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CEO Compensation, Green Innovation and Environmental Performance: Evidence from Chinese Listed Companies

Yuhang Ma[1], Imani Mokhtar[1]

[1]Faculty of Business and Management, Universiti Teknologi MARA, Puncak Alam, Selangor, Malaysia

Email: mayuhang724@gmail.com, imani895@uitm.edu.my

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Abstract

This study investigates the relationship between CEO compensation, green innovation, and environmental performance. By analyzing a sample of listed companies on China's stock exchanges from 2012 to 2022, the findings indicate that CEO compensation has a positive impact on environmental performance. Furthermore, green innovation can strengthen the positive impact of CEO compensation on environmental performance. Heterogeneity analysis indicates that the impact of CEO compensation on environmental performance is more significant within the non-state-owned enterprises. Likewise, a comparable circumstance emerges in the central region of China. Therefore, this study provides empirical insights that enrich the limited literature on CEO compensation, green innovation, and environmental performance. In terms of practical contributions, the most direct significance of this study is to investigate how CEO compensation design can effectively enhance corporate environmental performance and facilitate the synergistic development of economy and environment.

Keywords: CEO Compensation, Environmental Performance, Corporate Social Responsibility, Green Innovation, CEO Characteristics

Introduction

In light of the United Nations' adoption of the 17 Sustainable Development Goals in 2015, this initiative primarily focuses on ensuring sustainable ecological development while offering strategic guidance for governments, businesses, and society. These guidelines emphasize environmental considerations as a priority in fostering ecological harmony (UNEP, 2015). Besides, the latest 'Global Resources Outlook 2024' published by the United Nations Environment Programme (UNEP) indicates that the environmental performance of businesses is intricately linked to global ecology, environment, and resource management, and the world is facing an Earth crisis related to climate change, biodiversity loss, and pollution (UNEP, 2024).

Moreover, there is still a gap in society's response to environmental challenges, which fails to align with the contemporary requirements for environmental sustainability (Saeed et al., 2024). In the context of China, while the country has garnered global recognition for its rapid economic growth, it concurrently faces significant environmental challenges. For instance, approximately one-third of Chinese cities have been affected by acid rain in recent years, and industrial pollution continues to escalate (Li et al., 2024). Given the ongoing environmental degradation, the Chinese government has proactively engaged in environmental governance, advocating for a harmonious coexistence between economic development and ecological sustainability. The China Ecological Environmental Protection Conference convened on July 18, 2024, emphasizing that environmental protection is a critical prerequisite for economic and social development, and indicating the imperative to harmonize high-quality economic growth with ecological sustainability (China, 2024). Therefore, the issue regarding how to balance business development with environmental protection while ensuring sustainability has become a real issue.

As primary contributors to environmental pollution, companies have garnered significant scholarly attention regarding the factors that determine their environmental performance. Prior research has investigated the influence of both macroeconomic and microeconomic conditions on corporate environmental governance, respectively. From a macroeconomic perspective, government environmental incentive policies significantly enhance environmental governance and positively influence the reduction of governance costs while improving the frameworks for environmental supervision and management (Qin et al., 2024). Based on environmental regulation, the implementation of environmental regulations is more conducive to improving environmental performance, particularly for heavy-polluting industries (Chen et al., 2024). The disclosure of environmental information by the government significantly contributes to enhancing environmental performance, particularly in the developed regions of China (Zhu et al., 2021). From a microeconomic perspective, the factors influencing environmental performance are fundamentally rooted in corporate level. Corporate innovation has a significant positive impact on environmental performance, and companies with higher levels of innovative capacity are more likely to recognize the importance of developing environmental performance (Deng et al., 2022). Furthermore, corporate digital transformation serves as a critical determinant of environmental performance and it can enhance the improvement of environmental performance through the corporate green capabilities (Li & Lin, 2024).

Nevertheless, the aforementioned perspective neglects the executives' personal factors. According to upper echelons theory, the individual characteristics of executives can significantly influence the execution of business decisions (Hambrick, 2007). Environmental governance, recognized as a critical strategy for contemporary corporations, executives' characteristics inevitably have an impact on environmental performance. Therefore, the CEO wields substantial authority and oversees the corporate critical resources, who has a greater impact on environmental performance compared to other executives (Li et al., 2024). Previous studies have investigated the impact of CEO inside debt (Benlemlih et al., 2022), CEO career dynamics matter (Al-Najjar & Abualqumboz, 2024)，CEO green experience (Li et al., 2024) and CEO political orientation (Kim, 2024) on environmental performance, respectively. CEO characteristics frequently embody their personal preferences, values, and cognitive

capabilities. These traits can inform the CEO decision-making processes concerning environmental protection based on available evidence.

