Research Article

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More Philanthropy, More Consistency? Examining the Impact of Corporate Charitable Donations on ESG Rating Uncertainty

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Abstract: The variability in environmental, social, and governance (ESG) ratings poses challenges for investors and companies. Drawing on data from Chinese A-share listed firms (2015–2023), we show that corporate charitable donations (CCD) significantly reduce ESG rating uncertainty (ESGSTD), reinforced by CEO green experience, overseas education, and academic background. Robust checks confirm these findings. Corporate reputation and media attention are key mechanisms linking CCD to reduced rating inconsistency. ESG-focused investors further amplify this effect. Our results underscore the importance of strategic corporate social responsibility activities, CEO attributes, and public visibility in enhancing ESG rating consistency.

Keywords: corporate charitable donations, ESG rating uncertainty, CEO green experience, CEO overseas education experience, CEO academic background

1 Introduction

In recent years, environmental, social, and governance (ESG) ratings have emerged as critical indicators of corporate sustainability and ethical conduct (Shaikh, 2022a). These ratings are used by investors, regulators, and other stakeholders to evaluate a company's long-term viability, risk profile, and overall commitment to sustainability (Bao et al., 2024; Li et al., 2025; Zhang et al., 2025). ESG ratings encompass a broad range of criteria, including environmental impact, labor practices, corporate governance structures, and community engagement (Tsang et al., 2023). The growing importance of ESG ratings is underscored by the rise of sustainable investing, where investors seek to allocate capital to companies that not only deliver financial returns but also contribute positively to society and the environment (Gan et al., 2023; Park & Lee, 2023).

Despite their importance, ESG ratings are often fraught with variability and inconsistency, a phenomenon known as ESG rating uncertainty. This uncertainty arises because different rating agencies use varied methodologies, criteria, and data sources to assess companies' ESG performance (Billio et al., 2021). For instance, one agency might place more emphasis on environmental factors, while another might prioritize governance or social aspects, leading to divergent ratings for the same company. This lack of standardization creates significant challenges for stakeholders who rely on these ratings to make informed decisions. Investors may find it difficult to compare companies accurately, and companies themselves may struggle to understand and improve their ESG performance due to conflicting feedback from different rating agencies (Olayinka, 2022).

Corporate charitable donations (CCD), defined as voluntary contributions to social causes, have long been recognized as a critical component of corporate social responsibility (CSR) strategies (Carroll, 1991). Existing literature highlights CCD's dual role in enhancing corporate reputation (CR) and fostering stakeholder trust (Porter, 2002). By engaging in CCD, firms signal their commitment to societal welfare, which can improve brand loyalty, employee morale, and investor confidence. However, the effectiveness of CCD depends on its strategic alignment with corporate objectives. Strategic donations – those tied to long-term social or environmental goals – are more likely to generate sustainable value compared to symbolic or ad hoc contributions, which may be perceived as "greenwashing" (Lyon & Montgomery, 2015).

Recent studies further emphasize CCD's potential to influence ESG performance. For example, Kim and Park (2023) argue that CCD acts as a costly signal, reducing information asymmetry between firms and rating agencies by demonstrating genuine CSR commitment. Similarly, Chauvey et al. (2015) posit that CCD enhances a firm's

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legitimacy, aligning it with stakeholder expectations and encouraging rating agencies to adopt standardized evaluation criteria. Despite these insights, the literature remains divided on how CCD affects ESG rating uncertainty – specifically, whether it mitigates discrepancies across rating agencies. While some studies suggest that CCD improves social (S) and governance (G) scores, the mechanisms linking CCD to reduced ESG rating variability remain underexplored.

