.98 and 22.93 (both significant at the 0.01 level), indicating that there is no weak instrumental variable problem. Additionally, as shown in the regression results in columns (2) and (4) of Table 4, the regression coefficients for climate risk exposure are −0.635 and −6.054, respectively, and both coefficients are significant at the 1% level. This reaffirms that an increase in climate risk exposure has a negative impact on risk-taking, thus validating the accuracy of the benchmark regression conclusions in this paper.

Table 4. Endogeneity Test of Instrument Variable Regression

	(1)	(2)	(3)	(4)
	clinot	risk1	clinot	risk1
L.clinot	0.523***			
	(46.82)			
iv3			0.243***	
			(4.82)	
clinot		-0.635***		-6.054***
		(-2.58)		(-2.74)
Lnsale	0.0220***	-0.874***	0.0482***	-0.593***
	(3.16)	(-7.79)	(4.24)	(-3.63)
Lev	-0.0749***	3.987***	-0.0369	3.851***
	(-2.95)	(7.33)	(-0.92)	(7.15)

Liquidity	-0.0991***	0.0755	-0.267***	-1.440*
	(-2.98)	(0.17)	(-5.28)	(-1.95)
Growth	-0.00348	-0.0281	-0.00189	-0.0117
	(-1.02)	(-0.69)	(-0.46)	(-0.27)
Tq1	-0.00681	-1.947***	-0.0207	-2.519***
	(-0.41)	(-7.46)	(-0.84)	(-8.75)
Soe	0.00748	0.624***	0.0288**	0.924***
	(0.92)	(6.07)	(2.54)	(6.70)
Year FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
LM statistics	339.98***		22.93***	
N	19022	19022	23011	22811

5.2.2 PSM Method

To further mitigate the influence of endogeneity on the results of this paper, we employ propensity score matching (PSM) to examine the impact of climate risk exposure on risk-taking levels. Following Zhou et al. (2022), we use the median level of corporate climate attention among listed companies as a threshold to divide the sample into a treatment group and a control group. Companies with a climate risk exposure level above this median threshold are classified into the treatment group, whereas those below are placed into the control group. We select the control variables from the benchmark regression as covariates and use both 1:1 and 1:2 nearest-neighbor matching methods to find similar sample data in the control and treatment groups for matching, after which panel regression is performed. As can be seen from Table 5, the regression coefficients for climate risk exposure are consistently negative and significant at the 1% level, thereby further validating the accuracy of Hypothesis 1.

Table 5. PSM Test

	(1)	(2)
	1:1 nearest-neighbor matching	1:2 nearest-neighbor matching
	risk1	risk1
clinot	-0.506***	-0.509***
	(-3.81)	(-4.04)
Lnsale	-0.980***	-0.884***
	(-8.97)	(-8.41)
Lev	4.350***	4.179***
	(8.05)	(8.32)
Liquidity	0.102	-0.019

	(0.23)	(-0.04)
Growth	0.016	0.006
	(0.41)	(0.14)
Tq1	-2.398***	-2.407***
	(-8.93)	(-9.49)
Soe	0.820***	0.783***
	(6.83)	(7.05)
Year FE	YES	YES
Firm FE	YES	YES
N	19822	21782

5.2.3 Placebo Test

To avoid the interference of random events on the results, this paper also conducts a placebo test on the benchmark regression results. Specifically, we randomly assign climate risk exposure levels to sample enterprises and perform 1,000 regressions based on these randomly treated samples. If the negative impact of corporate climate risk exposure on risk-taking levels observed in the benchmark regression is genuine, then under the setting of random samples, the regression coefficient corresponding to the placebo should not significantly differ from 0. Figure 1 depicts the kernel density distribution of the regression coefficients of clinot across the 1,000 regressions and the corresponding p-values. It can be observed that most regression coefficients are concentrated near 0, significantly higher than the estimated value of −0.505 from the benchmark regression. In addition, most p-values are less than 0.1, indicating that random unobserved factors do not affect the results, further demonstrating the robustness of the benchmark regression results in this paper.