CEO compensation represents a significant aspect of CEO characteristics that warrants attention, as it exerts a direct influence on corporate decision-making, including the formulation of environmental protection strategies. The implementation of such strategies is likely to have consequential effects on the financial performance (Zhao et al., 2021). Given that CEO compensation is influenced by both financial performance and incentive structures, the financial performance directly impacting CEO compensation (Benlemlih et al., 2022; Zhao et al., 2021). However, existing evidence indicates that the relationship between CEO compensation and environmental performance is ambivalent. On the one hand, environmental strategies require substantial cash flow, which can significantly affect financial performance (Benlemlih & Cai, 2020). According to agency theory, CEOs are generally averse to engaging in high-risk investments, which can result in suboptimal financial performance (Cheng et al., 2023). On the other hand, environmental protection represents a critical issue for societal development. Companies with non-cost strategies are likely to prioritize environmental investments, integrate environmental performance metrics into the CEO compensation incentive, thereby incentivizing CEOs to enhance environmental performance (Benlemlih et al., 2022). Given the inconclusive relationship between CEO compensation and environmental performance, it is essential to investigate whether CEO compensation as a determinant of environmental performance. Furthermore, prior studies have neglected the moderating effect of green innovation on this relationship. This study aims to provide empirical evidence investigating the interactive relationship among CEO compensation, green innovation, and environmental performance.

This study presents an empirical analysis of the impact and mechanism of CEO compensation on environmental performance. Specifically, this study uses sample data from listed companies in China spanning the period from 2012 to 2022. The potential moderating effect of green innovation is examined by using CEO compensation and environmental performance as independent and dependent variables, respectively. Furthermore, a heterogeneity analysis is conducted based on business nature and business domicile, and to investigate how various organizational characteristics influence the relationship between CEO compensation and environmental performance.

This study makes significant contributions to the field. Firstly, it identifies a substantial relationship between CEO compensation and environmental performance, providing empirical evidence that supports prior studies into the positive impact of CEO compensation on environmental outcomes. Secondly, investigating green innovation as a moderating variable in the relationship between CEO compensation and environmental performance, thereby offering new theoretical insights into the mechanisms through which CEO compensation influences environmental performance. Thirdly, through a series of heterogeneity analyses—including factors such as business nature and business domicile—this study reveals that the influence of these variables on the relationship between CEO compensation and performance varies significantly. Finally, these findings offer valuable implications for corporate investors and policymakers while enhancing our understanding of regional and sectoral differences within the context of green investment.

Literature Review and Research Hypothesis

Environmental Performance

According to stakeholder theory, organizations should take into account the interests of stakeholders alongside their pursuit of economic profits (Gray et al., 2001). In essence, companies are obligated to fulfill corporate social responsibilities, which entails safeguarding the rights and interests of employees, customers, suppliers, governments, and other stakeholders. At present, the significance of stakeholders is increasingly pronounced, leading to a heightened demand for companies to uphold their social responsibilities (Hanjani & Kusumadewi, 2023). Therefore, the proactive enhancement of environmental performance represents an effective strategy for organizations to address stakeholder needs.

The agency theory suggests that corporate decisions should be formulated with careful consideration of their implications for shareholder value (Jensen & Meckling, 1976). Corporate environmental performance has consistently been regarded as a risk factor with uncertain implications for shareholder value (Rezaee, 2016). It is evident that the relationship between environmental performance and financial performance has long been a debating discussion. On the one hand, certain studies indicate that environmental performance may hinder the enhancement of financial performance(Horváthová, 2010; Lu & Taylor, 2018). This is primarily due to the substantial cash flow required for developing environmental initiatives, which often does not lead to significant short-term gains and may even result in a decline. Consequently, corporate managers are hesitant to compromise shareholder interests in pursuit of improved environmental performance (Benlemlih & Cai, 2020).

On the other hand, some studies suggest that environmental performance has a significant positive impact on financial performance (Muhammad et al., 2015; Ng & Rezaee, 2015). In terms of market competition, strong environmental performance can facilitate entry into new markets, enhance sales profits, and capitalize on the increasing demand for sustainable products and services (Rezaee, 2016). In terms of financing costs, the government implements green finance policies to provide lower financing costs for companies with higher environmental performance (Ng & Rezaee, 2015). With regard to goodwill, better environmental performance can enhance a corporate brand image and market reputation (Muhammad et al., 2015). As for human resources, better environmental performance can attract high-caliber talent and foster a greater sense of job satisfaction among employees (Greening & Turban, 2000).

Given the preceding discussion, there has been considerable debate and controversy surrounding the relationship between environmental performance and financial performance. However, merely discussing the impact of environmental performance on financial performance while neglecting the factors that influence environmental performance is inconsistent with contemporary demands for coordinated and sustainable economic development. Therefore, this study aims to investigate the relationship between CEO compensation and environmental performance by exploring the determinants of environmental performance.

CEO Compensation

Numerous theories and empirical studies have examined the relationship between CEO compensation and corporate decision-making. According to agency theory, CEO

compensation has a significant impact on corporate decision-making processes (Cheng et al., 2023). As CEO compensation decreases, the agency problem between the CEO and the board becomes more pronounced. This creates an information asymmetry between the CEO and the board, and which tempts psychologically imbalanced CEOs to seek personal interests at the expense of shareholders' interests (Francoeur et al., 2021). Regarding environmental performance, CEOs may neglect investments in sustainability due to a focus on personal performance metrics. According to tournament theory, increasing the compensation gap between CEO other employees is more advantageous for the organization in achieving elevated objectives (Connelly et al., 2013). CEO compensation gap can motivate vice presidents to surpass their performance targets and attain promotion to the CEO role. besides, the competitive environment can fulfill the psychological needs of newly appointed CEOs following the elevation of a vice president to that position. The majority of companies utilize financial performance as the primary criterion for assessing executive compensation, often at the expense of environmental performance. This oversight results in CEOs allocating insufficient attention to environmentally sustainable investments that necessitate substantial funding (Jermias & Mahmoudian, 2024). Therefore, CEO compensation has a negative impact on environmental performance based on short-sighted performance criteria.

