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EDITED BY
Sadia Samar Ali,
King Abdulaziz University, Saudi Arabia

REVIEWED BY
Lan Wang,
University of the Arts London, United Kingdom
Kai Huang,
Massey University, New Zealand
Yousen Jin,
Nanjing University of Science and Technology, China

*CORRESPONDENCE
Jiaqi Lu,
2022000134@stumail.dufe.edu.cn

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The impact of climate policy uncertainty on corporate green governance

Quanan Fu[1], Shanshan Ding[2], Xiaonan Wu[3] and Jiaqi Lu[1]*

[1]School of Accounting, Dongbei University of Finance and Economics, Dalian, Liaoning, China, [2]School of Accounting, Tongling University, Tongling, Anhui, China, [3]School of Business, Liaoning University, Shenyang, Liaoning, China

Introduction: Climate policy uncertainty plays a crucial role in shaping corporate green strategic decisions. However, the mechanisms through which this uncertainty influences corporate green governance and its boundary conditions remain underexplored. This study aims to fill this gap by examining the effect of climate policy uncertainty on corporate green governance in China. Using data from Chinese A-share listed companies between 2009 and 2023, the paper investigates how this uncertainty drives changes in corporate green behavior.
Method: To examine the impact of climate policy uncertainty on corporate green governance, we employ a rigorous two-way fixed effects model.
Results: The results reveal a significant positive impact of climate policy uncertainty on the level of corporate green governance. This effect is particularly pronounced in state-owned enterprises, firms with lower appeal to green investors, and companies operating in highly competitive sectors. Mechanism analyses indicate that the positive impact operates through three main channels: enhancing executives' green cognition, reducing managerial myopia, and improving the quality of environmental information disclosure. Furthermore, the results show that these factors collectively optimize corporate green governance structures, contributing to improved corporate environmental behavior.
Discussion: The findings provide important theoretical and empirical insights into the role of climate policy uncertainty in shaping corporate environmental decisions. By identifying the channels through which uncertainty influences corporate behavior, the study contributes to a deeper understanding of the drivers behind corporate green governance. Additionally, the paper highlights the significance of government climate policies in fostering effective corporate environmental strategies, suggesting that policies should be designed with an understanding of the mechanisms that facilitate governance optimization under uncertainty.

KEYWORDS
climate policy uncertainty, environmental information disclosure, executives' green cognition, green governance, managerial myopia

1 Introduction

With the increasing frequency of natural disasters and extreme weather events associated with global warming, climate change has escalated from a theoretical scientific concern to an immediate threat to global stability and development (Newman and Noy, 2023). While a consensus exists within the international community regarding the

urgency of climate action, the governance of climate risk is inherently complex due to its nature as a global public good. This complexity is compounded by persistent international political and economic negotiations, which drive continuous adjustments to national climate policies and foster significant uncertainty in climate policy (Khan and Munira, 2021). For national and regional governments, this uncertainty shapes the pathways for energy transition, influences the pace of industrial restructuring, and affects the setting of long-term emissions targets. For individual firms, it manifests as ambiguity in future regulatory frameworks, technical standards, market access, and financing conditions, thereby directly impacting strategic planning, investment decisions, and operational performance (Teeter and Sandberg, 2017). A systematic investigation into climate policy uncertainty is therefore critical for scholars, policymakers, and business leaders alike.

Within the global climate governance framework, China, as the world's largest greenhouse gas emitter and a significant clean energy market, plays a pivotal role in achieving global temperature control targets (Li et al., 2025). This study specifically focuses on uncertainty regarding policy stringency within the context of China's 'Dual Carbon' goals. These national targets provide a predictable long-term trajectory for emissions reduction and green development. While uncertainty in policy direction may trigger a wait-and-see effect, the persistent expectation of increasingly strict regulations primarily activates precautionary motives within Chinese firms. This form of uncertainty reflects the unpredictable timing and intensity of future regulatory tightening in China's evolving policy landscape. Consequently, firms strengthen their green governance systems to preemptively manage future compliance costs and regulatory risks. The uniqueness of its institutional context lies precisely in its construction of a state-led, market-participatory, and continuously evolving governance system. The inherent "policy uncertainty" generated by this ongoing evolution makes China an ideal setting for examining related impacts.

Climate policy uncertainty exerts significant influence on green governance at both regional and corporate levels. Drawing on sustainability theory, forward-looking enterprises respond to evolving policy conditions by proactively integrating green governance into their long-term development strategies (Zeng and Rojniruttikul, 2025). These firms establish environmental management systems and sustainability committees to institutionalize their response mechanisms, thereby enhancing organizational resilience to policy fluctuations. At the regional level, this uncertainty motivates local governments to accelerate the development of comprehensive green policy frameworks. Through technical guidance and service platforms, they steer businesses from passive compliance toward active environmental stewardship. From an information asymmetry perspective, corporations address decision-making challenges stemming from opaque policy signals by implementing environmental monitoring systems and strengthening policy analysis capabilities. Many firms voluntarily disclose their sustainability performance through social responsibility reports, effectively signaling their commitment to green governance and transparency to stakeholders (Chijoke-Mgbame et al., 2020). Simultaneously, regional authorities are working to reduce information gaps by establishing corporate environmental disclosure requirements and enhancing green credit systems, thereby creating favorable conditions for improved corporate green governance.

Confronting the external challenge of climate policy uncertainty, passive adaptation represents a suboptimal strategy for firms. The true solution lies in proactively transforming external pressures into endogenous drivers for change. This paradigm shift constitutes the core value of corporate green governance. Unlike simple environmental technologies or end-of-pipe solutions, corporate green governance entails the comprehensive integration of green, low-carbon, and sustainable development principles into corporate governance structures and strategic decision-making processes (Aguilera et al., 2021). It establishes a sustainable operational system spanning R&D, production, supply chain management, and marketing, ultimately aiming to build competitive advantage through green innovation and achieve long-term value creation through environmental stewardship (Bataineh et al., 2024). Consequently, identifying effective pathways to enhance corporate green governance transcends individual corporate risk management and sustainable development. It establishes the crucial micro-foundation for transitioning the entire socioeconomic system toward low-carbon patterns and achieving high-quality development objectives. The contemporary context renders the investigation of pathways for enhancing green governance particularly urgent.

This context naturally raises a fundamental research question: What inherent relationship exists between climate policy uncertainty, as an external macro-level challenge, and corporate green governance, as an internal micro-level response? Does such uncertainty suppress corporate motivation to advance green governance, or does it instead create a "forcing mechanism" that pressures firms to strengthen governance practices to mitigate risks and pursue new growth opportunities?

Elucidating the impact mechanism of climate policy uncertainty on corporate green governance carries significant theoretical and practical implications. Theoretically, this research bridges the gap between macro-level policy environments and micro-level corporate governance behavior, thereby enriching and expanding the application of sustainability theory and corporate governance theory in climate economics. Practically, the findings provide policymakers with scientific evidence to design more stable, predictable, and effective climate policy frameworks. Simultaneously, they offer managerial insights for corporate leaders to identify opportunities within uncertainty, mitigate policy risks through enhanced green governance, and secure first-mover advantages in green competition, thereby achieving synergistic improvement in economic, environmental, and social performance.

The marginal contributions of this study are threefold. First, in terms of research perspective, while existing literature primarily examines the isolated impacts of climate policy uncertainty on specific corporate activities such as investment levels or technological innovation, this study shifts the focus to the more fundamental and systematic framework of "corporate green governance," revealing how external policy pressure drives synergistic improvements in strategic cognition, internal governance, and information disclosure. Second, regarding the mechanisms of influence, this study is the first to empirically test the three parallel transmission channels of "executives' green

awareness," "managerial myopia," and "environmental information disclosure quality." This finding redirects the understanding of climate policy uncertainty's impact from macro-level corporate actions to micro-level cognitive and decision-making processes, clarifying the specific pathways through which it enhances internal governance efficacy. Third, concerning the contextual conditions, this study finds that the governance-enhancing effect of climate policy uncertainty is more pronounced in state-owned enterprises, firms less attractive to green investors, and those in highly competitive industries. This heterogeneity precisely delineates the boundary conditions of policy effectiveness, identifying which types of firms are more responsive to policy pressure, thereby providing a crucial supplement to understanding its complex effects.

2 Literature review

Existing research suggests that climate policy uncertainty has a profound influence on corporate strategic decisions and daily operations; however, the direction of its impact and the underlying mechanisms are complex and heterogeneous.

Regarding investment and efficiency, findings present a mixed picture of both "optimization" and "inhibition." Some studies, such as Huang and Kou (2024) based on Chinese data, suggest that CPU may create a "forcing effect," compelling firms to evaluate investment opportunities more prudently, thereby enhancing investment efficiency. However, a greater number of studies point to its inhibitory effects. Chang et al. (2024) found that CPU reduces investment levels in U.S. energy firms, while Ren et al. (2022) confirmed that CPU damages the total factor productivity of Chinese enterprises by hindering R&D investment and worsening cash flow. Furthermore, existing literature shows that CPU significantly inhibits corporate green governance and environmental performance, but this negative causal relationship is moderated by firm heterogeneity. CPU primarily suppresses corporate green investment, innovation, and ESG performance through channels such as exacerbating financing constraints and inducing managerial short-termism (Ge and Zhang, 2025; Hu et al., 2023; Zhou et al., 2024). However, this negative relationship is not absolute. Some studies indicate that a moderate level of CPU may generate a "forcing effect" or be transformed into an impetus for innovation. For example, Dai et al. (2025) discovered an inverted U-shaped nonlinear relationship between CPU and green performance, meaning moderate uncertainty may incentivize innovation, whereas excessively high uncertainty leads to performance decline.

In the areas of ESG, information disclosure, and corporate governance, the influence of CPU also presents a nuanced picture. On one hand, it may bring positive corporate governance effects. For instance, Liu R. et al. (2025) found that CPU corrects analysts' overly optimistic earnings forecasts for energy firms, improving forecast accuracy; Tran (2025) also discovered that high CPU inhibits corporate earnings management behavior. On the other hand, CPU may also induce opportunistic behavior. The research by Cheng and Wu (2025) reveals that CPU exacerbates corporate ESG greenwashing through means such as manipulating information disclosure and exploiting rating disparities.