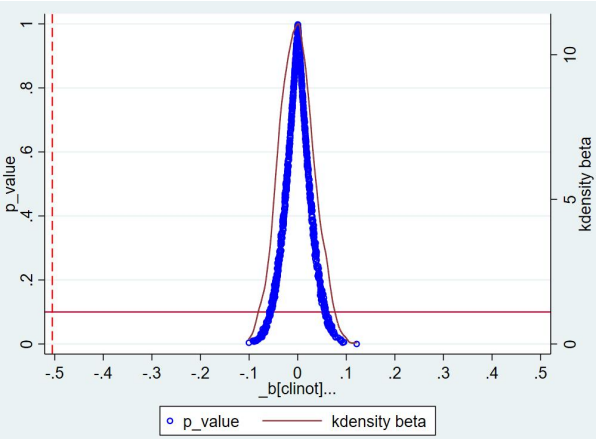

Figure 1. Placebo Test

5.3 Robustness Test

In addition to the above-mentioned endogeneity tests, this paper also conducts robustness checks from multiple aspects. Firstly, it replaces the measurement method of the explained variable by using the volatility of corporate cash flow as a proxy for corporate risk-taking. The regression results are summarized in column (1) of Table 6.

$$Risk\_taking3_{i,t}=\frac{1}{T}\sum_{t=1}^{T}\left(cfo_{it}-\frac{1}{T}\sum_{t=1}^{T}cfo_{it}\right)^2, T=3 \quad (4)$$

Secondly, this paper also generates a dummy variable (risk1_dummy) for the level of corporate risk-taking, using the median as the critical level. If risk-taking exceeds the critical level, risk1_dummy is assigned a value of 1; otherwise it is 0. Then, using risk1_dummy as the explained variable, the panel logit model is employed to estimate the regression coefficient of climate concern. The results are summarized in column (2) of Table 6. Thirdly, this paper includes fixed effects for both industry and year interactions, with the results presented in column (3) of Table 6. Fourthly, the COVID-19 pandemic disrupted enterprises' normal production and business activities as well as their investment and financing decisions, potentially interfering with the empirical results. Therefore, this paper controls the regression sample to include only those from 2019 and earlier, and re-analyzes the data. The results are summarized in column (4) of Table 6. Fifthly, to mitigate potential reverse causality—where the level of corporate risk-taking may also affect the disclosure and perception of climate risks by enterprises—this paper lags the explanatory variables by one and two periods, respectively, and re-conducts panel regression analysis. The results are presented in columns (5) and (6) of Table 6. As can be seen from Table 6, under different forms of robustness checks, the regression coefficient of clinot remains significantly negative, verifying the accuracy of the benchmark regression results.

Table 6. Robustness Test

	(1)	(2)	(3)	(4)	(5)	(6)
	risk _cfo	risk1_dummy	risk1	risk1	risk1	risk1
clinot	-0.211*	-0.287***	-0.418***	-0.456***	-0.442***	-0.314*
	(-2.01)	(-5.00)	(-3.33)	(-3.52)	(-3.40)	(-2.34)
Lnsale	0.070	-0.350***	-0.901***	-0.725***	-0.348***	0.085
	(0.87)	(-9.24)	(-8.44)	(-6.50)	(-3.44)	(0.73)
Lev	0.949**	0.999***	3.732***	3.285***	2.519***	2.151***
	(2.64)	(5.85)	(7.56)	(6.29)	(5.05)	(4.26)
Liquidity	3.213***	-1.043***	0.088	0.145	-1.542***	-2.795***
	(8.72)	(-5.71)	(0.21)	(0.33)	(-3.62)	(-5.48)
Growth	0.051	0.043	0.020	0.031	0.021	-0.091*
	(1.34)	(1.85)	(0.55)	(0.83)	(0.55)	(-2.46)

