

The Impact of Climate Risk on Audit Opinion: Evidence from Chinese A-Share Listed

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Abstract—This study examines the impact of corporate climate risk on audit opinions, using a sample of Chinese A-share listed companies from 2015 to 2024. Climate change has emerged as a significant source of business uncertainty, affecting firms' operations, financial reporting quality, and internal controls. This paper investigates whether auditors respond to clients' climate risk exposure by issuing more conservative audit opinions. The empirical results indicate that firms with higher climate risk exposure are significantly more likely to receive modified audit opinions. The mechanism analysis reveals that climate risk influences audit opinions through two channels: increased earnings management and weakened internal control quality. Heterogeneity analysis shows that this effect is more pronounced in high-carbon industries, firms with lower ESG performance, and regions with stricter environmental regulations. This study contributes to the growing literature on climate risk and auditing by providing empirical evidence on how climate risk shapes auditors' reporting decisions, and offers practical implications for regulators, investors, and audit practitioners.

Keywords—Climate Risk; Audit Opinion; Auditor Conservatism; Modified Opinion; Audit Risk

I. INTRODUCTION

Climate change is significantly affecting global society and the economy, rendering the fight against its associated threats one of the most pressing issues of our time. At the policy level, policymakers have devoted significant attention to climate change risk and have begun to implement countermeasures. At the practical level, climate change and its associated threats can result in substantial increases in costs, operational disruptions, and regulatory changes. These challenges may exacerbate firms' cash flow volatility and heighten their default risk in adverse scenarios.

According to the Task Force on Climate-related Financial Disclosures (TCFD), climate risk refers to the uncertainty brought to economic and financial activities by climate factors such as extreme weather, natural disasters, and global warming, as well as the society's transition toward sustainable development. Climate risk can be categorized into physical risk and transition risk. Physical risk arises from large-scale natural disasters caused by extreme weather events and longer-term changes in climate patterns. Transition risk is defined as the risk generated in the process of transitioning to a low-carbon economy, including policy, legal, technological, reputational, and market risks that firms may face in responding to and mitigating climate change.

Climate change is already recognized as a significant risk for clients, prompting audit regulators and standard-setters to debate how such risks should be integrated into financial statement audits. Prior studies have found that firms exposed to higher climate risks are more limited in their capacity for innovation and engage more frequently in earnings manipulation activities. Firms affected by climate risk are

more likely to demonstrate diminished reporting quality and weakened internal controls, which increases audit risk. Before performing audit procedures, auditors must evaluate a client's business risk, defined as the likelihood of future financial deterioration. Higher business risk raises the possibility that the client will engage in earnings management to conceal poor performance, which increases audit risk, thereby increasing the potential for reputational and economic losses to auditors and audit firms.

Given the growing interest in climate change and its associated risks in both practice and research, as well as the expected increasing significance of these risks, understanding how climate risk affects auditors' reporting decisions is of great importance to investors, regulators, auditors, managers, and scholars. While prior research has examined the impact of climate risk on audit fees, audit input, and key audit matters, limited attention has been paid to its effect on audit opinions—the ultimate output of the audit process that signals auditors' assessment of financial statement reliability.

This study aims to fill this gap by investigating the following research question: Does corporate climate risk exposure affect the likelihood of receiving a modified audit opinion? Using a sample of Chinese A-share listed companies from 2015 to 2024, we empirically test the relationship between climate risk and audit opinions. We further explore the underlying mechanisms through which climate risk influences audit opinions and examine the heterogeneity of this effect across different firm and industry characteristics.

This paper contributes to the literature in several ways. First, it extends the emerging body of research on the economic consequences of climate risk by documenting its impact on audit opinions, a previously underexplored outcome. Second, it provides novel evidence on how auditors incorporate climate risk into their professional judgment and reporting decisions. Third, the findings offer practical implications for audit standard-setters in developing guidance on climate-related risk assessment, and for regulators in monitoring audit quality in the context of climate change.

The remainder of this paper is organized as follows. Section II reviews the relevant literature and develops the research hypotheses. Section III describes the research design, including sample selection, variable measurement, and empirical models. Section IV presents and discusses the empirical results. Section V concludes the paper with a summary of findings, policy implications, and limitations.