Furthermore, in China, state-owned enterprises (SOEs), which benefit from policy support and resource buffers, experience a weaker negative impact from the COVID-19 pandemic on their green performance (Ge and Zhang, 2025; Zhang K. et al., 2024). In contrast, non-state-owned enterprises and highly polluting firms are more sensitive to it (Dai et al., 2025; Meng et al., 2025). Additionally, a firm's internal governance and ownership structure shape its strategic response to CPU. Sound corporate governance, combined with concentrated managerial power and a strong sense of social responsibility among top executives, enhances the efficiency of green governance (Amore and Bennedsen, 2016; Yi et al., 2023). Ownership structures with a long-term orientation (e.g., long-term institutional investors) typically have a positive influence on environmental performance (Kavadis and Thomsen, 2023).

The internal allocation of power and the characteristics of leadership are key factors determining a firm's green commitment. First, the overall quality of corporate governance is crucial. Amore and Bennedsen (2016) utilized a quasi-experimental design based on changes in U.S. anti-takeover laws to demonstrate that firms with weaker governance produce significantly less green innovation, revealing that sound corporate governance is a prerequisite for environmental benefits. Second, specific governance mechanisms act in a synergistic manner. From a stakeholder-agency perspective, Kock et al. (2012) found that mechanisms such as board oversight and managerial incentives help align the interests of stakeholders and managers regarding environmental activities, thereby enhancing environmental performance. Furthermore, the role of top management is paramount. Through input-output efficiency analysis, Yi et al. (2023) found that CEOs with concentrated power can more effectively mobilize corporate resources to improve green governance efficiency, and this relationship is strengthened when the CEO possesses a strong sense of social responsibility.

As external regulators and allocators of resources, governments significantly influence corporate green governance. On the one hand, government governance at the macro level is an important driver. Wang and Wang (2023) demonstrated, in the context of China's vertical environmental management system, that provincial-level green governance has a significant positive impact on green investment in highly polluting firms, with government subsidies playing a key mediating role. On the other hand, the personal characteristics of government officials can have a micro-level impact. The innovative study by Xu et al. (2025) introduced the concept of "green officials," finding that the appointment of local chief executives with environmental backgrounds significantly and persistently enhances the green innovation levels of firms within their jurisdiction through channels such as providing environmental subsidies and attracting external green investors.

Based on the literature review above, existing studies have extensively explored the inhibitory effects of climate policy uncertainty on green governance. However, their findings are significantly divergent. Most focus on localized or short-term impacts on specific corporate operations. These studies have not yet integrated green governance from the perspective of management governance. Our research demonstrates that climate

policy uncertainty does not suppress, but instead significantly enhances, the level of corporate green governance. This conclusion offers new evidence from the core of corporate governance, providing insight into the economic consequences of climate policy uncertainty. It forcefully challenges the prevailing pessimistic narrative that frames such uncertainty as a hindrance. Furthermore, it reveals its positive role in driving profound, systematic corporate transformation. Thus, this study makes a distinct contribution by helping to reconcile theoretical disagreements in the existing literature.

3 Theoretical analysis and hypotheses

Uncertainty in climate policy serves as a critical catalyst for strategic reevaluation among corporate leaders (Haigh and Griffiths, 2012). When confronted with such regulatory ambiguity, senior executives are compelled to move beyond treating environmental issues as peripheral compliance matters and engage in deeper, strategic reflection (Doyle et al., 2014). This shift in perspective is both fundamental and transformative, as it leads managers to recognize that the transition to a green economy is not merely an option but an inevitable macro-trend. Consequently, climate-related concerns, which were once dismissed as externalities, are now repositioned as central determinants of long-term corporate survival and competitiveness. This cognitive realignment effectively narrows the "psychological distance" that executives perceive regarding climate issues, transforming them from passive recipients of policy into proactive architects of future scenarios (Szymczak et al., 2025).

As executives internalize the strategic importance of green development, this cognitive evolution translates into concrete organizational actions. With a clarified understanding of the imperatives of sustainability, management gains strong intrinsic motivation to reallocate resources toward building long-term environmental competitive advantages (Tu and Wu, 2021). This realignment manifests directly in corporate investment behavior (Zhang et al., 2025), such as increased willingness to fund green technology innovation and environmental facility upgrades—projects characterized by high initial outlays but significant strategic value. Such investments are no longer categorized as operational costs but are reframed as essential strategic expenditures to mitigate future policy risks and secure operational legitimacy (Ji and Zhang, 2024). Beyond capital allocation, a deeper cognitive shift also drives firms to pursue innovation efficiency—not only increasing R&D investments but also optimizing innovation processes to enhance green total factor productivity (Ji et al., 2025). Furthermore, executives' renewed environmental awareness influences their leadership approach (Omarova and Jo, 2022), encouraging them to adopt roles as "environmental stewardship leaders". Through personal example, institutional mechanisms, and targeted resource support, they embed sustainability values into organizational culture, thereby activating employee-driven eco-innovation and establishing a robust micro-foundation for green governance. This cognitively driven strategic intent must be institutionalized through structured mechanisms to become a sustainable governance capability.

Climate policy uncertainty stems from the ambiguity, frequent volatility, and inconsistent enforcement of regulations, carbon pricing mechanisms, and energy transition targets adopted by governments to address climate change (Borozan and Pirgaip, 2024). Rather than inevitably leading firms to shirk their environmental responsibilities, such uncertainty may prompt a fundamental reassessment of their strategic horizons. While firms tend to delay irreversible traditional capital expenditures in highly uncertain environments, green governance investments possess significant strategic foresight and environmental adaptability. Consequently, fluctuations in climate policy may instead stimulate preventive innovation motives as a means of mitigating potential transition risks (Kolk and Pinkse, 2004).

In a stable policy environment, managers often face pressures from quarterly performance evaluations and shareholder return expectations (Lochmann and Steger, 2002), leading them to prioritize short-term gains and reduce long-term investments in green governance (Sewchurran et al., 2019; Ortiz-de-Mandojana and Bansal, 2016). In contrast, when confronted with climate policy uncertainty, management must account for potential compliance risks, stranded assets, and reputational damage arising from future policy shifts (Meng et al., 2025). This heightened awareness of long-term risks extends the decision-making horizon beyond immediate financial metrics, thereby effectively curbing myopic tendencies.

Furthermore, policy uncertainty alters managerial risk perceptions by highlighting the potential for elevated transition costs and operational disruptions if green governance is neglected (Ginglinger and Moreau, 2023). As investors, consumers, and other stakeholders increasingly prioritize environmental accountability, myopic decisions may result in higher capital costs and diminished market competitiveness (Peng and Yan, 2025). This shift in risk perception encourages managers to recalibrate the trade-offs between short-term returns and long-term value, reducing environmentally detrimental short-term behaviors.

More critically, when management recognizes that green investments not only mitigate future policy risks but also establish first-mover advantages once policies crystallize, green governance is reframed as a pathway to long-term value creation. This transformation in incentive structures turns managers from passive compliance actors into proactive value creators, significantly enhancing their intrinsic motivation to advance green governance.

In the context of deeply intertwined globalization and sustainable development agendas, corporate green governance has emerged as a core mechanism for addressing environmental challenges and achieving dual-carbon goals. Green governance not only pertains to the fulfillment of corporate environmental responsibilities but also reflects the directional, systematic, and effective allocation of long-term strategic resources. However, the enhancement of corporate green governance is often constrained by multiple factors, among which climate policy uncertainty constitutes an external constraint environment for strategic decision-making, potentially stimulating preventive motivation and prompting firms to reassess their strategic horizons (Wang et al., 2025). When policy directions remain unclear, companies face significant pressures from future compliance risks, asset stranding threats, and reputational capital erosion (Liu W. et al., 2025). These pressures compel management to integrate climate factors into core strategic considerations, and environmental information disclosure, as the

primary channel for conveying environmental risk perceptions and management effectiveness to external stakeholders, becomes a rational choice for coping with external uncertainty (Zou et al., 2025). Consequently, policy uncertainty initially drives improvements in the transparency and completeness of environmental information disclosure through heightened risk perception and strategic foresight requirements.

Furthermore, in a stable policy environment, management, driven by short-term performance evaluations and shareholder return pressures, may tend toward selective disclosure, oversimplified environmental information, or even greenwashing (Yang et al., 2025). However, the presence of policy uncertainty introduces powerful external constraints: on one hand, investors, regulators, and the public pay closer attention to corporate performance under uncertain conditions (Bin-Feng et al., 2024), amplifying the consequences of information asymmetry. Failure to provide high-quality environmental information may be perceived by the market as a lack of strategic foresight, leading to increased capital costs or downgrades in ESG ratings (Luo et al., 2019; Feng and Wu, 2023). On the other hand, policy shifts signal future tightening of mandatory disclosure requirements. For instance, recent initiatives such as the *Guidelines for Sustainability Reporting of Listed Companies* issued by stock exchanges and the *Exposure Draft of Corporate Sustainability Disclosure Standards No. 1 – Climate (Trial)* released by the Ministry of Finance establish comprehensive disclosure frameworks spanning governance, strategy, risk management, and metrics. To avoid high adaptation costs resulting from sudden policy changes, firms proactively improve disclosure quality to accumulate "compliance credibility" and "information disclosure capital."

High-quality environmental information disclosure requires companies to systematically assess environmental risks (Li et al., 2022), establish internal management processes, set quantifiable targets, and subject themselves to external oversight (Zhang Z. et al., 2024). This process inherently refines green governance capabilities. Specifically, when firms are compelled to disclose greenhouse gas emissions, climate risk management procedures, and emission reduction targets, management must first develop corresponding internal measurement, monitoring, and reporting systems (Sullivan, 2009). This transforms external disclosure requirements into internal management needs, directly promoting the enhancement of green governance structures—such as establishing dedicated sustainability committees or incorporating climate performance into executive compensation metrics.