Nevertheless, the stakeholder theory argues that environmental investments can address the needs of stakeholders and contribute to the long-term sustainability of the organization (Gray et al., 2001). As previously discussed, enhancing corporate environmental performance can foster a positive corporate image (Muhammad et al., 2015), strengthen employee engagement (Greening & Turban, 2000), build consumer trust(Rezaee, 2016), secure government support for green financing (Ng & Rezaee, 2015) and facilitate long-term stable financial growth (Jermias & Mahmoudian, 2024). Consequently, stakeholders contend that CEOs are incentivized to invest in environmental performance in pursuit of higher compensation and sustainable financial outcomes, while also safeguarding the interests of relevant parties. This study builds upon prior research to further investigate the relationship between CEO compensation and environmental performance.

Research Hypotheses

The preceding section reviews inconclusive result regarding the relationship between CEO compensation and environmental performance. It is evident that impact of CEO compensation on environmental performance remains a debating topic. This study supports that CEO compensation has a significant positive effect on environmental performance, primarily for three reasons. Firstly, in accordance with agency theory, linking CEO compensation to incentive pay serves to mitigate the agency problem (Francoeur et al., 2021). Reducing the compensation gap between CEOs and boards of directors can mitigate the information asymmetry between these entities, thereby enhancing the efficiency of corporate governance. Furthermore, CEOs with higher compensation reduce conflicts with the board, thereby reducing the likelihood of adverse behaviors towards stakeholders (Zhang et al., 2024). Secondly, in accordance with Maslow's hierarchy of needs, individuals who fulfill their lower-level needs are likely to pursue higher-level needs (Maslow, 1943). Therefore, CEOs with higher compensation are more inclined to pursue self-actualization needs, as they find it easier to satisfy the needs of lower and middle levels, including those related to survival, safety, social, and esteem (Su & Xue, 2023). Enhancing environmental performance can assist CEOs in fulfilling self-actualization needs and establishing personal reputations. Furthermore,

the current emphasis on corporate environmental performance aligns with societal development requirements. Several companies have already integrated environmental performance into CEO compensation incentives to address stakeholder demands. Therefore, the commonalities prove that CEO compensation can facilitate enhancements in environmental performance. This study proposes the following hypothesis:
H1: The CEO compensation has a significant positive impact on environmental performance.

This study further examines the relationship between CEO compensation, green innovation, and environmental performance. However, the existing studies have neglected the investigation of whether the relationship between CEO compensation and environmental performance is moderated by green innovation. The present empirical evidences indicate that green innovation serves as a critical determinant of environmental performance (Shuwaikh et al., 2023). Green innovation pertains to the development of new technologies that enable businesses to enhance energy efficiency and mitigate greenhouse gas emissions (Kraus et al., 2020). To mitigate the environmental degradation and resource wastage associated with corporate activities, stakeholders advocate for companies to engage in green innovation, invest in sustainable technologies, and enhance their environmental performance. Fatima et al. (2023) suggested that corporate green innovation can enhance both environmental and financial performance, asserting that investments in green innovation align more closely with a corporate long-term strategic objectives, based on a sample of global companies from 2013 to 2020 (Shuwaikh et al., 2023).

Furthermore, research has examined the relationship between CEO compensation and green innovation, revealing that CEO compensation can facilitate green innovation based on a sample of heavily polluting companies in China from 2015 to 2020 (J. F. Zhao et al., 2023). This is attributed to green innovation is more complex and specialized than traditional innovation (Jiao et al., 2020). The risks associated with green innovations that lack guaranteed returns are heightened, and CEOs who excessively focus on these initiatives may encounter innovation failures, resulting in reputational damage. According to agency theory, companies can establish appropriate compensation frameworks to mitigate CEOs' apprehensions regarding green innovation and encourage them to invest confidently in such endeavors (Manso, 2011). Compensation incentives serve as an effective mechanism for compensating CEOs and can also facilitate the alignment of interests between CEOs and shareholders, thereby mitigating agency problems and enhancing governance efficiency (Zulfiqar et al., 2020). A reduction in agency issues between shareholders and CEOs fosters a more conducive environment for decision-making aimed at maximizing shareholder wealth. Therefore, CEO compensation can promote corporate implementation of green innovation.