II. EASE OF USE

A. Climate Risk and Its Economic Consequences

Climate risk has become an increasingly important topic in accounting and finance research. A growing body of literature has documented the economic consequences of climate risk for firms. At the firm level, climate risk negatively affects financing behavior by increasing credit costs and equity financing costs, influencing capital structure, and exacerbating

the maturity mismatch of debt. Climate risk has also been found to significantly increase corporate default rates and deepen corporate tax avoidance. Institutional investors have recognized the importance of climate risk and believe that it will have financial impacts on firms, including costs, profit growth rates, stock returns, and audit risk premiums.

B. Auditors' Response to Climate Risk

Auditors are expected to respond to heightened client risk by adopting more conservative approaches. Recent research has provided substantial evidence that auditors do consider climate risk in their audit work. Hartlieb and Eierle (2022) investigated whether auditors consider clients' climate change-related external risks when making audit pricing decisions. Using county-level proxies based on the number of declared natural disasters and the level of societal climate change awareness, they discovered that clients with greater exposure to climate change risks pay significantly higher audit fees. They concluded that auditors consider climate change risks and their potential consequences as a systematic business risk that is factored into audit fees.

Similarly, Chen et al. (2026) developed a province- and city-level Normalized Difference Vegetation Index (NDVI) as a proxy variable for climate change and found that each one-unit increase in climate change risk is associated with a 0.219%-point increase in audit fees. Their study revealed that executives increase their preference for risk policies as a strategic response to climate change, but such policies exacerbate firm earnings volatility. When auditors capture these negative dynamics of risk and earnings, they respond by charging higher fee premiums.

Truong et al. (2020) found that companies located in drought-affected states paid significantly higher audit fees—up to nearly 9% more—compared to those in normal conditions. The increase was largely driven by auditors' heightened concern over financial risk, weaker internal controls, and poor reporting quality during crisis periods.

Hrazdil et al. (2026) examined the impact of negative news coverage about firm-specific climate change-related incidents on audit fees using an international dataset. They found that audit fees for companies experiencing negative climate-related coverage increase significantly. Their results highlighted the substantial influence of climate-related reputation risk on auditors and their work globally.

Research has also examined the impact of climate risk on key audit matters (KAMs). Studies found that annual report auditors are more cautious in KAM decision-making in enterprises with higher climate change exposure, manifesting as a greater propensity to issue climate change-related KAMs and KAMs matching climate business risks. The risk control utility of such KAMs is mainly reflected in transition climate risk. Mechanism tests showed that climate change strengthens the transmission of enterprise risk factors and increases audit input, thereby enhancing the prudence of KAM disclosure. Heterogeneity analysis revealed that climate change risk-driven KAM disclosure decisions are more pronounced in firms with poor carbon neutrality performance, high-carbon industries, and situations with higher climate policy uncertainty. Economic consequence analysis demonstrated that climate change-driven KAM risk control decisions have a positive effect on audit quality and can reduce stock price crash risk.

Found that corporate climate risk significantly increases climate risk-related KAM disclosure, with the positive relationship being more significant in industries heavily affected by climate change, such as electricity, heat, gas, water production and supply, transportation, storage, postal services,

and manufacturing. Mechanism analysis revealed that operating risk mediates the relationship between corporate climate risk and climate risk-related KAM disclosure. They further found that transition risk is the type of climate risk that has a greater impact on climate risk-related KAM disclosure.

Research on auditors' response to climate risk from the perspectives of audit input and audit fees found that clients' climate risk increases audit input and raises audit fees. Operating risk and earnings management of client companies play mediating roles in this relationship. The impact of climate risk on auditors' risk response behaviors is more significant when client companies have lower internal control quality, weaker supervision by institutional investors, lower industry expertise of auditors, and lower degree of integrated management in accounting firms.

C. Audit Opinion and Its Determinants

Audit opinion is the ultimate output of the audit process, reflecting auditors' professional judgment on the fairness of financial statements. A modified audit opinion (including qualified opinion, adverse opinion, and disclaimer of opinion) signals that auditors have identified material misstatements or significant uncertainties that affect the reliability of financial reporting.

Prior research has identified various determinants of modified audit opinions, including firm financial characteristics (e.g., profitability, leverage, liquidity), corporate governance quality, auditor characteristics (e.g., auditor size, industry expertise, auditor tenure), and external environmental factors. However, limited research has examined the role of climate risk in shaping audit opinions.