Research indicates that detailed and reliable environmental information disclosure can send positive signals to the market, alleviating financing constraints caused by information asymmetry (Tian et al., 2025), thereby enabling firms to allocate more substantial resources to green technology innovation and governance structure optimization. Simultaneously, the disclosure process itself serves as a comprehensive audit of corporate environmental impact, helping firms identify emission reduction opportunities, optimize resource allocation (Zhong and Jin, 2025), and ultimately support long-term green governance investments through improved operational performance.

Ultimately, the refinement of internal governance structures and the formation of external resource support collectively contribute to the systematic enhancement of corporate green governance. When companies establish robust internal measurement and management systems and secure necessary internal and external resources, they become more inclined to adopt forward-looking green strategies, such as increasing investments in green patent research and development, implementing lifecycle management practices, and advancing low-carbon transitions. Conversely, low-quality disclosure or greenwashing behaviors are more likely to be detected and penalized in high policy uncertainty environments, further incentivizing substantive green governance efforts.

Based on the conceptual framework above, climate policy uncertainty serves as a critical external stimulus that prompts a fundamental strategic reassessment within firms. It catalyzes this process by enhancing senior executives' green cognition, curbing managerial myopia, and incentivizing higher-quality environmental information disclosure. These intermediate changes collectively drive the systematic improvement of corporate green governance. Consequently, the following hypotheses are proposed to formalize these relationships:

Hypothesis 1: Climate policy uncertainty has a significant positive effect on the level of corporate green governance.

Hypothesis 2: Climate policy uncertainty promotes the level of corporate green governance by enhancing executives' green cognition.

Hypothesis 3: Climate policy uncertainty promotes the level of corporate green governance by reducing managerial myopia.

Hypothesis 4: Climate policy uncertainty promotes the level of corporate green governance by improving the quality of corporate environmental information disclosure.

Based on the above analysis and hypothesis, we drew Figure 1 to illustrate the mechanism proposed in this paper.

4 Research design

4.1 Research data

This study utilizes data from Chinese listed companies spanning 2009 to 2023 as the initial sample. To mitigate potential confounding effects arising from the substantial revisions to Chinese accounting standards in 2007 and the global financial crisis of 2008, the sample period commences in 2009. The data are primarily sourced from the CSMAR and CNRDS databases. Observations from financially distressed (i.e., ST-status) firms, financial institutions, and those with missing values are excluded. To minimize the influence of outliers, all continuous variables are winsorized at the 1st and 99th percentiles. The final sample consists of 32,101 firm-year observations.

4.2 Variable definition and model specification

4.2.1 Dependent variable

Following the approach of Wang and Xiao (2025), this study employs the Janis–Fadner (J–F) coefficient to measure corporate

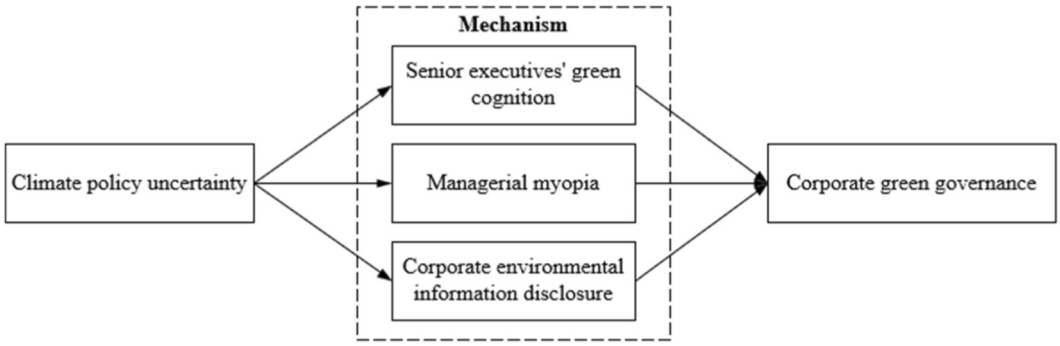

FIGURE 1
Mechanism research.

green governance performance (*GGP*), based on firms' positive and negative scores in green governance involvement. The specific calculation is presented in Equation 1:

$$GGP = \begin{cases} \frac{p^2 - p \times |q|}{r^2}, p > |q| \\ \frac{p \times |q| - q^2}{r^2}, p < |q| \\ 0, p = |q| \end{cases} \quad (1)$$

Here, p denotes the positive green governance score, calculated as the number of criteria met by a sample firm under positive assessment items (each item scored 1 point). Meanwhile, q represents the negative green governance score, derived from the number of criteria met under negative assessment items (each item scored −1 point). The variable r is defined as the sum of p and the absolute value of q, i.e., $r = p + |q|$. The GGP index ranges from −1 to 1, with higher values indicating better corporate green governance performance.

In addition, this study employs textual analysis to examine the annual reports of listed companies. Based on three dimensions—awareness of green competitive advantage, corporate social responsibility awareness, and perception of external environmental pressure—the following keywords were selected: energy conservation and emission reduction, environmental protection strategy, environmental protection philosophy, environmental management agency, environmental education, environmental training, environmental technology development, environmental audit, energy saving and environmental protection, environmental policy, environmental protection department, environmental inspection, low-carbon environmental protection, environmental protection work, environmental governance, environmental protection and environmental governance, environmental protection facilities, environmental protection-related laws and regulations, environmental pollution control.

The frequency of these keywords in the annual reports is used to construct the variable executives' environmental awareness, which measures the level of green attention in managerial decision-making. The proportion of executives' green awareness word frequency in the full text is calculated as:

$$\left(\text{Executives' green awareness word frequency} \middle/ \text{Total word count of the annual report}\right) \times 100.$$

4.2.2 Independent variable

This study adopts the China Climate Policy Uncertainty (*CPU*) index developed by Ma et al. (2023) as the primary proxy for climate policy uncertainty. Specifically, the index is quantitatively constructed by integrating manual review and deep learning techniques, following a detailed procedure: First, in terms of corpus sources, six mainstream media outlets—namely People's Daily, Guangming Daily, Economic Daily, Global Times, Science and Technology Daily, and China News Service—were selected as textual data sources based on three criteria: credibility, influence, and international reach as well as published between 2009 and 2023. Second, during the text recognition stage, the deep learning model MacBERT was employed to automatically process newspaper content, identifying and extracting keywords and text fragments related to "climate policy" and "uncertainty." Next, for index calculation, the number of news articles containing the aforementioned keywords within a given time window was counted and divided by the total number of articles published during that period to derive a raw value for climate policy uncertainty. Finally, the raw values were standardized to produce a climate policy uncertainty index suitable for empirical analysis The specific calculation of the index is presented in Equation 2:

$$CPU = \frac{3CPU_t + 2CPU_{t-1} + CPU_{t-2}}{6} \quad (2)$$

4.2.3 Control variables

In line with the approach of Luo and Lyu (2024), along with that of Han and Cheng (2025), this study selects the following variables as controls: the natural logarithm of regional GDP *per capita* (*lnGDP*), firm size (*Size*), leverage ratio (*Lev*), total asset growth rate (*AssetGrowth*), book-to-market ratio (*BM*), debt-to-equity ratio (*DER*), gross profit margin (*GrossProfit*), Tobin's Q (*TobinQ*), firm listing age (*ListAge*), and a dummy variable indicating

TABLE 1 Variable definitions.

Type	Name	Definition
Dependent variable	GGP	Corporate green governance performance
Independent variable	CPU	Climate policy uncertainty index
Control variables	lnGDP	The natural logarithm of *per capita* gross domestic product in each city
	Size	The natural logarithm of total assets
	Lev	Total liabilities/total assets
	AssetGrowth	Ratio of the change in total assets during the year to total assets at the beginning of the year
	BM	Ratio of book value to market value
	DER	Ratio of total liabilities to shareholders' equity
	GrossProfit	(Operating revenue - cost of goods sold)/Operating revenue
	TobinQ	Total market value of the firm divided by total assets
	ListAge	The natural logarithm of one plus the number of years since the firm's IPO
	Loss	An indicator variable that equals 1 if the firm reported a net loss in the previous fiscal year, and 0 otherwise

TABLE 2 Descriptive statistics results.

Variable	N	Mean	SD	p50	Min	Max
GGP	32,101	0.590	0.450	1	0	1
CPU	32,101	2.406	0.697	2.303	1.144	4.556
lnGDP	32,101	9.453	0.513	9.341	8.800	10.65
Size	32,101	22.30	1.194	22.12	20.52	24.82
Lev	32,101	0.421	0.192	0.416	0.109	0.763
AssetGrowth	32,101	0.132	0.182	0.0880	−0.112	0.622
BM	32,101	0.980	0.841	0.684	0.182	3.379
DER	32,101	0.980	0.833	0.711	0.122	3.187
GrossProfit	32,101	0.289	0.164	0.257	0.0620	0.661
TobinQ	32,101	1.940	0.961	1.617	0.953	4.522
ListAge	32,101	2.195	0.783	2.303	0.693	3.258
Loss	32,101	0.136	0.343	0	0	1

whether a firm incurred a net loss (*Loss*). Definitions of the main variables are provided in Table 1.

To empirically examine the impact of climate policy uncertainty on corporate green governance, we estimate the following regression model specified in Equation 3:

$$GGP_{i,t} = \beta_0 + \beta_1 CPU_{i,t} + \gamma Controls + Year + Firm + \varepsilon_{i,t} \quad (3)$$

In Equation 3, *GGP* denotes the level of corporate green governance performance. *CPU* represents the Climate Policy Uncertainty index, reflecting the degree of climate uncertainty in the city where a firm is located. *Controls* signifies the set of control variables. *Firm* and *Year* indicate firm- and year-fixed effects, respectively. All regressions are estimated with standard errors clustered at the firm level to control for potential within-firm correlation.

5 Empirical results and analysis

5.1 Descriptive statistics results

Table 2 presents the descriptive statistics for the key variables. The corporate green governance performance (GGP) exhibits a mean of 0.59 with a standard deviation of 0.45, ranging from 0 to 1. This considerable variation in GGP across firms is consistent with the findings reported by Wang and Xiao (2025). Similarly, the Climate Policy Uncertainty (CPU) index ranges from 1.144 to 4.556, with a mean of 2.406 and a standard deviation of 0.697, aligning with the pattern observed in Zhao et al. (2025).