China's unique policy landscape further complicates this relationship. The 2016 Charity Law institutionalized tax incentives for CCD, incentivizing firms to align philanthropic activities with national priorities such as poverty alleviation and environmental protection (Liu et al., 2023a). The 2021 Common Prosperity policy elevated CSR to a strategic imperative, positioning businesses as key actors in addressing social inequities (Kakwani et al., 2022). Consequently, Chinese listed firms – particularly state-owned enterprises (SOEs) – often engage in CCD not only to fulfill market-driven CSR objectives but also to comply with government directives. This dual pressure creates a distinctive institutional environment where ESG ratings reflect both market forces and political imperatives (Li et al., 2022). Yet, the interplay between CCD and ESG rating consistency in this context remains poorly understood.

Furthermore, the role of CEO characteristics in moderating the relationship between CCD and ESG rating uncertainty remains underexplored. CEOs with diverse experiences and backgrounds, such as green experience (CGE), overseas education experience (COE), and academic background (CAE), can significantly influence corporate strategies and outcomes. For instance, CEOs with green experience are likely to implement more effective and credible CSR strategies, which could reduce the impact of ESG rating uncertainty. Similarly, CEOs with overseas education might bring diverse perspectives and innovative practices that further strengthen the relationship between CCD and ESG rating reliability (Cortes & Herrmann, 2021). CEOs with strong academic backgrounds are often more adept at analytical thinking and strategic decision-making, which could help in leveraging CCD to improve ESG performance and reduce rating uncertainty.

Despite the potential significance of these CEO characteristics, their moderating effects on the relationship between CCD and ESG rating uncertainty have not been thoroughly examined. Addressing this gap is essential for both theoretical and practical reasons. From a theoretical perspective, understanding these dynamics can contribute to the literature on CSR, ESG ratings, and corporate governance. Practically, it can inform better corporate governance and CSR strategies, helping companies to improve their ESG ratings and reduce uncertainty, thereby gaining the trust of investors and other stakeholders.

The aim of this study is to address these gaps by investigating the following research questions:

RQ1: How do CCD impact ESG rating uncertainty?

RQ2: To what extent do CEO characteristics (green experience, overseas education experience, and academic background) moderate the relationship between CCD and ESG rating uncertainty?

We examine the impact of CCD on ESGSTD using a multivariate regression model and data from Chinese A-share listed companies from 2015 to 2023. Our results indicate that CCD significantly reduces ESGSTD. Moreover, CEO characteristics, specifically CGE, COE, and CAE, strengthen this effect. Robustness checks confirm these findings. ESG-focused investors further amplify the positive impact of CCD.

We utilize a comprehensive dataset from Chinese A-share listed companies, covering the period from 2015 to 2023. The data include information on CCD, ESG ratings from six different agencies, and various CEO characteristics. Our primary method of analysis involves multivariate regression models, controlling several firm-specific variables. To address potential endogeneity issues, we employ robustness checks such as first-order difference models, instrumental variable (IV) approaches, and propensity score matching (PSM).

The primary contributions of this study are threefold. First, it provides empirical evidence on the role of CCD in reducing ESG rating uncertainty. Second, it explores the moderating effects of CEO characteristics on this relationship, offering insights into how different types of CEO experiences influence ESG rating uncertainty. Third, it contributes to the broader CSR and corporate governance literature by highlighting the importance of external pressures and incentives, such as those from ESG-focused investment funds, in shaping corporate behavior.

The remainder of this study is organized as follows: Section 2 reviews the literature relevant to our study. Section 3 describes the data and methodology employed. Empirical findings are presented in Section 4. Finally, Section 5 offers conclusive remarks and summarizes the key insights of the study.