Tq1	-1.210***	-0.806***	-2.403***	-2.173***	-1.841***	-1.447***
	(-5.97)	(-6.80)	(-8.67)	(-8.33)	(-7.06)	(-5.18)
Soe	0.088	0.227***	0.776***	0.602***	0.322**	0.090
	(0.88)	(3.68)	(7.24)	(5.28)	(3.23)	(0.87)
Year FE	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
N	22828	20050	22720	18044	19022	16506
R^2	0.443		0.425	0.380	0.405	0.440

5.4 Mechanism Analysis

5.4.1 Resource Crowding-out Effect

In the theoretical section of this paper, analysis shows that resource crowding-out is one channel by which climate risk exerts a negative effect on risk-taking. Due to the relative limitation of resources that enterprises can mobilize, when facing an elevated level of climate risk exposure, enterprises will increase investments in green and environmental protection fields, which leaves insufficient resources for traditional venture capital investments. This paper uses the proportion of corporate environmental investment to total assets (green_inv1) and the proportion of pollution charges to total assets (green_inv2) as proxy variables for resource investment in environmental protection fields, empirically testing this effect through a mediation-effect model. Columns (2) and (4) of Table 10 show that when green_inv1 and green_inv2 are used as the explained variables, the regression coefficients of clinot are significantly positive at the 10% level. This indicates that as enterprises encounter more climate risks, they will significantly increase their investments in green and environmental protection fields. Meanwhile, columns (3) and (5) of Table 7 show that when the corporate risk-taking coefficient is used as the explained variable, the regression coefficients of green_inv1 and green_inv2 are significantly negative. This indicates that investments in environmental protection and green fields have a negative impact on corporate risk-taking. The higher the level of investment in environmental protection fields, the greater the “crowding-out effect” on investments in risk fields, thus reducing the level of corporate risk-taking. This verifies the accuracy of Hypothesis 2.

Table 7. Mechanism Test (Resource Crowding-Out Effect)

	(1)	(2)	(3)	(4)	(5)
	risk1	green_inv1	risk1	green_inv2	risk1
green_inv1			-0.815*		
			(-1.94)		
green_inv2					-0.462***
					(-4.82)

clinot	-0.505***	0.00862**	-0.463***	0.0189*	-0.469***
	(-4.14)	(2.01)	(-3.51)	(1.89)	(-3.72)
Lnsale	-0.859***	-0.00893***	-0.900***	0.958***	-0.426***
	(-8.31)	(-2.82)	(-7.51)	(104.34)	(-3.25)
Lev	4.073***	0.0579***	4.227***	0.0471	4.102***
	(8.18)	(3.83)	(7.75)	(1.34)	(7.89)
Liquidity	0.0247	-0.205***	0.0139	0.0231	0.0655
	(0.06)	(-13.23)	(0.03)	(0.73)	(0.15)
Growth	-0.000159	-0.00222**	0.00962	0.227***	0.103**
	(-0.00)	(-1.97)	(0.21)	(33.14)	(2.48)
Tq1	-2.392***	0.0205***	-2.127***	-0.0681***	-2.326***
	(-9.63)	(2.84)	(-8.03)	(-3.24)	(-9.12)
Soe	0.763***	0.0139**	0.810***	-0.00810	0.793***
	(7.06)	(2.04)	(7.00)	(-0.72)	(7.13)
Year FE	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES
N	22828	20356	20356	22116	22116
R^2	0.381	0.354	0.390	0.951	0.389

5.4.2 Principal-agent Effect

The entrusted agency problem between shareholders and managers is another pathway by which climate risk exposure adversely affects corporate risk-taking. Therefore, the inhibitory effect of climate risk disclosure on corporate risk-taking will vary significantly across different levels of corporate governance. This paper uses the model in Equation (2) to test this effect.

$$Risk_{i,t}=\alpha_0+\alpha_1 CAI_{it}+\alpha_2 CAI_{it}\times gover_{it}+\alpha_3 gover_{it}+\gamma X_{it}+\mu_i+\delta_t+\epsilon_{it}$$

Among them, represents the internal corporate governance level of the enterprise, while the other settings remain consistent with those in the benchmark regression. This paper uses management ownership (owner) and the degree of separation between ownership and control rights (depart) as proxy variables for corporate governance level. A higher management ownership percentage and a lower degree of separation between ownership and control rights indicate a higher level of corporate governance. Management ownership alleviates the problem of incompatible interests between corporate controllers and owners to some extent: The higher the management ownership percentage, the more likely enterprise owners are to make investment decisions that promote enterprise development and enhance enterprise value.