5.2 Baseline results

Table 3 presents the baseline regression results. Column (1) reports the estimates without control variables, while Column (2) includes the full set of controls. The coefficient on Climate Policy Uncertainty (CPU) is consistently positive and statistically significant at the 1% level across both specifications. This result indicates that climate policy uncertainty significantly enhances corporate green governance performance, thereby providing strong support for Hypothesis 1.

5.3 Robustness tests

5.3.1 PSM

To mitigate potential sample self-selection bias, this study employs Propensity Score Matching (PSM) for validation. Following the approach of Cang and Li (2024), firms facing climate policy uncertainty levels above the annual mean are

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TABLE 3 Baseline regression.

Variable	(1) GGP	(2) GGP
CPU	0.024***	0.022***
	(3.10)	(2.93)
lnGDP		−0.007
		(-0.16)
Size		0.013
		(1.26)
Lev		0.059*
		(1.66)
AssetGrowth		−0.002***
		(-2.77)
BM		−0.009***
		(-2.75)
DER		−0.001**
		(-2.30)
GrossProfit		−0.117***
		(-3.15)
TobinQ		−0.006***
		(-3.49)
ListAge		0.034**
		(2.48)
Loss		−0.019**
		(-2.24)
Constant	0.532***	0.278
	(29.04)	(0.58)
Firm	Yes	Yes
Year	Yes	Yes
N	32,101	32,101
Adj. R^2	0.306	0.308

We report the *t*-statistics presented in parentheses below each estimated coefficient based on robust standard errors adjusted for clustering at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

designated as the treatment group. Using a logit model that incorporates all firm-level control variables as covariates, we estimate the propensity scores. One-to-one nearest neighbor matching is then applied to pair treatment and control group observations. The results of the balance test, presented in Table 4, indicate no statistically significant differences in all covariates between the matched treatment and control groups. Subsequently, regression analysis is conducted using the matched sample. As shown in Column (1) of Table 5, the results remain consistent with the baseline regression findings.

5.3.2 IV

To enhance the reliability of our regression results, we address endogeneity concerns using an instrumental variable (IV) approach. Drawing on Chen et al. (2025), we employ the lagged value of the number of extreme weather days (Htd) as an instrument for Climate Policy Uncertainty (CPU). Extreme weather serves as a key indicator of extreme climate events, and the formulation and adjustment of climate policies are closely linked to the frequency of such events. Furthermore, as a natural climatic phenomenon, extreme weather is unlikely to be directly influenced by a firm's green governance practices, thus satisfying the exogeneity condition for a valid instrument. Data on extreme weather days are sourced from the CSMAR database. The first-stage regression results, reported in Column (2) of Table 5, show a statistically significant positive correlation (at the 1% level) between the instrument (Htd) and CPU. The Cragg-Donald Wald F-statistic exceeds the critical value of 16.83, and the Kleibergen-Paap rk Wald F statistic rejects the null hypothesis of weak identification, confirming the instrument's relevance. The second-stage regression results in Column (3) of Table 5 continue to show a significant positive relationship (at the 5% level) between CPU and firm green governance (GGP), suggesting that our baseline results are robust to potential reverse causality.

5.3.3 Additional fixed effects

Considering that corporate green governance may be influenced by factors such as local economic development plans, technology policies, and industry-specific technological characteristics, we incorporate additional fixed effects into our model, following Fu (2024). Building on Equation 3, we sequentially control for industry, region, and industry-region interaction fixed effects. The regression results, presented in Columns (4), (5), and (6) of Table 5, remain statistically significant, further validating the robustness of our conclusions.

5.3.4 Higher-level clustering

To mitigate potential biases arising from heteroskedasticity and autocorrelation, our baseline regression employs standard errors clustered at the firm level. However, given that firms within the same industry or region might exhibit similar green governance behaviors, we further bolster our inference by clustering standard errors at more aggregate levels. Specifically, we re-estimate our model with standard errors clustered at the industry level, the region level, and the industry-region level. As shown in Columns (1), (2), and (3) of Table 6, the coefficient for CPU remains positive and statistically significant, reinforcing the robustness of our findings.

5.3.5 Lagged independent variable

Acknowledging the potential time lag in both the external transmission of policies and firms' perception of climate policy uncertainty, firms may not be able to adjust their operations instantaneously in response to policy shifts. This lag can delay the accurate assessment of policy impacts and subsequent strategic adjustments in green governance. Therefore, drawing on Hoang (2022), we examine the effect of the one-period lagged

TABLE 4 PSM matching results.

Variable	Sample	Mean		Bias/%	Amplitude/%	t-tests	
		Treated	Control			t	p>|t|
Size	Before	22.315	22.331	−1.2	26.1	−1.05	0.292
	After	22.316	22.304	0.9		0.80	0.423
Lev	Before	0.418	0.424	−2.9	93.4	−2.59	0.010
	After	0.418	0.419	−0.2		−0.18	0.860
AssetGrowth	Before	0.210	0.206	0.1	−165.3	0.11	0.915
	After	0.210	0.201	0.3		0.30	0.762
BM	Before	1.086	1.136	−3.1	98.9	−2.83	0.005
	After	1.086	1.086	0.0		0.04	0.972
DER	Before	1.132	1.183	−1.2	35.9	−1.07	0.286
	After	1.132	1.099	0.8		0.79	0.428
GrossProfit	Before	0.294	0.291	1.7	24.1	1.54	0.123
	After	0.294	0.296	−1.3		−1.20	0.229
TobinQ	Before	2.053	2.077	−1.3	39.7	−1.19	0.233
	After	2.046	2.061	−0.8		−0.86	0.388
ListAge	Before	2.137	2.208	−8.6	94.2	−7.76	0.000
	After	2.137	2.133	0.5		0.46	0.646
Loss	Before	0.134	0.137	−0.7	80.6	−0.64	0.524
	After	0.134	0.135	−0.1		−0.13	0.899

Climate Policy Uncertainty (L.CPU) on corporate green governance. The regression result, reported in Column (4) of Table 6, indicates that L. CPU continues to exert a significant positive influence on GGP, suggesting that the impact of climate policy uncertainty on green governance exhibits persistence and a delayed effect.

5.3.6 Alternative dependent variable

Following Mei and Zhang (2025), we construct an alternative proxy for corporate green governance by manually collecting data on environmental management costs, such as greening and sanitation fees, from the "Administrative Expenses" account in firm financial reports (denoted as GAC). The robustness check result using this alternative dependent variable is presented in Column (5) of Table 6. The significant positive relationship between climate policy uncertainty and the alternative green governance measure persists, confirming the robustness of our baseline regression results.

5.4 Mechanism tests

This study follows the approach of Fu and Wang (2025) to examine the underlying mechanisms, employing Equation 4 and Equation 5 for formal mediation testing.

$$M_{i,t} = \gamma_0 + \gamma_1 CPU_{i,t} + \tau Controls + Year + Firm + \varepsilon_{i,t} \quad (4)$$

$$GGP_{i,t} = \delta_0 + \delta_1 CPU_{i,t} + \delta_2 M_{i,t} + \rho Controls + Year + Firm + \varepsilon_{i,t} \quad (5)$$

Here, M represents the hypothesized mechanism variable. The definitions of all other variables are identical to those specified in Equation 3.

5.4.1 Executives' green cognition

Following the methodology of Hao et al. (2025), this study employs textual analysis to examine corporate annual reports. We measure executives' green cognition (EGC), which reflects managerial attention to green issues in decision-making, by constructing a variable based on the frequency of keywords related to three dimensions: awareness of green competitive advantage, corporate social responsibility consciousness, and perception of external environmental pressures. The selected keywords include energy conservation and emissions reduction, environmental strategy, environmental philosophy, environmental management organization, environmental education, environmental training, environmental technology development, environmental auditing, energy saving and environmental protection, environmental policy, environmental department, environmental inspection, low-carbon environmental protection,

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TABLE 5 Robustness checks using PSM, IV, and fixed effects.

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	GGP	CPU	GGP	GGP	GGP	GGP
CPU	0.026**		0.536**	0.022***	0.022***	0.021***
	(2.53)		(0.241)	(2.97)	(2.96)	(2.77)
Htd		0.001***				
		(0.000)				
lnGDP	0.016	−0.591***	0.250	−0.004	−0.004	−0.008
	(0.28)	(0.057)	(0.155)	(-0.09)	(-0.09)	(-0.18)
Size	0.002	0.035***	0.002	0.011	0.011	0.014
	(0.15)	(0.013)	(0.017)	(1.12)	(1.12)	(1.35)
Lev	0.066	0.032	0.030	0.055	0.055	0.064*
	(1.46)	(0.041)	(0.048)	(1.55)	(1.55)	(1.80)
AssetGrowth	−0.002***	0.004	−0.007	−0.002***	−0.002***	−0.003**
	(-2.74)	(0.008)	(0.008)	(-2.82)	(-2.82)	(-2.04)
BM	−0.006	−0.016***	−0.004	−0.009***	−0.009***	−0.010***
	(-1.18)	(0.004)	(0.006)	(-2.76)	(-2.76)	(-2.89)
DER	−0.002***	−0.001	−0.001	−0.001**	−0.001**	−0.001**
	(-2.89)	(0.001)	(0.001)	(-2.26)	(-2.26)	(-2.08)
GrossProfit	−0.135***	0.041	−0.187***	−0.118***	−0.118***	−0.117***
	(-3.01)	(0.042)	(0.048)	(-3.19)	(-3.18)	(-3.14)
TobinQ	−0.006**	0.003	−0.007**	−0.006***	−0.006***	−0.005***
	(-1.96)	(0.003)	(0.003)	(-3.42)	(-3.42)	(-2.75)
ListAge	0.049***	−0.023	−0.030	0.035**	0.035**	0.036***
	(2.83)	(0.028)	(0.033)	(2.56)	(2.56)	(2.64)
Loss	−0.017	−0.013	−0.007	−0.019**	−0.019**	−0.017**
	(-1.41)	(0.009)	(0.011)	(-2.22)	(-2.22)	(-2.01)
Constant	0.263	-	-	0.284	0.284	0.265
	(0.43)	-	-	(0.60)	(0.60)	(0.56)
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	No	No	No	Yes	Yes	No
Id	No	No	No	No	Yes	No
Industry × Id	No	No	No	No	No	Yes
N	17,418	23,544	23,544	32,101	32,101	32,094
Adj. R^2	0.301	-	-	0.309	0.308	0.310

We report the *t*-statistics presented in parentheses below each estimated coefficient based on robust standard errors adjusted for clustering at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

environmental work, environmental governance, environmental protection and governance, environmental facilities, environmental laws and regulations, and environmental pollution control. The keywords were selected from each dimension, and their total frequency was calculated. The natural logarithm of this total frequency was then computed, with one added to the result. This

TABLE 6 Robustness to clustering, lagged effects, and variable measurement.