The aforementioned evidence indicates a significant positive relationship between green innovation and environmental performance, as well as a significant positive relationship between CEO compensation and green innovation. By strengthening green innovation, companies not only achieve breakthroughs in environmental technology but also foster sustainable development. Besides, the significant impact of CEO compensation on environmental performance is likely to be strengthened by the influence of green innovation. This phenomenon can be attributed to the Chinese government's encouragement for companies to enhance their environmental performance and pursue corporate green innovation (J. Zhao et al., 2023). Should a corporation exhibit negligent or detrimental

behavior concerning environmental issues or green innovation, the CEO may incur significant administrative penalties (Zhou et al., 2021). To mitigate reputational risks, CEOs are likely to proactively improve environmental performance and develop green innovation. Furthermore, in order to incentivize CEOs towards the development of green innovation, companies can implement compensation incentive policies that encourage bold decision-making. Therefore, within the framework of green innovation, higher CEO compensation is associated with a greater willingness to promote environmental performance. This study proposes the following hypotheses:

H2: Green innovation can enhance the positive impact of CEO compensation on environmental performance.

Methodology

Sample and Data

To investigate the impact and mechanisms of CEO compensation on environmental performance, this study analyzes listed companies on the Shenzhen and Shanghai stock exchanges in China from 2012 to 2022. Furthermore, this study excluds ST companies (characterized by abnormal financial conditions), financial insurance companies (noted for significant disparities in asset-liability structures), and instances of missing data (Deng et al., 2022; Zhang et al., 2024). The CEO characteristics and financial data are obtained from the China Stock Market & Accounting Research (CSMAR) in this study, while environmental performance data are obtained from the Wind database, and green patent data were obtained from China Research Data Services (CNRDS). To reduce the impact of outliers on the regression, this study winsorizes all continuous values from 1% to 99%. Ultimately, 6,676 observations are used in this study.

Variable Definition

Dependent Variable: Environmental Performance

Based on previous literature (Hoang et al., 2020; Petitjean, 2019), The dependent variable in this study comes from Bloomberg Environmental Performance. The environmental performance in this segment is superior. Firstly, it covers a wide range of environmental issues, including air quality, climate exposure, ecological impact, energy management, environmental supply chain management, GHG emissions management, sustainable product, waste management and water management. Secondly, Bloomberg Environmental Performance is model-driven and methodology is transparent. Thirdly, there are professional analysts and experts who identify all the indicators and data, and the methodology is peer-reviewed to ensure its professionalism. Finally, all the indicators align with the UNEP Sustainable Development Indicators, and the performance reflects a corporate sustainability capacity and attitude towards environmental factors. The performance standard for Environmental Performance (EP) is 0-100 points, with a minimum score of 0 and a maximum score of 100.

Independent Variable: CEO Compensation

This study follows previous studies (Khan et al., 2021; Kong et al., 2022), CEO compensation (CEOPay) includes the CEO's base salary, allowances, and bonuses. All the above data are sourced from the corporate annual report and recorded in CSMAR.

Moderating Variable: Green Innovation

The stronger a corporate green innovation capacity, the more it represents a breakthrough in green technology. This can help the company reduce energy consumption and emissions, thereby improving its environmental performance. Furthermore, investments in green innovation, along with the targeted incentives offered to CEOs in terms of compensation, contribute to enhanced environmental performance. To investigate whether green innovation strengthens the relationship between CEO compensation and environmental performance, this study employs the number of green patents as a metric for assessing firms' levels of green innovation. This methodology is followed by Li & Pang (2023) and Kong et al. (2022) (Hou & Zhang, 2024; Li & Pang, 2023; J. Zhao et al., 2023). The logarithm of the total number of green patent applications filed by companies. Currently, green patents classified into five main categories in China: alternative energy, environmental materials, energy conservation and emission reduction, pollution control and treatment, and recycling technologies (Li & Pang, 2023).

Control Variable

This study follows previous studies (Hanjani & Kusumadewi, 2023; Hou & Zhang, 2024), some financial indicators as control variables. These variables encompass board size (Boardsize), the proportion of independent directors (Inboard), Tobin's Q value (TobinQ), financial leverage (Lev), the representation of female executives (Female), and the shareholding ratio of the top 10 shareholders (Top10). To account for the potential influence of other variables on the regression model, all variables are detailed in Table 1.

Table 1
Definition of Variables

Variable	Meaning	Symbol	Description
Dependent variable	Environmental performance	EP	Corporate environmental performance
Independent variable	CEO compensation	CEOPay	The logarithm of CEO compensation, which includes base salary, allowance and bonus
Moderating Variable	Green innovation	GrInnov	The number of green patents filed plus one is taken as a logarithm
Control variable	Board size	Boardsize	The logarithm of the board number
	Inboard ratio	Inboard	Number of independent directors / Number of board
	Tobin's Q Value	TobinQ	Total market value of firm at end of year/ Total asset value of firm at end of year
	Leverage	Lev	Total liabilities / Total assets
	Management female proportion	Female	Number of female executives / Number of executives
	Proportion of the top 10 shareholders	Top10	Number of shares held by the top 10 shareholder / Total number of shares

Model Design

This study focuses on the impact of CEO compensation on environmental performance and baseline model (1) is established as follows:

$$EP_{i,t} = a_0 + a_1 CEOPay_{i,t} + \delta \sum Control_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (1)$$

Where EP is environmental performance, CEOpay represents CEO compensation, Control signifies that this study incorporates a set of control variables, Industry and Year represent that the model control for industry and year, respectively. $\boldsymbol{\varepsilon}$ is the random error term, and $\boldsymbol{\alpha}$ is the coefficient of the regression model. Furthermore, the model controls at the individual company level, using robust standard errors to ensure the accuracy of the model estimates.