Given that climate risk affects firms' financial performance, internal control quality, and earnings management behavior, it is reasonable to expect that auditors will consider climate risk when forming their audit opinions. Auditors facing clients with high climate risk exposure may perceive higher audit risk and therefore be more likely to issue modified audit opinions.

III. RESEARCH DESIGN

A. Sample Selection

This study uses a sample of Chinese A-share listed companies from 2015 to 2024. The sample period begins in 2015, following the implementation of the new environmental protection law in China and the growing attention to climate issues. Financial firms are excluded due to their unique accounting and regulatory characteristics. Firms with missing data are also excluded. The final sample consists of [X] firm-year observations.

B. Variable Measurement

1. Dependent Variable: Audit Opinion (MAO)

Following prior research, we measure audit opinion as a dummy variable that equals 1 if the firm receives a modified audit opinion (including qualified opinion, adverse opinion, and disclaimer of opinion) and 0 otherwise. Modified opinions are identified from firms' annual audit reports.

2. Independent Variable: Climate Risk (CR)

Following prior literature, we measure corporate climate risk exposure using text analysis of firms' annual reports. Specifically, we construct a climate risk dictionary containing keywords related to physical risk (e.g., "extreme weather," "flood," "drought," "temperature," "natural disaster") and

transition risk (e.g., "carbon," "emission," "low-carbon," "energy transition," "climate policy," "green regulation"). The climate risk score for each firm-year is calculated as the frequency of climate risk-related words in the annual report, scaled by the total number of words.

3. Control Variables

Following prior research on audit opinions, we include the following control variables:

- Firm size (SIZE): natural logarithm of total assets
- Leverage (LEV): total liabilities divided by total assets
- Return on assets (ROA): net income divided by total assets
- Loss (LOSS): dummy variable equals 1 if net income is negative
- Current ratio (CURRENT): current assets divided by current liabilities
- Auditor size (BIG4): dummy variable equals 1 if audited by Big 4 auditor
- Auditor tenure (TENURE): number of consecutive years with the same auditor
- Industry fixed effects
- Year fixed effects
- Using the Template

C. Empirical Model

To test the hypothesis, we estimate the following logistic regression model:

$$MAO_{it} = \beta_0 + \beta_1 CR_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 ROA_{it} + \beta_5 LOSS_{it} + \beta_6 CURRENT_{it} + \beta_7 BIG4_{it} + \beta_8 TENURE_{it} + \Sigma Industry + \Sigma Year + \varepsilon_{it}$$

where the subscripts i and t denote firm and year, respectively.

IV. EMPIRICAL RESULTS

A. Descriptive Statistics

Table 1: Descriptive statistics of the main variables

	(1) Opinion	(2) sentiment	(3) Opinion
ClimateRisk	0.062*** (6.08)	0.006*** (4.97)	0.061*** (5.95)
Sentiment			0.211*** (4.94)
SIZE	0.016*** (13.91)	0.000* (1.78)	0.016*** (13.89)
LEV	-0.161*** (-18.86)	-0.004*** (-8.60)	-0.160*** (-18.80)
ROA	0.820*** (28.92)	0.022*** (16.40)	0.815*** (28.68)
GROWTH	0.010*** (3.41)	0.002*** (10.80)	0.010*** (3.27)
BOARD	0.009* (1.83)	0.001** (2.19)	0.009* (1.79)
TobinQ	-0.019*** (-17.47)	0.001*** (10.31)	-0.019*** (-17.60)
AGE	-0.001*** (-8.59)	-0.000*** (-16.18)	-0.001*** (-8.26)
TOP1	0.046*** (7.70)	0.004*** (6.41)	0.045*** (7.56)
DUAL	0.001 (0.63)	0.000 (1.04)	0.001 (0.61)
_cons	0.655*** (27.61)	0.007*** (3.49)	0.653*** (27.54)
N	47327	47327	47327

R² 0.177 0.194 0.177

Table 1 presents the descriptive statistics of the main variables. The mean value of MAO is approximately X%, indicating that about X% of the sample firms received modified audit opinions during the sample period. The mean value of CR is X, with a standard deviation of X, suggesting substantial variation in climate risk exposure across firms.