If one of the channels through which climate risk perception negatively affects risk-taking stems from internal corporate governance issues, then the inhibitory effect of corporate climate risk exposure on risk-taking will be more pronounced when agency costs are higher and corporate governance levels are

lower. Therefore, for management ownership, the expected sign is significantly positive; for the degree of separation between ownership and control rights, the expected sign is negative, indicating that an improvement in corporate governance level can mitigate the negative relationship between climate risk perception and risk-taking.

Table 8 shows that the regression coefficient of the interaction term between climate risk exposure and management ownership is significantly positive at the 10% level, while the regression coefficient of the interaction term between climate risk exposure and the degree of separation between ownership and control rights is significantly negative at the 1% level. This suggests that an improvement in corporate governance level can mitigate the negative relationship between corporate climate risk perception and risk-taking. The lower the corporate governance level, the more pronounced the negative effect of climate risk exposure on corporate risk-taking.

Table 8. Mechanism Test (Principal agent Effect)

	(1)	(2)
	risk1	risk1
clinot	-0.513***	-0.312**
	(-3.85)	(-2.20)
clinot*ratio	0.00809*	
	(1.66)	
clinot*depart		-0.0214***
		(-2.61)
depart		0.0402*
		(1.85)
ratio	-0.0619***	
	(-5.51)	
Lnsale	-0.947***	-0.883***
	(-8.45)	(-7.72)
Lev	3.859***	4.057***
	(7.16)	(7.38)
Liquidity	0.356	0.169
	(0.79)	(0.37)
Growth	-0.000838	-0.000733
	(-0.02)	(-0.02)
Tq1	-1.896***	-2.139***
	(-7.22)	(-8.13)
Soe	0.766***	0.851***

	(6.63)	(7.31)
Year FE	YES	YES
Firm FE	YES	YES
N	20658	21049
R^2	0.399	0.393

There are significant differences in investment risk appetite between corporate controllers and owners. Firstly, corporate controllers have stronger incentives to choose more stable investment activities. Therefore, when enterprises' degree of disclosure and perception of climate risks increase, so too do the entrusted agency costs increase, and the more likely it becomes for corporate controllers to allocate more resources to green and environmental investments from their own interests; the result is insufficient venture capital activities for the enterprise (Zhu et al., 2022). At the same time, the higher the agency costs, the more worried corporate controllers will be about the short-term adverse consequences of climate risks for themselves; they will therefore choose lower-risk projects for investment, ultimately manifesting a stronger negative effect of climate risk exposure on corporate risk-taking. This verifies Hypothesis 3, which states that the entrusted agency channel is one of the pathways through which climate risk exposure negatively affects corporate risk-taking.

5.5 Heterogeneity Test

5.5.1 Ownership

Firstly, this paper divides companies into two sub-samples based on their ownership: state-owned enterprises (SOEs) and non-state-owned enterprises (non-SOEs). Columns (1) and (2) of Table 9 show that, for the SOE sample, the regression coefficient of clinot is −0.44, whereas for the non-SOE sample, this value changes to −0.404. This indicates that the negative impact of climate risk exposure on risk-taking is greater for SOEs. Compared to non-SOEs, SOEs can obtain more support from government departments and financial institutions, and they are also more susceptible to the influence of related policies. Because the potential losses resulting from climate risk exposure are more severe for SOEs, when the level of climate risk exposure increases, SOEs become more reluctant to engage in venture capital investments, leading to a more pronounced decline in the risk-taking coefficient.