Variable	(1) GGP	(2) GGP	(3) GGP	(4) GGP	(5) GAC
CPU	0.022*	0.022*	0.022*		5.661**
	(2.03)	(1.84)	(1.88)		(2.23)
L.CPU				0.023**	
				(2.42)	
lnGDP	−0.007	−0.007	−0.007	−0.029	−9.807
	(-0.12)	(-0.19)	(-0.17)	(-0.60)	(-0.89)
Size	0.013	0.013	0.013	0.016	8.936***
	(1.16)	(1.31)	(1.51)	(1.39)	(3.56)
Lev	0.059***	0.059	0.059	0.046	15.125
	(3.13)	(1.18)	(1.70)	(1.18)	(1.30)
AssetGrowth	−0.002**	−0.002***	−0.002**	−0.007	−0.179*
	(-2.69)	(-2.99)	(-2.61)	(-0.95)	(-1.95)
BM	−0.009*	−0.009**	−0.009*	−0.012***	−4.106
	(-1.79)	(-2.57)	(-1.91)	(-3.43)	(-1.35)
DER	−0.001**	−0.001*	−0.001*	−0.001*	0.057
	(-2.24)	(-2.02)	(-2.07)	(-1.92)	(1.04)
GrossProfit	−0.117**	−0.117***	−0.117***	−0.146***	14.007
	(-2.74)	(-3.92)	(-3.31)	(-3.73)	(1.26)
TobinQ	−0.006***	−0.006***	−0.006***	−0.004**	0.224
	(-3.65)	(-3.96)	(-4.25)	(-2.43)	(0.82)
ListAge	0.034***	0.034*	0.034**	0.022	−7.112*
	(3.49)	(1.84)	(2.22)	(1.02)	(-1.94)
Loss	−0.019*	−0.019**	−0.019	−0.016*	2.669*
	(-2.04)	(-2.10)	(-1.69)	(-1.75)	(1.80)
Constant	0.278	0.278	0.278	0.447	−96.600
	(0.47)	(0.76)	(0.77)	(0.86)	(-0.81)
Firm	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes
N	32,101	32,101	32,101	27,555	31,039
Adj. R^2	0.308	0.308	0.308	0.307	0.578

We report the *t*-statistics presented in parentheses below each estimated coefficient based on robust standard errors adjusted for clustering at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

process facilitated the measurement of executive green cognition. Additionally, to address the right-skewed distribution of environmental word frequency data, this study standardized the frequency counts. As presented in Columns (1) and (2) of Table 7, Climate policy uncertainty influences Corporate green governance by enhancing executives' green cognition. This result leads us to confirm Hypothesis 2.

5.4.2 Managerial myopia

Following the methodology of Zhu et al. (2025), the primary metric for managerial myopia (Myopia) is defined as the ratio of short-sightedness-related words in the Management Discussion and Analysis (MD&A) section of annual reports to the total word count in that section, multiplied by 100. We obtained the firms' annual

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TABLE 7 Mechanism tests.

Variable	(1) EGC	(2) GGP	(3) Myopia	(4) GGP	(5) ENV	(6) GGP
CPU	0.213**	0.022***	−0.002*	0.022***	0.262**	0.021***
	(2.23)	(2.84)	(-1.82)	(2.88)	(2.45)	(2.77)
EGC		0.002***				
		(3.99)				
Myopia				−0.101**		
				(-2.00)		
ENV						0.004***
						(6.67)
lnGDP	−0.179	0.018	−0.007	0.017	−0.574	0.020
	(-0.28)	(0.40)	(-0.90)	(0.38)	(-0.90)	(0.44)
Size	−0.042	0.014	0.004**	0.014	1.664***	0.007
	(-0.25)	(1.24)	(2.30)	(1.27)	(10.00)	(0.59)
Lev	−0.565	0.063	−0.064***	0.055	−0.409	0.063
	(-0.56)	(0.91)	(-5.80)	(0.79)	(-0.45)	(0.92)
AssetGrowth	−0.226	−0.008	0.035***	−0.005	−0.162	−0.007
	(-1.18)	(-0.49)	(13.99)	(-0.30)	(-0.89)	(-0.48)
BM	−0.093	−0.004	−0.004***	−0.004	−0.498***	−0.002
	(-0.78)	(-0.42)	(-3.72)	(-0.49)	(-3.91)	(-0.20)
DER	−0.040	−0.001	0.004*	−0.001	−0.126	−0.001
	(-0.16)	(-0.10)	(1.92)	(-0.08)	(-0.63)	(-0.07)
GrossProfit	1.070*	−0.116**	−0.005	−0.115**	1.467**	−0.120**
	(1.66)	(-2.49)	(-0.63)	(-2.45)	(2.36)	(-2.57)
TobinQ	−0.210***	−0.002	0.000	−0.002	0.027	−0.002
	(-2.97)	(-0.30)	(0.29)	(-0.38)	(0.40)	(-0.41)
ListAge	0.640***	0.030*	0.029***	0.035**	−0.346	0.033**
	(2.82)	(1.94)	(12.86)	(2.21)	(-1.63)	(2.13)
Loss	−0.295***	−0.020**	−0.000	−0.020**	−0.302***	−0.019**
	(-2.64)	(-2.30)	(-0.10)	(-2.38)	(-3.09)	(-2.23)
Constant	6.437	−0.002	−0.021	0.011	−23.540***	0.113
	(0.93)	(-0.00)	(-0.24)	(0.02)	(-3.34)	(0.22)
Sobel (Z)	2.479**		−2.081**		24.81***	
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
N	32,008	32,008	32,008	32,008	32,008	32,008
Adj. R^2	0.657	0.310	0.510	0.310	0.688	0.311

We report the *t*-statistics presented in parentheses below each estimated coefficient based on robust standard errors adjusted for clustering at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

reports from the CNINFO website and extracted the Management Discussion and Analysis (MD&A) sections. The textual content of these sections was then segmented into discrete words using the Python-based Chinese text processing module, Jieba. To construct the managerial myopia measure, we calculated the ratio of the frequency of short-term oriented words—such as "within days," "within months," "within years," "as soon as possible," "immediately," and "pressure"—to the total word count of the MD&A text for each firm-year observation. As reported in Columns (3) and (4) of Table 7, Climate policy uncertainty influences Corporate green governance by reducing managerial myopia. This finding confirms Hypothesis 3.

5.4.3 Environmental information disclosure

Following the approach of Lu and Li (2023), this study employs the Environmental Research Database from CSMAR to classify corporate environmental information disclosure based on whether the information is monetized. For monetized information, indicators disclosed in both quantitative and qualitative terms are assigned a value of 2, those disclosed only qualitatively receive a value of 1, and items not disclosed are assigned 0. For non-monetized information, disclosed indicators are scored 2, while undisclosed ones receive 0. Specifically, indicators under environmental liability disclosure, as well as environmental performance and governance disclosure, are treated as monetized information. Indicators related to environmental management disclosure, environmental certification disclosure, and environmental information disclosure carriers are classified as non-monetized. These two categories together span five dimensions and comprise 25 scoring items. The aggregate score across these items is then logarithmically transformed to construct the variable ENV, which comprehensively reflects the quality of corporate environmental information disclosure. As shown in Columns (5) and (6) of Table 7, Climate policy uncertainty influences Corporate green governance by improving the quality of corporate environmental information disclosure quality, supporting Hypothesis 4.

5.5 Heterogeneity analysis

5.5.1 Ownership type

Columns (1) and (2) of Table 8 present the differential effects of climate policy uncertainty on corporate green governance across ownership types. In China, state-owned enterprises (SOEs) benefit from unique resource advantages and enjoy relatively stable funding sources. Moreover, listed SOEs are subject to stricter regulatory oversight and generally demonstrate a higher level of green governance. The results indicate that climate policy uncertainty has a significantly stronger positive effect on the green governance of SOEs relative to non-SOEs.

On one hand, SOEs bear a dual institutional mandate to implement national policies and maintain social stability, which subjects their operational behavior to stronger institutional isomorphic pressures. When confronted with climate policy uncertainty, SOEs tend to interpret it as a forward-looking signal of the government's intent to strengthen environmental regulations. Consequently, they proactively adjust their governance structures to align with anticipated policy directions. Such preemptive actions not only mitigate future compliance risks but also serve as a critical means to maintain political legitimacy and secure institutional recognition. In contrast, non-SOEs prioritize market efficiency and maximize shareholder value. Their interpretation of policy signals is primarily based on cost-benefit analyses. When policy direction remains unclear, adopting a wait-and-see approach.

On the other hand, SOEs possess distinct advantages in resource access and risk-bearing capacity. Government subsidies, policy-directed loans, and specialized technological resources provide a solid foundation for advancing green governance, enabling them to pursue long-term environmental investments even in uncertain times. Furthermore, the performance evaluation and promotion mechanisms for SOE executives are often closely linked to policy-oriented targets such as energy savings and emissions reduction, which strengthens their intrinsic motivation to drive green transformation. In comparison, non-SOEs face tighter financing constraints and more immediate profit pressures. The substantial investments required for green governance often exceed their short-term financial capacity. Given the long payback period and positive externalities associated with environmental investments, non-SOEs are inclined to allocate limited resources to projects that generate more immediate economic returns, particularly when policy outcomes remain uncertain.