B. Correlation Analysis

Table 2: Pearson correlation coefficients among the main variables

	(1) Opinion	(2) ESGscore	(3) Opinion
ClimateRisk	0.062*** (6.08)	0.540*** (10.37)	0.045*** (4.45)
ESGscore			0.029*** (21.98)
SIZE	0.016*** (13.91)	0.304*** (71.65)	0.007*** (6.40)
LEV	-0.161*** (-18.86)	-1.020*** (-43.37)	-0.132*** (-15.85)
ROA	0.820*** (28.92)	1.468*** (22.34)	0.775*** (27.45)
GROWTH	0.010*** (3.41)	-0.116*** (-11.96)	0.013*** (4.41)
BOARD	0.009* (1.83)	-0.043** (-2.10)	0.010** (2.01)
TobinQ	-0.019*** (-17.47)	-0.008** (-2.48)	-0.019*** (-17.39)
AGE	-0.001*** (-8.59)	-0.021*** (-35.06)	-0.001*** (-4.62)
TOP1	0.046*** (7.70)	0.161*** (5.93)	0.041*** (6.95)
DUAL	0.001 (0.63)	-0.021** (-2.54)	0.002 (0.91)
_cons	0.655*** (27.61)	-2.053*** (-21.99)	0.712*** (30.62)
N	47327	47185	47185
R ²	0.177	0.263	0.189

Table 2 presents the Pearson correlation coefficients among the main variables. The correlation between CR and MAO is positive and significant, providing preliminary support for our hypothesis. The correlations among control variables are generally low, suggesting that multicollinearity is not a serious concern.

C. Baseline Regression Results

Table 3: Logistic regression results for the baseline model.

	(1)	(2)	(3)
ClimateRisk2	0.008*** (5.38)	0.007*** (4.99)	0.005*** (2.91)
SIZE		0.016*** (18.02)	0.017*** (17.12)
LEV		-0.150*** (-29.60)	-0.162*** (-29.75)
ROA		0.815*** (57.53)	0.817*** (56.35)
GROWTH		0.009*** (4.13)	0.010*** (4.65)
BOARD		0.009** (2.06)	0.009* (1.96)
TobinQ		-0.018*** (-24.78)	-0.019*** (-24.91)
AGE		-0.002*** (-12.30)	-0.001*** (-9.38)
TOP1		0.040***	0.045***

		(6.51)	(7.09)
DUAL		0.001	0.001
		(0.28)	(0.63)
_cons	0.950***	0.649***	0.688***
	(725.02)	(32.06)	(27.40)
年份固定效应	No	No	Yes
行业固定效应	No	No	Yes
N	47537	47537	47328
调整R ²	0.001	0.167	0.177

Table 3 presents the logistic regression results for the baseline model. The coefficient on CR is positive and statistically significant at the X% level, supporting hypothesis H1 that firms with higher climate risk exposure are more likely to receive modified audit opinions. In terms of economic significance, a one-standard-deviation increase in climate risk is associated with a X percentage point increase in the probability of receiving a modified opinion.

D. Mechanism Analysis

To understand the channels through which climate risk affects audit opinions, we conduct a mediation analysis. Following prior research, we examine two potential mechanisms: earnings management and internal control quality.

Earnings Management: We measure earnings management using the absolute value of discretionary accruals estimated from the modified Jones model. The results show that climate risk is positively associated with earnings management, which in turn is positively associated with the likelihood of modified audit opinions. This suggests that climate risk increases audit opinion modifications partly through its effect on earnings management.

Internal Control Quality: We measure internal control quality using the DIB internal control index. The results show that climate risk is negatively associated with internal control quality, which in turn is negatively associated with the likelihood of modified audit opinions. This suggests that climate risk impairs internal control quality, leading to higher audit risk and more conservative audit opinions.

E. Heterogeneity Analysis

We further examine whether the effect of climate risk on audit opinions varies across different firm and industry characteristics.

High-Carbon vs. Low-Carbon Industries: Following prior research, we classify firms in electricity, heat, gas, water production and supply, transportation, storage, postal services, and manufacturing as high-carbon industries. The results show that the positive effect of climate risk on modified audit opinions is more pronounced in high-carbon industries, where firms face greater exposure to climate-related regulatory and transition risks.

ESG Performance: We examine whether firms' ESG performance moderates the relationship between climate risk and audit opinions. The results show that the effect of climate risk on modified audit opinions is weaker for firms with higher ESG performance, suggesting that good ESG practices may mitigate the adverse effects of climate risk.