Table 9. Heterogeneity Test (Industry Attribute and Ownership)

	(1)	(2)	(3)	(4)
	SOE	Non-SOE	large firms	small firms
	risk1	risk1	risk1	risk1
clinot	-0.440**	-0.404***	-0.497***	-0.587***
	(-2.03)	(-2.83)	(-4.09)	(-2.70)
Lnsale	-0.469**	-0.985***	-0.744***	-1.074***

	(-2.41)	(-8.14)	(-6.01)	(-5.31)
Lev	1.390	4.596***	1.045*	6.158***
	(1.38)	(7.96)	(1.70)	(7.61)
Liquidity	1.422	-0.053	1.570***	-0.171
	(1.26)	(-0.11)	(2.74)	(-0.25)
Growth	0.115*	-0.038	0.018	-0.123
	(1.71)	(-0.83)	(0.49)	(-1.53)
Tq1	-2.923***	-2.371***	-1.382***	-2.650***
	(-4.32)	(-8.42)	(-4.67)	(-5.64)
Soe			0.397***	1.385***
			(3.63)	(5.73)
Year FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
N	3589	19154	11352	11231
R^2	0.514	0.407	0.411	0.465

5.5.2 Company Size

The marginal impact of corporate climate risk exposure on risk-taking may also vary with company size. When companies have different asset sizes, the marginal impact of climate risk perception on the mismatch between investment and financing horizons may also differ. This paper divides companies into two sub-samples: large companies and small companies, based on the size of their total assets. A company is classified as large if its asset size is greater than the average asset size of all companies in that year; otherwise, it is classified as small. As shown in columns (3) and (4) of Table 9, for the sub-sample of small companies, the regression coefficient for climate risk exposure is −0.587, whereas for large companies, this value is −0.497, indicating that the marginal impact of climate risk exposure on risk-taking is more significant in the sub-sample of small companies. For small companies, their resources are relatively limited, and their ability to resist risks is weaker. They will be more concerned about the adverse impacts of climate risks on their businesses and will adopt a more conservative approach to investment. Therefore, the negative impact of climate risk exposure on risk-taking is stronger for small companies.

5.5.3 Industry Attributes

Firstly, this paper divides companies into two sub-samples based on whether they operate in heavily polluting industries. The relationship between climate concern and corporate risk-taking levels is then studied within each of these two sub-samples. As columns (1) and (2) of Table 10 show, the negative effect of corporate climate risk exposure on risk-taking is more significant for companies in heavily polluting industries. For non-heavily polluting companies, the regression coefficient for climate risk exposure is −0.432, whereas for companies in heavily polluting industries, this value decreases to

−0.542. The absolute value of the clinot regression coefficient for heavily polluting companies increases significantly. Heavily polluting companies are more susceptible to the impacts of climate change and government environmental regulatory policies. Therefore, as the degree of climate risk exposure increases, these companies need to adjust their development strategies and allocate more resources to environmental protection, leading to a reduction in investment in risky projects. Consequently, the negative impact of climate risk exposure on risk-taking is more pronounced for heavily polluting companies.

Table 10. Heterogeneity Test (Industry Attribute)

	(1)	(2)
	heavily polluted	Not heavily polluted
	risk1	risk1
clinot	-0.542***	-0.432***
	(-2.79)	(-2.67)
Lnsale	-0.788***	-1.080***
	(-4.46)	(-8.20)
Lev	2.534***	5.664***
	(3.12)	(8.86)
Liquidity	0.854	-0.452
	(1.19)	(-0.86)
Growth	0.067	-0.037
	(0.75)	(-0.89)
Tq1	-2.881***	-1.995***
	(-6.84)	(-6.39)
Soe	0.572***	0.929***
	(3.10)	(6.97)
Year FE	YES	YES
Firm FE	YES	YES
N	8480	14312
R^2	0.382	0.403