2 Literature Review and Research Hypothesis

2.1 CCD and ESG Rating Certainty

CCD refer to voluntary contributions made by companies to charitable causes, non-profit organizations, or

community projects (Atmeh et al., 2020; Cheng & Geng, 2021). These contributions can take various forms, including monetary donations, in-kind contributions, and volunteer programs (Saleh, 2020). Monetary donations involve direct financial support to charities or community programs, while in-kind contributions consist of donations of goods or services instead of cash (Osei & Alagidede, 2023). Volunteer programs involve companies allowing their employees to volunteer for community services during paid work hours (Hatami et al., 2024). The importance of CCD in modern business practices cannot be overstated. CCD plays a significant role in enhancing a company's social responsibility profile. By engaging in charitable activities, companies can improve their public image and build goodwill among stakeholders (Wirba, 2024). This, in turn, can lead to increased customer loyalty, employee satisfaction, and overall CR (Kim et al., 2020; Le, 2023). Companies are often motivated to make charitable donations to fulfill their CSR obligations, enhance their corporate image, and gain trust among stakeholders, including customers, employees, investors, and the community at large (Amin & Harris, 2020; Maung et al., 2020; Wu et al., 2021).

The impact of CCD on corporate performance has been widely studied, with mixed findings in the literature. On the financial performance front, some studies suggest that CCD can lead to improved profitability and stock returns (Al Frijat et al., 2024; Alatawi et al., 2023; Shin et al., 2021). For instance, companies engaged in charitable activities may benefit from increased sales due to enhanced brand reputation and customer loyalty (Rodell et al., 2020). However, other studies find no significant relationship or even a negative impact, suggesting that the resources allocated to charitable donations could have been used more effectively elsewhere in the business (Yu et al., 2022). These mixed findings highlight the need for a deeper understanding of the conditions under which CCD can positively impact financial performance. In terms of non-financial performance, research indicates that CCD can significantly enhance various non-financial performance indicators. For example, companies that engage in charitable activities often see higher levels of employee satisfaction and morale, as employees feel proud to work for a socially responsible organization (Khaskheli et al., 2020). The role of CCD in building a positive CR is particularly crucial, as it helps companies differentiate themselves from competitors and foster long-term relationships with stakeholders (Vo et al., 2020). Signaling theory suggests that companies engage in activities like CCD to signal their quality and commitment to stakeholders (DesJardine et al., 2021; Suchman, 1995).

ESG ratings evaluate a company's performance in three key areas: environmental, social, and governance. These ratings are provided by various rating agencies, which use different criteria and methodologies to assess how well companies manage ESG issues (Clementino & Perkins, 2021; Rajesh, 2020). The criteria typically include factors such as environmental impact, labor practices, corporate governance structures, and community engagement (Sancha et al., 2023). ESG ratings are significant to investors, regulators, and other stakeholders. Investors increasingly use ESG ratings to make informed investment decisions, as high ESG-rated companies are perceived to be more sustainable and less risky (Barka et al., 2023). Regulators may also rely on ESG ratings to ensure companies adhere to certain standards and practices (Krueger et al., 2021). For companies, high ESG ratings can lead to better access to capital, lower cost of capital, and enhanced reputational benefits.

ESG rating uncertainty refers to the variability or inconsistency in ESG ratings assigned to the same company by different rating agencies. This uncertainty can arise due to differences in rating methodologies, criteria, and data sources (Gibson Brandon et al., 2021). The lack of standardization in ESG ratings can create challenges for investors and other stakeholders in accurately assessing a company's ESG performance (Cort & Esty, 2020).

The relationship between CCD and ESG ratings has been explored in several studies. The direct impact of CCD on ESG ratings is generally positive, as charitable donations can enhance a company's social and governance scores (Liao et al., 2023; Sandberg et al., 2023), thereby improving its overall ESG ratings. By engaging in charitable activities, companies demonstrate their commitment to social responsibility, which is favorably viewed by ESG rating agencies (You, 2024). However, there are nuances and limitations in the existing literature. While Lopatta et al. (2024) highlight the positive impacts of CCD on ESG ratings, they do not fully explore the mechanisms through which this occurs. Additionally, many studies do not account for the potential endogeneity between CCD and ESG ratings. For instance, companies with better ESG ratings might have more resources to allocate to charitable donations (Zhang & Li, 2024), creating a reverse causality problem. Furthermore, CCD can impact ESG rating certainty. Companies that consistently engage in charitable activities signal their commitment to social responsibility and transparency (Conte et al., 2023). This can reduce ESG rating uncertainty by providing more consistent and reliable data for rating agencies to assess (Sun et al., 2024a). Increased stakeholder engagement and improved corporate transparency, driven by CCD, can lead to greater certainty and alignment in ESG ratings across different agencies. By engaging in charitable donations, firms signal their commitment to CSR (Lewin & Warren, 2025), which in turn reduces ESG rating uncertainty. More