To investigate the mechanism of CEO compensation on environmental performance, the moderation model (2) is established as follows:

$$EP_{i,t} = a_0 + a_1 CEOPay_{i,t} + a_2 CEOPay_{i,t} * GrInnov_{i,t} + a_3 GrInnov_{i,t} + \delta \sum Control_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (2)$$

This study examines the impact and mechanism of CEO compensation on environmental performance, with green innovation as a moderating variable within the model. Specifically, $GrInnov$ denotes the moderating variable that indicates whether the companies have achieved innovation in green patents, while $CEOPay_{i,t} * GrInnov$ represents the interaction term between CEO compensation and green innovation. Besides, this study focuses on coefficient a_2, where a positive coefficient represents the mechanism can strengthen the impact of CEO compensation on environmental. Otherwise, it represents an inhibitory effect.

Results and Discussion

Descriptive Analysis

The descriptive analysis of all variables is summarized in Table 2, encompassing sample size, mean value, standard deviation value, maximum value, and minimum value. Environmental performance exhibits a maximum of 64.87 and a minimum of 0, with a standard deviation of 13.46. It suggests considerable variability in environmental performance across different companies. Furthermore, CEO compensation ranges from a minimum of 8.7 to a maximum of 17.37, with a standard deviation of 0.867, indicating notable disparities in CEO compensation as well. Regarding green innovation, the values range from 0 to a maximum of 0.159 and mean value is 0.366. It reflects that the majority of companies demonstrate relatively limited capabilities in green innovation.

Table 2
Descriptive Analysis

Variable	Obs	Mean	Std.Dev.	Min	Max
EP	6,676	10.350	13.460	0.000	64.870
CEOPay	6,676	13.710	0.867	8.700	17.370
GrInnov	6,676	0.366	0.846	0.000	6.159
Boardsize	6,676	2.169	0.199	1.609	2.708
Inboard	6,676	37.550	5.454	28.570	60.000
TobinQ	6,676	2.086	1.548	0.802	15.610
Lev	6,676	0.461	0.194	0.035	0.908
Female	6,676	17.520	10.690	0.000	56.250
Top10	6,676	60.54	15.810	21.930	90.970

Regression Analysis Results

Baseline Model Results

Based on previous studies, they found mixed results regarding the impact of CEO compensation on environmental performance. It is assumed that CEO compensation has a significant positive impact on environmental performance. The regression results of CEO compensation on environmental performance are presented in Table 3. Column (1) shows that CEO compensation has a positive impact on environmental performance at the 1% significant level, without controlling for control variables. Column (2) shows that CEO compensation has a positive impact on environmental performance after controlling for control variables, with a coefficient of 0.765 at the 1% significant level. These findings support to Hypothesis 1, suggesting that higher levels of CEO compensation is associated with an increased likelihood of investment in environmental protection initiatives, thereby improving environmental performance (Benlemlih et al., 2022). This suggests that increasing CEO compensation can mitigate conflicts between CEOs and boards of directors, thereby narrowing the information asymmetry between the two parties and improve efficiency. Furthermore, it encourages CEOs to make decisions that are conducive to improving environmental performance.

Regarding other variables, corporate green innovation exerts a positive influence on environmental performance at the 1% significance level. This suggests that a stronger green innovation capacity correlates with an increased emphasis on environmental protection and the implementation of strategies conducive to enhancing environmental performance. Furthermore, Tobin's Q value and the proportion of independent directors have significant impact on environmental performance.

Table 3
The Impact of CEO Compensation on Environmental Performance

Variable	(1)	(2)
	EP	EP
CEOPay	0.761***	0.765***
	(0.232)	(0.230)
GrInnov		1.143***
		(0.298)
Boardsize		-0.842
		(1.307)
Inboard		0.098**
		(0.041)
TobinQ		0.498***
		(0.108)
Lev		-0.034
		(1.354)
Female		0.004
		(0.022)
Top10		0.030
		(0.018)
_cons	-0.103	-5.319
	(3.176)	(4.983)
N	6607	6607
R^2	0.729	0.732
adj. R^2	0.677	0.680
Year	YES	YES
Industry	YES	YES

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Endogeneity Test

Lagged Independent Variables

Current CEO compensation may be influenced by environmental performance. In other words, to enhance environmental performance, companies might incentivize CEOs through compensation. Therefore, panel data could present endogeneity issues. To address this issue, the present study integrates the lagged dependent variable as an exogenous variable in the regression analysis, based on prior research. For the lagged CEO compensation, the error term for the current period is considered exogenous, thereby mitigating endogeneity arising from reverse causality. As shown in Table 4 of column (1), there is still a positive impact of lagged CEO compensation on environmental performance at the 1% significant level. Obviously, these findings reveal that the baseline model regression results remain robust after accounting for potential endogeneity.