5.5.2 Green investor

This study categorizes firms based on the annual mean number of green investors. Although grouping by the median yields regression results consistent with those obtained using the mean, the median split leads to a substantial imbalance in sample sizes between the two groups, which may compromise the validity of the findings. Therefore, the mean-based grouping is adopted. The results of the subgroup regression, presented in Columns (3) and (4) of Table 8, indicate that the effect of climate policy uncertainty on green governance is more pronounced in the group with a lower number of green investors. Potential explanations for this observed pattern may include the following:

On one hand, firms with minimal green investor participation operate under substantially weaker external monitoring mechanisms and face lower baseline expectations for environmental transparency. When confronted with climate policy uncertainty, these organizations experience a pronounced legitimacy gap and face elevated regulatory risks due to their lack of established environmental credentials. The emergence of Climate Policy Uncertainty therefore functions as a critical exogenous trigger that motivates such firms to actively improve their green governance systems. This strategic adaptation serves dual purposes: it helps secure institutional legitimacy while simultaneously preempting potential regulatory penalties. In contrast, firms that already maintain strong appeal to green investors benefit from continuous environmental oversight and are typically well-aligned with prevailing sustainability standards. For these organizations, Climate Policy Uncertainty represents merely an incremental pressure rather than a transformative stimulus, as their relatively mature green governance structures offer limited scope for substantial additional improvement.

TABLE 8 Heterogeneity analysis.

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	SOEs	Non-SOEs	High green investor appeal	Low green investor appeal	High market competition	Low market competition
CPU	0.032***	0.017*	0.019	0.027***	0.012	0.037***
	(2.75)	(1.70)	(1.64)	(2.63)	(1.08)	(3.53)
lnGDP	−0.050	0.068	−0.042	0.043	−0.000	0.017
	(-0.73)	(1.09)	(-0.61)	(0.68)	(-0.00)	(0.26)
Size	0.013	0.017	0.045***	−0.006	0.011	0.026
	(0.76)	(1.18)	(2.64)	(-0.38)	(0.59)	(1.58)
Lev	0.077	0.068	0.183	0.025	0.023	0.115
	(0.67)	(0.76)	(1.63)	(0.29)	(0.22)	(1.17)
AssetGrowth	−0.007	−0.017	−0.061***	0.026	−0.008	−0.012
	(-0.28)	(-0.89)	(-2.58)	(1.20)	(-0.34)	(-0.53)
BM	−0.004	−0.015	0.015	−0.014	0.002	−0.019
	(-0.31)	(-1.18)	(1.14)	(-1.08)	(0.15)	(-1.42)
DER	0.000	−0.005	−0.027	0.006	0.010	−0.008
	(0.02)	(-0.23)	(-1.11)	(0.32)	(0.43)	(-0.36)
GrossProfit	−0.178**	−0.058	−0.005	−0.146***	0.010	−0.205***
	(-2.52)	(-0.93)	(-0.06)	(-2.58)	(0.14)	(-3.26)
TobinQ	−0.014	0.000	0.004	−0.007	−0.007	−0.000
	(-1.52)	(0.01)	(0.50)	(-0.94)	(-0.91)	(-0.06)
ListAge	0.041	0.047**	0.027	0.024	0.047**	0.009
	(1.43)	(2.30)	(1.05)	(1.21)	(2.17)	(0.38)
Loss	−0.022	−0.017	−0.009	−0.018*	−0.012	−0.030***
	(-1.64)	(-1.56)	(-0.50)	(-1.81)	(-0.86)	(-2.77)
Constant	0.635	−0.565	−0.196	0.244	0.231	−0.220
	(0.81)	(-0.85)	(-0.26)	(0.35)	(0.30)	(-0.30)
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Fisher's test	−0.015***		0.008*		0.025***	
N	12,354	19,654	13,206	18,802	16,005	16,003
Adj. R^2	0.269	0.336	0.330	0.314	0.316	0.333

Variable	(1)	(2)	(3)	(4)
	High-intensity environmental regulation	Low-intensity environmental regulation	High-pollution industries	Low-pollution industries
CPU	−0.004	0.030***	0.026*	0.019**
	(-0.30)	(3.24)	(1.65)	(2.14)
lnGDP	0.120	0.015	0.226***	−0.041
	(1.28)	(0.26)	(2.60)	(-0.77)

(*Continued*)

TABLE 8 Continued

Variable	(1)	(2)	(3)	(4)
	High-intensity environmental regulation	Low-intensity environmental regulation	High-pollution industries	Low-pollution industries
Size	0.002	0.021	0.017	0.010
	(0.13)	(1.54)	(0.69)	(0.81)
Lev	0.177	0.054	0.042	0.036
	(1.50)	(0.64)	(0.32)	(0.44)
AssetGrowth	0.033	−0.034*	−0.061*	0.009
	(1.22)	(-1.73)	(-1.90)	(0.50)
BM	−0.010	−0.002	0.009	−0.007
	(-0.70)	(-0.14)	(0.53)	(-0.72)
DER	−0.038	0.006	0.014	−0.004
	(-1.46)	(0.35)	(0.51)	(-0.22)
GrossProfit	−0.109	−0.108*	−0.046	−0.120**
	(-1.36)	(-1.91)	(-0.42)	(-2.28)
TobinQ	−0.014	0.005	−0.008	−0.001
	(-1.53)	(0.82)	(-0.66)	(-0.17)
ListAge	0.030	0.032*	−0.036	0.058***
	(1.07)	(1.68)	(-1.09)	(3.27)
Loss	−0.023	−0.011	−0.023	−0.018*
	(-1.48)	(-1.02)	(-1.37)	(-1.84)
Constant	−0.647	−0.157	−1.828*	0.588
	(-0.65)	(-0.26)	(-1.86)	(0.99)
Firm	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Fisher's test	0.034***		−0.008***	
N	12,240	19,768	7,205	24,803
Adj. R^2	0.313	0.317	0.246	0.321

We report the *t*-statistics presented in parentheses below each estimated coefficient based on robust standard errors adjusted for clustering at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

On the other hand, the strategic motivation for governance enhancement differs substantially between these two types of firms. Organizations with limited green investor appeal recognize that proactive environmental governance improvements under conditions of policy uncertainty can serve as powerful signaling mechanisms to attract environmentally-conscious capital. This potential access to new funding sources provides strong motivation for governance enhancement, particularly for firms facing financing constraints. Furthermore, these firms typically begin from a lower baseline in environmental governance, meaning even moderate investments can generate significant visible progress and regulatory compliance benefits. Conversely, firms with established green investor relationships already maintain developed governance frameworks and secured funding channels for environmental initiatives. For these organizations, the marginal benefits of further signaling through additional governance improvements are substantially lower, while the costs of achieving incremental advances are comparatively higher.

5.5.3 Market competition

This study further examines the role of industry competition intensity by conducting subgroup analyses. In line with conventional academic practice, we employ the Herfindahl-Hirschman Index (HHI) to measure the degree of competition within each industry. A lower HHI value indicates lower market concentration and thus more intense competition. Firms are divided into two groups based on the annual median HHI value. The regression results presented in

Columns (5) and (6) of Table 8 show that the effect of climate policy uncertainty is more pronounced among firms operating in highly competitive industries. The potential mechanisms underlying this finding may include the following:

On one hand, firms in fiercely competitive industries face acute pressure to secure strategic differentiation and capture first-mover advantages in evolving institutional landscapes. Climate policy uncertainty signals an impending shift in regulatory and market conditions, transforming green governance from a peripheral compliance issue into a potential source of competitive leverage. For these firms, proactive investment in environmental governance represents a strategic opportunity to enhance brand reputation, access emerging green markets, and establish technological leadership ahead of rivals. In contrast, firms in less competitive environments typically benefit from more stable market positions and weaker innovation imperatives, reducing their urgency to treat Climate Policy Uncertainty as a critical inflection point requiring substantial strategic realignment.

On the other hand, the organizational structures and dynamic capabilities of firms in highly competitive industries are inherently more adaptable to external perturbations. Through continual exposure to market pressures, these firms have developed robust capacities for resource reconfiguration, rapid learning, and strategic flexibility. This enhanced adaptive capacity allows them to reallocate resources toward green initiatives more efficiently when confronted with policy uncertainty. Moreover, their experience in managing volatile environments enhances their ability to interpret ambiguous policy signals and convert them into actionable environmental strategies. Conversely, firms in less competitive settings often exhibit greater structural inertia, more hierarchical decision-making processes, and weaker absorptive capacity, collectively constraining their ability to transform policy stimuli into substantive governance improvements.

5.5.4 Environmental regulation

In this study, the intensity of environmental regulation is measured by the ratio of completed industrial pollution control investment to the secondary industry GDP in the enterprise's region. Based on the median value of this measure, we divide the sample into high and low environmental regulation groups. As reported in columns (1) and (2) of Continued (Table 8), the impact of climate policy uncertainty on corporate green governance is more pronounced in the low environmental regulation group. Potential explanations for this finding include the following:

In regions with stringent environmental regulations, firms operate under a well-defined and strictly enforced policy framework. Regulatory compliance serves as a mandatory baseline for operational legitimacy, dominating corporate environmental decision-making. Under such conditions, firms prioritize meeting established high standards, resulting in consistently elevated levels of green governance.

By contrast, in regions with lax environmental regulations, institutional pressure is minimal and compliance costs are low. In the absence of strong regulatory mandates, climate policy uncertainty emerges as a critical external signal that reshapes corporate risk perception. Firms in these regions face heightened regulatory risk, meaning they anticipate potential sudden shifts toward stricter climate policies. This anticipation incentivizes proactive measures such as adopting cleaner technologies, improving environmental disclosure, or obtaining green certifications. Such voluntary actions help firms mitigate future compliance costs, build organizational resilience, and secure early-mover advantages in an evolving policy landscape.

Moreover, in low-regulation environments, stakeholder expectations exert stronger influence. Investors, customers, and international partners often perceive firms in these regions as environmentally lagging, making them more vulnerable to reputational and market-access risks. Climate policy uncertainty amplifies these concerns, prompting firms to demonstrate environmental responsibility through self-initiated green governance practices.