precisely, CCD serve as credible and costly signals that directly address the information asymmetry problem between firms and ESG rating agencies. When rating agencies consistently observe substantive donation activities, they directly interpret these actions as tangible and reliable indicators of the firm's genuine CSR engagement. Consequently, this direct signaling mechanism reduces subjective judgment and ambiguity during ESG assessments, thereby leading to greater consistency and lower uncertainty in ESG ratings.

Recent empirical studies have further deepened our understanding of how corporate philanthropy influences ESG rating discrepancies, presenting an increasingly nuanced picture. First, several studies highlight the importance of donation consistency, showing firms with stable and continuous charitable activities achieve greater rating convergence across ESG agencies (Dai et al., 2024; He et al., 2025). Furthermore, other recent research emphasizes that the strategic alignment between corporate donations and core business sustainability objectives significantly reduces ambiguity among ESG evaluators (Annesi et al., 2025). Finally, some scholars have explored context-specific mechanisms, demonstrating how firms in emerging economies particularly benefit from clearly articulated philanthropic efforts to mitigate rating uncertainty, due to heightened information asymmetry and institutional complexity (Ferdous et al., 2025). Collectively, these contemporary insights not only reinforce earlier theoretical predictions but also underline the critical importance of examining specific moderating factors – such as CEO attributes – that may enhance or limit the effectiveness of charitable donations in reducing ESG rating variability.

Under the political context of mainland China, CCD are not merely voluntary CSR initiatives but are also significantly driven by institutional pressures. On the one hand, firms with close ties to the government often leverage CCD to obtain policy support, such as project approvals, financing facilitation, and tax incentives (Kong et al., 2022). This institutional pressure renders CCD a strategic and instrumental practice, where firms actively engage in philanthropic activities to secure policy-related resources and enhance their market competitiveness. On the other hand, the institutional linkages between the government and enterprises lead to CCD being assigned greater weight in corporate ESG ratings. Government-driven policy objectives and governance models encourage rating agencies to consider firms' relationships with the government, their responsiveness to policy directives, and their willingness to fulfill social responsibilities when assessing ESG performance (Li et al., 2022; Zhang & Zhao, 2022).

Thus, CCD not only reflects a firm's CSR awareness but also serves as a signaling mechanism in government–corporate relations. By demonstrating their engagement in public welfare initiatives, firms can strengthen their political and economic legitimacy and gain advantageous positions within the regulatory environment. This phenomenon further elevates the weighting of political capital in corporate ESG ratings, meaning that higher ESG scores may not solely reflect a firm's ESG performance but may also indicate the strength of its ties with the government.

In summary, from the perspective of signaling theory, CCD, as a voluntary and high-cost commitment behavior, serve as a credible signal of CSR to rating agencies, reducing information asymmetry and thereby minimizing rating discrepancies caused by information differences across agencies. From the perspective of legitimacy theory, CCD helps firms gain social recognition from stakeholders, enhancing their normative legitimacy in ESG evaluations and prompting rating agencies to adopt more consistent evaluation standards. Based on the literature review, the following hypotheses are developed:

H1: CCD reduce ESG uncertainty.

2.2 Role of CEO Multiple Experiences

The role of CEO characteristics in shaping corporate strategies and outcomes has garnered significant attention in the academic literature. This section synthesizes the findings related to three specific CEO experiences: CGE, COE, and CAE, and explores their moderating effects on the relationship between CCD and ESG rating uncertainty.