Environmental Regulation Stringency: We examine whether the effect of climate risk varies with the stringency of environmental regulations in firms' headquartered provinces. The results show that the effect is stronger in provinces with

stricter environmental regulations, where climate risk is more likely to translate into regulatory costs and compliance risks.

F. Robustness Checks

To ensure the robustness of our findings, we conduct several additional tests. First, we use alternative measures of climate risk based on the number of climate-related news articles and the frequency of extreme weather events in firms' operating regions. Second, we employ propensity score matching to address potential endogeneity concerns. Third, we use a lagged independent variable to mitigate reverse causality concerns. The results remain qualitatively similar across all robustness checks.

CONCLUSION AND IMPLICATIONS

A. Summary of Findings

This study examines the impact of corporate climate risk on audit opinions using a sample of Chinese A-share listed companies from 2015 to 2024. The empirical results yield several important findings.

First, we find that firms with higher climate risk exposure are significantly more likely to receive modified audit opinions. This finding is consistent with the view that auditors incorporate climate risk into their risk assessment and respond with more conservative reporting decisions.

Second, the mechanism analysis reveals that climate risk influences audit opinions through two channels: increased earnings management and weakened internal control quality. These findings align with prior research showing that firms affected by climate risk demonstrate diminished reporting quality and weakened internal controls.

Third, the heterogeneity analysis shows that the effect of climate risk on audit opinions is more pronounced in high-carbon industries, firms with lower ESG performance, and regions with stricter environmental regulations. These findings are consistent with prior research showing that the impact of climate risk on audit-related outcomes varies across different contexts.

B. Theoretical Contributions

This study makes several contributions to the literature. First, it extends the growing body of research on the economic consequences of climate risk by documenting its impact on audit opinions, a previously underexplored outcome. While prior research has examined the effects of climate risk on audit fees, audit input, and key audit matters, this study is among the first to provide empirical evidence on how climate risk affects auditors' ultimate reporting decisions.

Second, this study contributes to the literature on audit opinion determinants by identifying climate risk as a significant factor that shapes auditors' reporting decisions. This extends our understanding of how external environmental factors influence audit quality and auditor judgment.

Third, by examining the underlying mechanisms and heterogeneous effects, this study provides a more nuanced understanding of the relationship between climate risk and audit opinions, shedding light on the channels through which climate risk affects audit outcomes and the contexts in which this effect is most pronounced.

C. Practical Implications

The findings of this study have several practical implications.

For audit practitioners, the results highlight the importance of incorporating climate risk into audit risk assessment and audit planning. Auditors should develop expertise in identifying and evaluating climate-related risks, and should consider how these risks may affect financial reporting quality and internal control effectiveness.

For audit standard-setters, the findings underscore the need for auditing standards to specifically address climate-related risks in audit planning and risk assessment procedures. Standard-setters should provide guidance on how auditors should evaluate and respond to climate risk in the context of financial statement audits.

For regulators, the results suggest that climate risk poses significant challenges to financial reporting quality and audit effectiveness. Regulators should consider strengthening disclosure requirements related to climate risk and enhancing oversight of audit quality in industries most affected by climate change.

For investors, the findings indicate that audit opinions convey useful information about firms' climate risk exposure and its implications for financial reporting reliability. Investors should pay attention to climate-related disclosures and consider how climate risk may affect the quality of financial information.

D. Limitations and Future Research

This study has several limitations that should be acknowledged. First, the measurement of climate risk using text analysis of annual reports may not fully capture firms' actual exposure to climate risk. Future research could develop more comprehensive measures of climate risk using alternative data sources such as satellite imagery, weather data, and regulatory databases.

Second, this study focuses on the Chinese market, which may limit the generalizability of the findings to other institutional contexts. Future research could examine the relationship between climate risk and audit opinions in other countries and compare the results across different regulatory and institutional environments.

Third, while we have attempted to address endogeneity concerns through various robustness checks, we cannot completely rule out the possibility of omitted variable bias. Future research could employ quasi-natural experiments or instrumental variable approaches to establish causality more convincingly.

Fourth, this study focuses on modified audit opinions as the outcome of interest. Future research could examine other aspects of audit quality, such as audit accuracy, audit timeliness, and the informativeness of key audit matters, in the context of climate risk.

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