5.5.4 Panel Quantile Regression

In the baseline analysis, this paper finds that corporate climate risk exposure has a significant negative impact on risk-taking levels. The above analysis focuses on the overall impact; here we will adopt a more granular perspective. The marginal impact of corporate climate risk exposure on risk-taking may vary with changes in the latter’s value. Next, this paper employs a panel quantile regression model to

investigate this variability, using the 75th, 50th, and 25th percentiles of the dependent variable to represent high, medium, and low levels of corporate risk-taking, respectively. As shown in Table 11, the negative effect of climate risk exposure on risk-taking levels is significantly greater for firms with already-higher risk-taking levels. For example, when a firm's risk-taking level is at the 75th percentile, the regression coefficient for climate risk disclosure is −0.121; at the median, this value changes to −0.092; and at the 25th percentile, it further changes to −0.048. For firms with high levels of risk-taking that have already undertaken a significant amount of risky business, there is a greater need to prioritize risk management. When these firms perceive climate risks to be greater, they will be more concerned than average firms about the adverse impacts of climate change on their businesses, leading them to adjust their investment portfolios and choose lower-risk projects for investment. At this point, such firms have higher average profits and are more motivated to replace some risky business ventures with safer ones, thereby intensifying the negative effect of increased climate risk perception on risk-taking. Additionally, managers may take their own perspectives into account: When the level of risk-taking is already high, managers become more risk-averse and concerned about the potential adverse consequences of uncertainty for themselves, thus manifesting a greater negative impact of climate risk exposure on risk-taking.

Table 11. Panel Regression Result

	(1)	(2)	(3)
	high risk-taking(75th)	medium risk-taking(50th)	low risk-taking(25th)
	risk1	risk1	risk1
clinot	-0.121***	-0.092***	-0.048***
	(-48.82)	(-116.02)	(-59.39)
Lnsale	-0.408***	-0.094***	-0.025***
	(-193.37)	(-132.79)	(-45.09)
Lev	1.908***	0.251***	-0.197***
	(158.77)	(86.81)	(-67.46)
Liquidity	-2.892***	-1.167***	-0.509***
	(-107.93)	(-189.72)	(-160.98)
Growth	-0.009**	0.002***	0.008***
	(-2.40)	(4.84)	(19.36)
Tq1	-1.740***	-0.942***	-0.423***
	(-181.68)	(-262.62)	(-107.53)
Soe	0.132***	-0.030***	-0.084***
	(23.40)	(-14.72)	(-14.10)
Year FE	YES	YES	YES

Firm FE	YES	YES	YES
N	23027	23027	23027

6. Conclusions and Policy Implications

Using data from more than 2,400 Chinese non-financial A-share listed companies between 2007 and 2022, this paper investigates the impact of firm-level climate risk exposure on corporate risk-taking. The main findings of this paper are as follows: (1) First, corporate climate risk exposure has a significant inhibitory effect on risk-taking levels. This conclusion remains valid under a series of robustness checks, including instrumental variable regression, propensity score matching regression, and placebo tests. (2) Second, the positive impact of climate risk exposure on risk-taking is more pronounced for heavily polluting firms, smaller firms, and state-owned enterprises. Additionally, when firms already have high levels of risk-taking, the negative effect of climate risk exposure on them is intensified. (3) Third, climate risk exerts a negative influence on corporate risk-taking primarily through the principal-agent and resource-based channels. Due to concerns about their reputation and future careers, corporate managers tend to make more short-sighted and cautious decisions compared to owners, thereby amplifying the negative impact of climate risk exposure on risk-taking. Furthermore, climate risk exposure increases firms' investments in green and environmental protection, which in turn crowds out traditional venture investments, thus reducing their risk-taking levels.

Based on the research findings, this paper proposes the following three policy recommendations:

First, strengthen long-term incentive policies for corporate management and implement performance evaluation policies for long-term investment projects. The research results indicate that improving corporate governance can alleviate short-sightedness and conservatism among corporate owners, aligning their risk appetites more closely with the firm's while also mitigating the adverse effects of climate risk on corporate risk-taking.

Second, increase support for corporate green investments. This paper finds that climate risk may lead firms to increase their investments in green and environmental protection, thereby crowding out venture investments. Thus, government departments can appropriately introduce green investment support policies to reduce firms' investment costs in the green sector, thereby enabling them to effectively address climate risks while retaining sufficient resources to invest in risky projects.