2.2.1 CGE

CGE refers to the professional background and experience that a CEO has in environmental management and sustainability practices (Li et al., 2023; Uyar et al., 2024). Studies have shown that CEOs with green experience are more likely to implement effective CSR strategies and promote sustainability initiatives within their organizations (Huang & Wei, 2023; Le et al., 2024; Li et al., 2024; Ma et al., 2025). For instance, Mahran and Elamer (2024) found that CEOs with a strong background in environmental management are more likely to improve their firms' environmental performance and engage in sustainable practices. This aligns with Signaling theory, which suggests that such CEOs can signal their commitment to sustainability, thereby enhancing the credibility and effectiveness of their companies' CCD efforts (Elbardan et al., 2023). Despite the positive influence of CGE on

corporate environmental performance being well-documented, its impact on the relationship between CCD and ESG rating uncertainty remains underexplored. This gap is significant because CGE could enhance the credibility and effectiveness of CCD, thereby reducing ESG rating uncertainty. By incorporating CGE into the analysis, this study aims to provide a more comprehensive understanding of how CEO characteristics influence ESG outcomes. CEOs with green experience can more effectively align CCD with environmental performance. Through the lens of signaling theory, such CEOs convey a stronger commitment to environmental responsibility, thereby reducing discrepancies in environmental assessments among rating agencies. Based on the literature review, the following hypotheses are developed:

H2: CGE moderates the negative impact of CCD on ESG rating uncertainty.

2.2.2 COE

COE refers to the international educational background of a CEO. CEOs who have studied abroad often bring diverse perspectives and a global mindset to their organizations (Cao et al., 2024; Zhong et al., 2023). Research suggests that CEOs with overseas education are more likely to adopt innovative practices and promote international standards in their companies (Hussain et al., 2024; Liu et al., 2024). Additionally, COE can enhance a CEO's understanding of global sustainability issues and CSR practices (Zhang & Dong, 2023), thereby aligning with Legitimacy theory, which posits that organizations seek to gain legitimacy by adhering to societal norms and values (Bukari et al., 2024; Ying et al., 2024). However, the literature on COE's impact on CCD and ESG rating uncertainty is limited. While studies like those by Karniouchina et al. (2023) have highlighted the broader advantages of international experience for corporate governance, they do not specifically address how COE might influence the effectiveness of CCD in reducing ESG rating uncertainty. CEOs with an international educational background are more familiar with global ESG rating frameworks (e.g., MSCI environmental, social, and governance [ESG] ratings), facilitating the alignment of CCD with international standards. Through the lens of institutional theory, this alignment enhances rating agencies' recognition of consistency in ESG evaluations. Based on the literature review, the following hypotheses are developed:

H3: COE moderates the negative impact of CCD on ESG rating uncertainty.

2.2.3 CAE

CAE refers to the formal education and academic qualifications of a CEO (Mun et al., 2020; Oradi et al., 2020). CEOs with strong academic backgrounds are often more adept at analytical thinking and strategic decision-making. Studies have shown that such CEOs are more likely to implement evidence-based strategies and promote a culture of learning and innovation within their organizations (Chin et al., 2021; Mukherjee & Sen, 2022; Zheng et al., 2020). For instance, Ren et al. (2023) found that CEOs with advanced degrees are more likely to pursue long-term strategic goals. The literature on CAE's impact on corporate outcomes is extensive, but its specific role in moderating the relationship between CCD and ESG rating uncertainty is less understood. Given that CEOs with strong academic backgrounds might better leverage CCD to enhance their companies' social responsibility profiles (Erin et al., 2021), this study investigates this potential moderating effect. Meanwhile, CEOs with an academic background excel in optimizing CCD strategies through data analysis. From the perspective of behavioral decision theory, such CEOs enhance the transparency and interpretability of CCD, thereby reducing subjective discrepancies among rating agencies. Based on the literature review, the following hypotheses are developed:

H4: CAE moderates the positive impact of ESG rating uncertainty on CCD.