Additionally, the differential impact reflects underlying resource allocation patterns. In high-regulation regions, firms have already committed substantial resources to mandatory environmental improvements. Further investments driven by policy uncertainty may yield diminishing returns and thus appear less pronounced in empirical analyses. In low-regulation regions, however, baseline environmental investment is typically limited. Even moderate proactive efforts can generate significant observable improvements in green governance, making the response to climate policy uncertainty more statistically detectable.

5.5.5 Industry characteristics

To further examine heterogeneous responses, we conduct subsample analyses based on whether firms belong to high-pollution industries. The results presented in Columns (3) and (4) of Continued (Table 8) indicate that the impact of climate policy uncertainty on corporate green governance is more pronounced for high-pollution firms. Potential explanations for this pattern include the following:

Firms operating in high-pollution sectors are inherently subject to greater regulatory scrutiny and tighter environmental constraints. When climate policy becomes uncertain, these firms perceive an elevated risk of future regulatory tightening, such as stricter emission standards, higher carbon taxes, or more stringent compliance mandates. This anticipatory regulatory pressure creates a compelling incentive for them to proactively invest in green governance measures. By adopting cleaner technologies, improving environmental management systems, and reducing their ecological footprint ahead of potential mandates, they seek to mitigate future compliance costs and avoid operational disruptions.

From an economic perspective, high-pollution firms typically bear heavier environmental externalities and face more volatile cost structures linked to resource use and emissions. Climate policy uncertainty directly affects expectations regarding future carbon pricing, energy costs, and market access. In response, these firms are motivated to accelerate green transformation initiatives, such as energy efficiency upgrades and circular production models, to hedge against future cost shocks and secure long-term competitiveness. Early adoption of green practices may also allow them to access emerging opportunities in green finance, preferential regulatory treatment, and growing markets for sustainable products, thereby turning regulatory uncertainty into a strategic advantage.

Furthermore, stakeholder pressures amplify this dynamic. High-pollution firms are increasingly held accountable by investors, consumers, and advocacy groups for their environmental

performance. Heightened policy uncertainty raises public awareness and scrutiny regarding corporate climate resilience, prompting these firms to strengthen their green governance as a signal of commitment to environmental stewardship.

6 Conclusion

This study empirically examines the impact of climate policy uncertainty on corporate green governance using data from Chinese listed companies from 2009 to 2023. The findings reveal that climate policy uncertainty significantly promotes the level of corporate green governance, a conclusion that remains robust after a series of robustness tests. Mechanism analysis indicates that this positive effect operates through three primary channels: enhancing executives' green cognition, reducing managerial myopia, and improving the quality of corporate environmental information disclosure. Heterogeneity analysis further shows that the promoting effect is more pronounced in state-owned enterprises, firms less attractive to green investors, and those operating in highly competitive industries.

Our findings present a constructive contrast to the prevailing literature emphasizing the "inhibitive effect" of climate policy uncertainty on investment and innovation, revealing its positive governance role as a "push factor" under specific contexts. This provides crucial evidence at the corporate governance level to reconcile the seemingly contradictory "optimization" and "inhibition" perspectives in existing studies. Furthermore, unlike most research focusing on singular corporate actions, this study elevates the perspective to the systematic concept of "corporate green governance," which integrates strategy, cognition, and information disclosure, thereby deepening the understanding of how climate policy uncertainty drives profound and systematic green transformation. Additionally, by identifying internal behavioral mechanisms such as enhanced executive green awareness and reduced managerial myopia, along with heterogeneous effects across different ownership structures, investor appeal, and market competition, this study addresses previous literature gaps regarding micro-level transmission pathways and boundary conditions, significantly expanding the theoretical framework of climate policy uncertainty's microeconomic consequences.

Based on the findings, regulators should adopt differentiated measures to effectively incentivize green governance, the present study makes the following policy recommendations. To incentivize green governance, it is recommended that policymakers integrate the environmental performance of non-state-owned enterprises into formal local social honor appraisal systems, thereby transforming corporate environmental investments into personal reputational capital for entrepreneurs. Simultaneously, for firms with lower appeal to green investors, a phased mandatory environmental information disclosure system should be implemented, coupled with a tiered certification mechanism linked to tangible improvement outcomes, supported by incentives such as corporate income tax deductions. Furthermore, adaptable financing instruments including green bonds and ESG equity funds should be developed. Incorporating such certifications into public procurement and supply chain evaluations will effectively translate corporate environmental governance efforts into financing advantages and market competitiveness.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

QF: Conceptualization, Writing – review and editing, Methodology, Writing – original draft. SD: Visualization, Supervision, Writing – original draft. XW: Writing – review and editing, Investigation. JL: Writing – review and editing, Project administration, Funding acquisition.

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References

Aguilera, R. V., Aragón-Correa, J. A., Marano, V., and Tashman, P. A. (2021). The corporate governance of environmental sustainability: a review and proposal for more integrated research. *J. Manag.* 47 (6), 1468–1497. doi:10.1177/0149206321991212

Amore, M. D., and Bennedsen, M. (2016). Corporate governance and green innovation. *J. Environ. Econ. Manag.* 75, 54–72. doi:10.1016/j.jeem.2015.11.003

Bataineh, M. J., Sánchez-Sellero, P., and Ayad, F. (2024). Green is the new Black: how research and development and green innovation provide businesses a competitive edge. *Bus. Strategy Environ.* 33 (2), 1004–1023. doi:10.1002/bse.3533

Bin-Feng, C., Mirza, S. S., Ahsan, T., and Qureshi, M. A. (2024). How uncertainty candetermine corporate ESG performance? *Corp. Soc. Responsib. Environ. Manag.* 31 (3), 2290–2310. doi:10.1002/csr.2695

Borozan, D., and Pirgaip, B. (2024). Climate policy uncertainty and firm-level carbon dioxide emissions: assessing the impact in the US market. *Bus. Strategy Environ.* 33 (6), 5920–5938. doi:10.1002/bse.3784

Cang, H., and Li, C. (2024). Corporate climate risk and bond credit spreads. *Finance Res. Lett.* 67, 105741. doi:10.1016/j.frl.2024.105741

Chang, C. L., Zhang, J., and Lin, Y. E. (2024). Climate policy uncertainty, corporate social responsibility and corporate investments of the energy firms. *Energy Econ.* 140, 107968. doi:10.1016/j.eneco.2024.107968

Chen, A., Feng, J., and Cheng, Y. (2025). How does climate policy uncertainty affect green innovation among Chinese companies? *Sustainability* 17 (9), 3857. doi:10.3390/su17093857

Cheng, Z., and Wu, Y. (2025). The impact of climate policy uncertainty on corporate ESG greenwashing. *J. Environ. Manag.* 394, 127353. doi:10.1016/j.jenvman.2025.127353

Chijoke-Mgbame, A. M., Mgbame, C. O., Akintoye, S., and Ohalehi, P. (2020). The role of corporate governance on CSR disclosure and firm performance in a voluntary environment. *Corp. Gov. Int. J. Bus. Soc.* 20 (2), 294–306. doi:10.1108/CG-06-2019-0184

Dai, J., Kiaw, J. P. A., and Hiung, E. Y. T. (2025). Is some uncertainty better than none? Nonlinear relationships between climate policy uncertainty and corporate green performance. *Int. Rev. Econ. Finance* 102, 104336. doi:10.1016/j.iref.2025.104336

Doyle, E., McGovern, D., and McCarthy, S. (2014). Compliance–innovation: integrating quality and compliance knowledge and practice. *Total Qual. Manag. Bus. Excell.* 25 (9-10), 1156–1170. doi:10.1080/14783363.2014.914641

Feng, Z., and Wu, Z. (2023). ESG disclosure, REIT debt financing and firm value. *J. Real Estate Finance Econ.* 67 (3), 388–422. doi:10.1007/s11146-021-09857-x

Fu, Q. A. (2024). Green finance and the mitigation of corporate debt financing in China: evidence and implications for sustainable finance. *Front. Environ. Sci.* 12, 1426837. doi:10.3389/fenvs.2024.1426837

Fu, Q. A., and Wang, L. (2025). Does public data openness matter for corporate social responsibility? *Appl. Econ. Lett.*, 1–7. doi:10.1080/13504851.2025.2566890

Ge, H., and Zhang, X. (2025). From uncertainty to sustainability: how climate policy uncertainty shapes corporate ESG? *Int. Rev. Econ. Finance* 98, 104011. doi:10.1016/j.iref.2025.104011

Ginglinger, E., and Moreau, Q. (2023). Climate risk and capital structure. *Manag. Sci.* 69 (12), 7492–7516. doi:10.1287/mnsc.2023.495217

Haigh, N., and Griffiths, A. (2012). Surprise as a catalyst for including climatic change in the strategic environment. *Bus. and Soc.* 51 (1), 89–120. doi:10.1177/0007650311427425

Han, L., and Cheng, Z. (2025). Can the belt and road initiative improve corporate environmental performance? *J. Environ. Plan. Manag.* 68 (12), 2838–2864. doi:10.1080/09640568.2024.2326104

Hao, X., Miao, E., Wen, S., Wu, H., and Xue, Y. (2025). Executive green cognition on corporate greenwashing behavior: evidence from a-share listed companies in China. *Bus. Strategy Environ.* 34 (2), 2012–2034. doi:10.1002/bse.4095

Hoang, K. (2022). How does corporate R&D investment respond to climate policy uncertainty? Evidence from heavy emitter firms in the United States. *Corp. Soc. Responsib. Environ. Manag.* 29 (4), 936–949. doi:10.1002/csr.2246

Hu, Y., Bai, W., Farrukh, M., and Koo, C. K. (2023). How does environmental policy uncertainty influence corporate green investments? *Technol. Forecast. Soc. Change* 189, 122330. doi:10.1016/j.techfore.2023.122330

Huang, Q., and Kou, M. (2024). Does climate policy uncertainty impair or improve corporate investment efficiency? *Econ. Lett.* 244, 112015. doi:10.1016/j.econlet.2024.112015