Table 4
Endogeneity Test

Variable	(1)	(2)
	EP	EP
L. CEOPay	0.884***	
	(0.273)	
CEOPayP		0.765**
		(0.338)
GrInnov	1.073***	1.293***
	(0.348)	(0.317)
Boardsize	0.434	-0.805
	(1.549)	(1.390)
Inboard	0.095*	0.094**
	(0.049)	(0.044)
TobinQ	0.616***	0.506***
	(0.141)	(0.118)
Lev	0.001	-0.410
	(1.734)	(1.394)
Female	-0.000	-0.003
	(0.028)	(0.024)
Top10	0.004	
	(0.024)	
_cons	-7.416	6.242
	(6.051)	(4.129)
N	5034	5739
R^2	0.756	0.726
adj. R^2	0.699	0.665
Year	YES	YES
Industry	YES	YES

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Propensity Score Matching (PSM)

CEOs with high compensation and CEOs with low compensation may have differences in their environmental awareness. Due to the influence of confounding variables, the estimated results are biased. To address this issue, this study employs PSM to ensure the robustness of the findings. First, we divide CEO compensation by the mean value in the industry and establish a dummy variable (CEOPayP). When CEO compensation is higher than the mean value of industry, it is assigned a value of 1, representing the treatment group; Otherwise, it is assigned a value of 0, representing the control group. Second, we utilize all the aforementioned control variables as covariates and conduct nearest neighbor matching at a 1:3. Finally, a total of 5,739 observations are acquired and incorporated into the regression analysis.

According to Table 4, Column (2) shows the matched results, with a positive coefficient for CEOPayP at the 5% significant level. This indicates that the baseline result still holds, suggesting a significant positive impact of CEO compensation on environmental performance.

Robustness Test

Replace Core Variables

This study employs a methodology consistent with prior research to ensure the robustness of the baseline model (Hou & Zhang, 2024; Li et al., 2024). CEO compensation is established as a dummy variable (CEOPayP), and divided based on the mean value of industry. If a CEO compensation exceeded the mean value of industry, it is assigned a value of 1; otherwise, it was set to 0. The results presented in Column (1) of Table 5 indicate that CEO compensation have a significant positive effect on environmental performance, thereby affirming the robustness of the baseline model findings.

Table 5
Robustness Test

Variable	(1)	(2)
	EP	EP
CEOPay		0.807***
		(0.231)
CEOPayP	0.747**	
	(0.324)	
GrInnov	1.155***	1.184***
	(0.298)	(0.300)
Boardsize	-0.665	-0.660
	(1.306)	(1.316)
Inboard	0.101**	0.099**
	(0.041)	(0.041)
TobinQ	0.502***	0.495***
	(0.108)	(0.109)
Lev	-0.023	-0.500
	(1.355)	(1.365)
Female	0.006	0.002
	(0.022)	(0.022)
Top10	0.029	0.034*
	(0.018)	(0.018)
_cons	4.316	-6.351
	(4.021)	(5.022)
N	6607	6607
R^2	0.732	0.734
adj. R^2	0.680	0.682
Industry	Yes	Yes
Year	Yes	Yes
Province	No	Yes

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Provincial Control

China is a multi-provincial country, and there are significant differences in environmental governance and support among provinces(Shang, 2024). In more developed provinces, the government offers more substantial policy subsidies to companies that demonstrate a higher level of environmental awareness compared to less developed provinces. Furthermore, in regions with a greater degree of marketization, economic participants exhibit heightened sensitivity to economic fluctuations and policies(Zeng et al., 2021). In other words, in areas with advanced marketization, CEOs tend to be more responsive to environmental policies, thereby facilitating improvements in environmental performance. Conversely, in regions with lower levels of marketization, CEOs may display apathy and reluctance to engage in environmental investments. As a result, CEO characteristics may have a weak significant impact on environmental performance.

Therefore, this study controls for provinces to ensure robustness of the baseline model regression results. The results are presented in the second (2) column of Table 5, which shows a significant positive impact of CEO compensation on environmental performance, supporting the results of the baseline model.

Mechanism Test

To explore the mechanism of CEO compensation on environmental performance, this study examines the moderating effect of green innovation on the relationship between CEO compensation and environmental performance. It suggests that green innovation signifies a breakthrough in technologies related to environmental protection and resource conservation, thereby enabling companies to enhance environmental performance more effectively. Furthermore, under the influence of green innovation, companies are likely to adjust CEO compensation incentive, which subsequently enhances CEO autonomy. As a result, CEOs are expected to mitigate conflicts with shareholders, improve governance efficiency, and demonstrate a greater willingness to invest in environmentally sustainable initiatives that promote overall environmental performance.