3 Data and Methods

3.1 Data and Sample

CCD and basic information on listed companies are sourced from the CSMAR database. Specifically, the financial statement notes on non-operating expenses detail corporate investments in charitable and volunteer projects. This study selects the charitable donation data to calculate the annual donation total for each firm. Considering data availability and the recognition of ESG rating agencies, we selected six ESG rating agencies for measurement: Sino-Securities ESG Ratings, SynTao Green Finance ESG Ratings, Alipay ESG Ratings, Wind ESG Ratings, Bloomberg ESG Ratings, and FTSE Russell ESG Ratings. Sino-Securities ESG Ratings began in 2009; SynTao Green Finance ESG Ratings and Alipay ESG Ratings started in 2015; Wind ESG Ratings and FTSE Russell ESG Ratings started in 2018; and Bloomberg ESG Ratings

began in 2011. To ensure sufficient sample size, we retained A-share listed companies rated by at least three ESG rating agencies from 2015 to 2023, following Wang et al. (2024). Additionally, we excluded financial, insurance, and ST category listed companies, as well as samples with missing values. The final sample consists of 13,719 firm-year observations. The data used in this study mainly come from the Wind database, CSMAR database, and CNRDS database. We also winsorized continuous variables at the 1% level to mitigate the influence of extreme values.

3.2 Variables of Study

3.2.1 Independent Variable

Existing studies on measuring the level of charitable donations mainly use absolute and relative indicators. To eliminate the influence of heteroscedasticity, transform the variables as linearly as possible, and reduce the skewness of the sample data distribution, we refer to previous research and measure corporate donation size by taking the logarithm of the annual CCD amount plus one (Huang et al., 2024; Wang et al., 2023). Donation data are sourced from the detailed items of charitable donation expenditures in the financial statements of listed companies in the CSMAR.

Although CCD are generally regarded as a positive signal of ESG performance, their effects may be moderated by donation motives and execution quality. For example, symbolic donations may be perceived by rating agencies as "greenwashing" behaviors, exacerbating discrepancies in ESG ratings. In contrast, strategic donations are more likely to convey credible signals due to their high costs and verifiability. This study captures the impact of donation scale on signal strength by using the logarithm of donation amounts instead of a binary variable. Furthermore, it examines the moderating role of CEO characteristics in donation strategies, identifying the driving factors behind high-quality CCD.

3.2.2 Dependent Variable

There are differences in the ESG rating scales of different rating agencies. To make the ratings from different agencies comparable, this study first standardizes the ratings from six ESG rating agencies. Following Berg et al. (2022), Christensen et al. (2022), and Serafeim and Yoon (2023), we apply a *z*-score normalization method to each agency's ratings. Specifically, for each agency, we calculate the *z*-score of a firm's ESG rating as follows:

$$z_{i,j} = \frac{R_{i,j} - \mu_j}{\sigma_j}, \tag{1}$$

where $R_{i,j}$ is the ESG rating of firm i from agency j, μ_j is the mean ESG rating of all firms from agency j, and σ_j is the standard deviation of ESG ratings from agency j. This transformation ensures that the ratings from different agencies are on a comparable scale with a mean of 0 and a standard deviation of 1.

After standardization, we calculate the ESGSTD for each firm as the standard deviation of the *z*-scores across the six agencies:

$$\text{ESGSTD}_i = \sqrt{\frac{1}{N-1}\sum_{j=1}^{N}(z_{i,j} - \bar{z}_i)^2}, \tag{2}$$

where N is the number of rating agencies (six in this study), and $\bar{z}_i$ is the mean *z*-score of firm i across all agencies. A higher ESGSTD value indicates greater inconsistency in ESG ratings across agencies.