Ji, M., and Zhang, X. (2024). Assessing the impacts and mechanisms of green bond financing on the enhancement of green management and technological innovation in environmental conservation enterprises. *J. Knowl. Econ.* 15 (3), 12709–12750. doi:10.1007/s13132-023-01594-1

Ji, D., Jing, L., and Kong, L. (2025). Executives' environmental awareness and corporate green technology innovation: evidence from textual analysis. *Emerg. Mark. Finance Trade* 62, 1–23. doi:10.1080/1540496X.2025.2536117

Kavadis, N., and Thomsen, S. (2023). Sustainable corporate governance: a review of research on long-term corporate ownership and sustainability. *Corp. Gov. Int. Rev.* 31 (1), 198–226. doi:10.1111/corg.12486

Khan, M. R., and Munira, S. (2021). Climate change adaptation as a global public good: implications for financing. *Clim. Change* 167 (3), 50. doi:10.1007/s10584-021-03195-w

Kock, C. J., Santalo, J., and Diestre, L. (2012). Corporate governance and the environment: what type of governance creates greener companies? *J. Manag. Stud.* 49 (3), 492–514. doi:10.1111/j.1467-6486.2010.00993.x

Kolk, A., and Pinkse, J. (2004). Market strategies for climate change. *Eur. Manag. J.* 22 (3), 304–314. doi:10.1016/j.emj.2004.04.011

Li, Q., Ruan, W., Shi, H., Xiang, E., and Zhang, F. (2022). Corporate environmental information disclosure and bank financing: moderating effect of formal and informal institutions. *Bus. Strategy Environ.* 31 (7), 2931–2946. doi:10.1002/bse.3055

Li, R., Fang, D., and Xu, J. (2025). Does climate policy uncertainty (CPU) hinder carbon reduction? Evidence using the city-level CPU index in China. *Energy Econ.* 141, 108098. doi:10.1016/j.eneco.2024.108098

Liu, R., Li, J., and Wu, M. (2025). The impact of climate change risk on corporate debt financing capacity: a moderating perspective based on carbon emissions. *Sustainability* 17 (14), 6276. doi:10.3390/su17146276

Liu, W., Liu, Y., Wen, F., and Gong, X. (2025). Climate policy uncertainty and analyst earnings forecasts: evidence from the Chinese energy sector. *Int. Rev. Financ. Anal.* 100, 103960. doi:10.1016/j.irfa.2025.103960

Lochmann, H. D., and Steger, U. (2002). Performing under pressure: managers embracing new realities. *Eur. Manag. J.* 20 (4), 341–355. doi:10.1016/S0263-2373(02)00053-1

Lu, Z., and Li, H. (2023). Does environmental information disclosure affect green innovation? *Econ. Anal. Policy* 80, 47–59. doi:10.1016/j.eap.2023.07.011

Luo, X., and Lyu, C. (2024). Green bonds drive environmental performance: evidences from China. *Sustainability* 16 (10), 4223. doi:10.3390/su16104223

Luo, W., Guo, X., Zhong, S., and Wang, J. (2019). Environmental information disclosure quality, media attention and debt financing costs: evidence from Chinese heavy polluting listed companies. *J. Clean. Prod.* 231, 268–277. doi:10.1016/j.jclepro.2019.05.237

Ma, Y. R., Liu, Z., Ma, D., Zhai, P., Guo, K., Zhang, D., et al. (2023). A news-based climate policy uncertainty index for China. *Sci. Data* 10 (1), 881. doi:10.1038/s41597-023-02817-5

Mei, K., and Zhang, Z. (2025). Environmental regulation, green investment and corporate green governance: evidence from China's new environmental protection law. *Finance Res. Lett.* 76, 106979. doi:10.1016/j.frl.2025.106979

Meng, D., Li, Y., and Wang, L. (2025). Climate policy uncertainty and corporate green strategy adjustment: a perspective on hiring executives with environmental experience. *Bus. Strategy Environ.* 35, 351–373. doi:10.1002/bse.70185

Newman, R., and Noy, I. (2023). The global costs of extreme weather that are attributable to climate change. *Nat. Commun.* 14 (1), 6103. doi:10.1038/s41467-023-41888-1

Omarova, L., and Jo, S. J. (2022). Employee pro-environmental behavior: the impact of environmental transformational leadership and GHRM. *Sustainability* 14 (4), 2046. doi:10.3390/su14042046

Ortiz-de-Mandojana, N., and Bansal, P. (2016). The long-term benefits of organizational resilience through sustainable business practices. *Strategic Manag. J.* 37 (8), 1615–1631. doi:10.1002/smj.2410

Peng, M., and Yan, Q. (2025). The impact of managerial myopia on enterprise digital innovation. *Finance Res. Lett.* 80, 107377. doi:10.1016/j.frl.2025.107377

Ren, X., Zhang, X., Yan, C., and Gozgor, G. (2022). Climate policy uncertainty and firm-level total factor productivity: evidence from China. *Energy Econ.* 113, 106209. doi:10.1016/j.eneco.2022.106209

Sewchurran, K., Dekker, J., and McDonogh, J. (2019). Experiences of embedding long-term thinking in an environment of short-termism and sub-par business performance: investing in intangibles for sustainable growth. *J. Bus. Ethics* 157 (4), 997–1041. doi:10.1007/s10551-018-3959-2

Sullivan, R. (2009). The management of greenhouse gas emissions in large European companies. *Corp. Soc. Responsib. Environ. Manag.* 16 (6), 301–309. doi:10.1002/csr.187

Szymczak, W., Wagner, S. A., and Busch, T. (2025). Climate (in) action? The relationship between CEO early-life experiences and corporate climate policies. *Ecol. Econ.* 237, 108635. doi:10.1016/j.ecolecon.2025.108635

Teeter, P., and Sandberg, J. (2017). Constraining or enabling green capability development? How policy uncertainty affects organizational responses to flexible environmental regulations. *Br. J. Manag.* 28 (4), 649–665. doi:10.1111/1467-8551.12188

Tian, Y., Lai, E., Fu, Y., and Li, Y. (2025). Exploring the impacts of ESG disclosure on corporate financing constraints: a perspective of classifying corporate carbon emissions. *Corp. Soc. Responsib. Environ. Manag.* 32 (6), 7630–7647. doi:10.1002/csr.70097

Tran, V. (2025). Climate policy uncertainty and earnings management. *Finance Res. Lett.* 71, 106393. doi:10.1016/j.frl.2024.106393

Tu, Y., and Wu, W. (2021). How does green innovation improve enterprises' competitive advantage? The role of organizational learning. *Sustain. Prod. Consum.* 26, 504–516. doi:10.1016/j.spc.2020.12.031

Wang, W., and Wang, X. (2023). Does provincial green governance promote enterprise green investment? Based on the perspective of government vertical management. *J. Clean. Prod.* 396, 136519. doi:10.1016/j.jclepro.2023.136519

Wang, W., and Xiao, D. (2025). Marketization of data elements and enterprise green governance performance: a quasi-natural experiment based on data trading platforms. *Manag. Decis. Econ.* 46 (3), 1686–1700. doi:10.1002/mde.4471

Wang, Z., Xu, J., Zhang, Z., and Lei, X. (2025). Pressure makes diamonds: do extreme climate risks force firms to innovate green? *Sustainability* 17 (20), 9113. doi:10.3390/su17209113

Xu, H., Lin, K., Wang, H., Lin, W., and Du, L. (2025). Does local green governance promote corporate green innovation? A new perspective from green officials. *Empir. Econ.* 68 (4), 1861–1892. doi:10.1007/s00181-024-02682-0

Yang, X., Liu, B., Liu, Z., Zhang, J., and Sun, Q. (2025). Does environmental uncertainty increase the likelihood of greenwashing? The roles of government subsidies and media attention. *Corp. Soc. Responsib. Environ. Manag.* 32 (2), 2616–2629. doi:10.1002/csr.3086

Yi, L., Li, T., Zhang, X., Huang, Q., Ma, Y., and Wang, P. (2023). CEO power and corporate green governance from the perspective of input-output efficiency. *Emerg. Mark. Finance Trade* 59 (3), 836–847. doi:10.1080/1540496x.2022.2108318

Zeng, X., and Rojniruttikul, N. (2025). The impact of the forward-looking strategy on the sustainable development of enterprises under the background of digital economy—Based on dynamic regulation. *Sustainability* 17 (1), 272. doi:10.3390/su17010272

Zhang, K., Li, J., Ma, W., and Wang, X. (2024). Does environmental information disclosure promote enterprise green technology innovation? *PLoS One* 19 (12), e0312901. doi:10.1371/journal.pone.0312901

Zhang, Z., Feng, Y., Zhou, H., Chen, L., and Liu, Y. (2024). The impact of climate policy uncertainty on the ESG performance of enterprises. *Systems* 12 (11), 495. doi:10.3390/systems12110495

Zhang, Z., Hong, Y., Yang, Z., Chen, L., and Feng, Y. (2025). Navigating uncertainty: how climate policy uncertainty drives firms' green transformation. *Sustainability* 17 (18), 8370. doi:10.3390/su17188370

Zhao, L., Ma, Y., Chen, N., and Wen, F. (2025). How does climate policy uncertainty shape corporate investment behavior? *Res. Int. Bus. Finance* 74, 102696. doi:10.1016/j.ribaf.2024.102696

Zhong, W., and Jin, L. (2025). The impact of climate risk disclosure on corporate green technology innovation. *Sustainability* 17 (6), 2699. doi:10.3390/su17062699

Zhou, C., Qi, S., and Li, Y. (2024). Environmental policy uncertainty and green transformation dilemma of Chinese enterprises. *J. Environ. Manag.* 370, 122891. doi:10.1016/j.jenvman.2024.122891

Zhu, X., Chen, H., Xiang, E., and Qi, Y. (2025). Digital transformation and corporate green technology transfer: the moderating effect of executive green cognition. *Finance Res. Lett.* 76, 107035. doi:10.1016/j.frl.2025.107035

Zou, X., Li, W., Wu, W., Hunt, A., and Lu, H. (2025). How do executives' overseas experiences reshape corporate climate risk disclosure in emerging countries? Evidence from China's listed firms. *Systems* 13 (6), 494. doi:10.3390/systems13060494