Third, strengthen training for firms on climate risk management. Through public awareness campaigns and educational activities, raise society's understanding of climate change and encourage firms to establish climate-risk response systems. To achieve sustainable development, firms should not neglect their long-term venture investments while pursuing green transformation.

Reference

Bernile, G., Bhagwat, V., & Rau, P. R. (2017). What doesn't kill you will only make you more risk-loving: Early-life disasters and CEO behavior. *The Journal of Finance*, *72*(1), 167-206.

Cang, H., & Li, C. (2024). Corporate climate risk and bond credit spreads. *Finance Research Letters*, 105741.

Chen, X., & Yang, L. (2019). Temperature and industrial output: Firm-level evidence from China. *Journal of Environmental Economics and Management*, *95*, 257-274.

Faccio, M., Marchica, M. T., & Mura, R. (2011). Large shareholder diversification and corporate risk-taking. *The Review of Financial Studies*, *24*(11), 3601-3641.

He, F., Ding, C., Yue, W. et al. (2023). ESG performance and corporate risk-taking: Evidence from China. *International Review of Financial Analysis*, *87*, 102550.

Heo, Y. (2021). *Climate change exposure and firm cash holdings*.

John, K., Litov, L., & Yeung, B. (2008). Corporate governance and risk-taking. *The journal of finance*, *63*(4), 1679-1728.

Kim, K., Patro, S., & Pereira, R. (2017). Option incentives, leverage, and risk-taking. *Journal of Corporate Finance*, *43*, 1-18.

Koirala, S., Marshall, A., Neupane, S. et al. (2020). Corporate governance reform and risk-taking: Evidence from a quasi-natural experiment in an emerging market. *Journal of Corporate Finance*, *61*.

Lei, L., Zhang, D., Ji, Q. et al. (2023). A text-based managerial climate attention index of listed firms in China. *Finance Research Letters*, *55*.

Li, C., Tang, W., Liang, F. et al. (2024). The impact of climate change on corporate ESG performance: The role of resource misallocation in enterprises. *Journal of Cleaner Production*, *445*, 141263.

Liu, W., Lin, G., & He, Q. (2024). Enhanced management information disclosure responsibilities and corporate risk-taking: Evidence from the accountability system for errors in China. *International Review of Economics & Finance*, *89*, 511-531.

Nakano, M., & Nguyen, P. (2012). Board size and corporate risk taking: further evidence from Japan. *Corporate Governance: An International Review*, *20*(4), 369-387.

Ren, X., Zhang, X., Yan, C. et al. (2022). Climate policy uncertainty and firm-level total factor productivity: Evidence from China. *Energy Economics*, *113*, 106209.

Tian, Y., Chen, S., & Dai, L. (2024). How climate risk drives corporate green innovation: Evidence from China. *Finance Research Letters*, *59*, 104762.

Wang, S., & Xu, B. (2024). Environmental protection tax policy and corporate risk-taking: Evidence from China. *International Review of Financial Analysis*.

Yin, Z., Deng, R., Xia, J. et al. (2024). Climate risk and corporate ESG performance: Evidence from China. *The North American Journal of Economics and Finance*, *74*, 102245.

Yu, C., Song, A., & Yu, F. (2024). Media attention and corporate risk-taking: Evidence from China. *International Review of Economics & Finance*, *93*, 1459-1482.

Zhou, M., Jiang, K., & Chen, Z. (2022). Temperature and corporate risk taking in China. *Finance Research Letters*, *48*, 102862.

Zhu, D., Gao, X., Luo, Z. et al. (2022). Environmental performance and corporate risk-taking: Evidence from China. *Pacific-Basin Finance Journal*, *74*, 101811.

Zivin, J. G., Song, Y., Tang, Q. et al. (2020). Temperature and high-stakes cognitive performance: Evidence from the national college entrance examination in China. *Journal of Environmental Economics and Management*, *104*, 102365.