Table 6
Mechanism Test

Variable	(1)
	EP
CEOPay	0.783***
	(0.229)
CEOPay*GrInnov	0.680***
	(0.226)
GrInnov	0.725**
	(0.304)
Boardsize	-0.664
	(1.310)
Inboard	0.101**
	(0.041)
TobinQ	0.490***
	(0.108)
Lev	-0.187
	(1.353)
Female	0.005
	(0.022)
Top10	0.031*
	(0.018)
_cons	-5.982
	(4.988)
N	6607
R^2	0.733
adj. R^2	0.681
Industry	Yes
Year	Yes

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Column (1) of Table 6 presents the interrelationship among CEO compensation, green innovation, and environmental performance, revealing that the coefficient for the interaction term between CEO compensation and green innovation is positive and statistically significant at the 1% level. Besides, both coefficients for green innovation and CEO compensation in relation to environmental performance are positive and significant, indicating that the moderating effect has been robustly validated. In conclusion, under the influence of green innovation, the significant positive impact of CEO compensation on environmental performance has been strengthened, thereby providing support for Hypothesis H2.

Further Analysis

Heterogeneity of Business Nature

This study further investigates the impact of CEO compensation on environmental performance under different business nature. Prior research has analyzed the incentive policies for CEO compensation in state-owned enterprises (SOEs) and non-state-owned

enterprises (NON-SOEs), indicating that SOEs are frequently constrained by national policies and administrative regulations, resulting in a lower degree of flexibility in CEO compensation incentive systems compared to NON-SOEs (Hui & Fang, 2023). CEO compensation in Non-SOEs is more market-oriented and closely tied to the financial performance (Ji & Liu, 2023). In other words, NON-SOEs are more flexible in driving improvements in the environment. Furthermore, the external pressures faced by NON-SOEs and SOEs is different. The supervision of SOEs is more from government supervision, with less pressure from the market or the public (Leutert, 2016). Therefore, CEOs of SOEs are more inclined to adhere to the minimum standards mandated by the government rather than actively enhancing environmental performance. In contrast, the impact of CEO compensation is weaker. Instead, CEOs of NON-SOEs are subject to various forms of supervision, with a particular focus on consumers and investors. This pressure forces CEOs to proactively improve environmental performance for maintaining the corporate reputation and long-term development.

Above the discussion, this study argues that the significant positive impact of CEO compensation on environmental performance is stronger in NON-SOEs. Therefore, the sample is divided based on business nature to examine both SOEs (SOE) and NON-SOEs (NON-SOE). The results are presented in Table 7, which indicates that in NON-SOEs, CEO compensation has a positive impact on environmental performance at a significant level of 1%. In SOEs, CEO compensation has a positive effect on environmental performance, with a coefficient of 0.442, but there is no statistical significance. Our results confirm that the impact of CEO compensation on environmental performance varies across different business nature. These findings provide valuable guidance for investors and corporate managers seeking to enhance their understanding of environmental performance and optimize sustainable strategies.

Table 7
Heterogeneity Test

Variable	CEO gender		Business nature		Business domicile		
	FemaleCEO	MaleCEO	SOE	NON-SOE	West	Central	East
	EP	EP	EP	EP	EP	EP	EP
CEOPay	2.899**	0.698***	0.442	1.232***	1.068	1.441***	0.583**
	(1.143)	(0.241)	(0.287)	(0.382)	(0.769)	(0.499)	(0.278)
GrInnov	1.340	1.131***	0.543	1.679***	2.247**	1.469*	0.886***
	(1.554)	(0.304)	(0.393)	(0.446)	(1.034)	(0.859)	(0.330)
Boardsize	-13.053***	-0.611	-0.661	-0.612	-2.589	1.330	-0.500
	(4.849)	(1.345)	(1.910)	(1.785)	(3.238)	(2.642)	(1.672)
Inboard	-0.229*	0.104**	0.041	0.152***	0.026	-0.105	0.156***
	(0.127)	(0.043)	(0.058)	(0.057)	(0.101)	(0.090)	(0.050)
TobinQ	0.959**	0.443***	0.683***	0.360***	-0.049	0.178	0.640***
	(0.391)	(0.114)	(0.255)	(0.124)	(0.431)	(0.258)	(0.127)
Lev	4.275	-1.052	-2.925	2.500	1.859	-1.523	-0.131
	(5.153)	(1.433)	(2.422)	(1.750)	(4.044)	(3.422)	(1.603)
Female	0.265***	-0.016	-0.061	0.041	0.077	0.012	-0.009
	(0.084)	(0.024)	(0.041)	(0.028)	(0.078)	(0.055)	(0.026)
Top10	-0.099	0.025	-0.007	0.048*	-0.055	0.010	0.068***
	(0.080)	(0.019)	(0.032)	(0.026)	(0.082)	(0.041)	(0.022)
_cons	0.719	-3.808	6.507	-17.951**	2.176	-9.963	-7.979
	(18.844)	(5.221)	(6.954)	(7.392)	(14.426)	(11.146)	(6.163)
N	451	6123	3052	3533	738	1153	4676
R^2	0.773	0.740	0.738	0.738	0.767	0.728	0.734
adj. R^2	0.698	0.687	0.688	0.679	0.709	0.670	0.682
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Heterogeneity of Business Domicile

In examining the impact of CEO compensation on environmental performance, it is essential to consider the business domicile. China is divided into central, eastern, and western regions based on geographical orientation. Previous studies indicate that the eastern region is a developed area characterized by stringent environmental regulations that constrain corporate behavior (Hou & Zhang, 2024). While environmental management practices are becoming increasingly sophisticated, many companies have already established mature environmental management systems (Song et al., 2019), resulting in diminishing marginal returns for further enhancements in environmental performance. Besides, the eastern region is mostly home to high-tech companies, the likelihood of environmental pollution is small, and the impact of environmental performance in improving is limited (Zhao & Yuan, 2022). Therefore, CEOs may have lower levels of commitment to enhancing environmental performance, leading to a weaker correlation between CEO compensation and environmental outcomes.

In the context of central China, the industrial structure remains in a state of industrialization, with traditional industries comprising a larger portion. Companies in central

region face dual pressures from both government and market forces (Hou & Zhang, 2024). As a result, these companies are more inclined to enhance their environmental performance to secure government support and gain competitive advantages in the market. Therefore, CEOs are motivated to improve environmental performance, leading to a correlation between CEO compensation and environmental performance.

In contrast, companies in the western region of China tend to prioritize resource extraction and heavy industries, with their level of development being relatively lower (Hou & Zhang, 2024). The primary challenges faced by these companies are related to survival and growth, resulting in environmental issues being assigned a lower priority. Furthermore, due to the limited regulatory of environmental performance by the government while pursuing economic development, relevant laws and policies remain inadequately developed (Song et al., 2019). Therefore, CEOs are more inclined to emphasize financial performance over environmental performance, leading to a negligible impact of CEO compensation on environmental outcomes.

In conclusion, this study adhere to the methodology established in prior research(Hou & Zhang, 2024), and divided the provinces where companies are listed on the stock exchange into three regions: Western, Central, and Eastern. The results presented in Table 7 reveal that there is no significant impact of CEO compensation on environmental performance for companies located in the Western region. Conversely, a significant positive impact of CEO compensation and environmental performance in both the Central and Eastern regions, with coefficients of 1.441 and 0.583, respectively. This indicates that the positive impact of CEO compensation on environmental performance is more significant among companies in the Central region compared to those in the Eastern region. Therefore, when investigating the impact of CEO compensation on environmental performance, it is essential to consider the business domicile. This finding helps investors and managers understand the multiple factors that influence environmental performance, including economic levels, government policy oversight, and industrial structure differences, for guiding them to make corresponding adjustments effectively.

Conclusions

Main Conclusion

This study investigated the impact and mechanism of CEO compensation on environmental performance in listed companies on the Shenzhen and Shanghai stock exchanges in China from 2012 to 2022. The findings indicate that CEO compensation has a significant positive impact on environmental performance, and green innovation can further strengthen this positive impact. Moreover, the positive impact of CEO compensation on environmental performance is more pronounced in NON-SOEs compared to SOEs. Notably, in China's central region, as CEO compensation increases, CEOs show stronger motivation to promote environmental investment, thereby promoting environmental performance. Conversely, the impact of CEO compensation on environmental performance is relatively weak in the eastern region, while no significant impact is shown in the western region.

Contribution

This study offers significant theoretical and contextual contributions to the intersection of executive compensation, green innovation, and environmental performance. Theoretically,

it bridges the gap in understanding how CEO compensation influences corporate environmental strategies, extending the insights of agency theory and stakeholder theory by incorporating green innovation as a moderating factor. This novel integration elucidates the mechanisms through which financial incentives can drive environmentally sustainable outcomes, enriching the limited discourse on executive decision-making in sustainability contexts. Contextually, the study is pivotal in the Chinese corporate environment, where the tension between rapid industrial growth and ecological sustainability presents unique challenges. By examining the heterogeneity across regions and business types, the research highlights how localized economic conditions and organizational characteristics shape the effectiveness of compensation strategies. These insights not only enhance existing frameworks but also inform tailored policies for fostering green innovation and improving environmental performance. The findings underscore the broader implications of aligning corporate governance with sustainability objectives, positioning this study as a cornerstone for future research and policy development in emerging markets.

Recommendations

This study provides valuable insights for corporate managers, investors, and policy makers.

1. For corporate managers, it suggests that companies can effectively guide CEOs to balance the pursuit of financial performance with a commitment to environmental sustainability. A thoughtfully designed CEO compensation framework can significantly improve corporate environmental performance. Furthermore, CEOs should increase investments in green technologies to further advance corporate environmental outcomes, thereby securing favorable market positions and reputations.
2. For investors, reliance on short-term economic gains is increasingly inadequate in present diversified market landscape. Investors must also consider a corporate environmental performance as an essential factor that can mitigate various risks, which including compliance-related risks and potential threats posed by climate change. Moreover, those who prioritize high levels of environmental performance may find opportunities in NON-SOEs, which tend to receive greater recognition from the market for their environmental and social contributions.
3. For policy makers, government initiatives could encourage companies to incorporate environmental metrics into CEO compensation evaluations, thus incentivizing top management to drive green development strategies. Besides, policies should facilitate the transition of businesses from traditional high-pollution and energy-intensive practices toward sustainable low-carbon models—an approach. This approach can support sustainable development among underdeveloped companies in western regions.

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