The *z*-score normalization method ensures that ratings from different agencies are comparable by removing scale differences. Rating dispersion directly captures the divergence in evaluations among agencies, reflecting the core definition of ESG uncertainty as inconsistency in external assessments. A higher dispersion (ESGSTD) indicates greater disagreement, which undermines stakeholders' ability to rely on ESG ratings for decision-making. By standardizing each agency's ratings (via *z*-scores), we eliminate scale differences, ensuring comparability across agencies. This step is critical to isolate true disagreement from methodological heterogeneity.

However, this approach assumes that the distribution of ratings from each agency is approximately normal. If the distribution is highly skewed, alternative normalization methods (e.g., min-max scaling) may be more appropriate. Nonetheless, *z*-score normalization is widely used in ESG research due to its simplicity and interpretability.

3.2.3 Mechanism Variables

COE is a binary variable indicating whether the CEO has received education abroad (1 if yes, 0 otherwise), supported by Agcayazi et al. (2024) and Xu (2024). CAE indicates if the CEO has an academic background related to sustainability or governance (1 if yes, 0 otherwise), following Liang et al. (2024) and Li et al. (2024). CGE measures if the CEO has prior experience in environmental initiatives (1 if yes, 0 otherwise), as shown by Deng et al. (2024) and Kallias et al. (2023). CEO personal information, ownership structure data, board structure data, and firm

characteristics data are sourced from the CSMAR database, with the manual screening of CEO personal information.

3.2.4 Control Variables

To accurately isolate the effect of our main explanatory variables on ESG uncertainty, we include several control variables that are commonly used in the literature. Firm size (Size), measured by the natural logarithm of total assets, captures resource availability for ESG issues (El Badlaoui & Cherqaoui, 2023). Leverage (Lev), the ratio of total debt to total assets, accounts for financial constraints (Wang et al., 2025; Xu et al., 2024a). Return on equity (ROE), net income divided by shareholders' equity, controls for profitability (Jin et al., 2024a). Growth, the percentage increase in total revenue, considers resource allocation. The largest Shareholder Ownership (Top1) accounts for ownership concentration, Tobin's Q for firm valuation, and Audit Opinion (Opinion) for financial reporting quality. The detailed variable definitions are shown in Table 1.

3.3 Model Specification

3.3.1 Benchmark Regression Model Construction

To examine the impact of CCD on ESG uncertainty, we construct the following benchmark regression model. The model includes year and industry-fixed effects to control for temporal and sector-specific influences:

$$\begin{aligned} \mathrm{ESGSTD}_{i,t} = {} & \beta_0 + \beta_1 \mathrm{CCD}_{i,t} + \beta_2 \mathrm{Size}_{i,t} + \beta_3 \mathrm{Lev}_{i,t} \\ & + \beta_4 \mathrm{ROE}_{i,t} + \beta_5 \mathrm{Growth}_{i,t} + \beta_6 \mathrm{Top1}_{i,t} \\ & + \beta_7 \mathrm{TobinQ}_{i,t} + \beta_8 \mathrm{Opinion}_{i,t} + \sum \mathrm{Year}_t \\ & + \sum \mathrm{Industry}_i + \epsilon_{i,t}, \end{aligned} \tag{3}$$

where ESGSTD represents the ESG uncertainty of firm i in year t; CCD denotes the CCD; Size, Lev, ROE, Growth, Top1, TobinQ, and Opinion are control variables.

3.3.2 Moderating Effect Regression Model Construction

To investigate the moderating effects of CEO characteristics on the relationship between CCD and ESG uncertainty, we construct six models to examine both direct and interaction effects of COE, CAE, and CGE.

Direct Moderation Model for COE:

$$\begin{aligned} \mathrm{ESGSTD}_{i,t} = {} & \delta_0 + \delta_1 \mathrm{CCD}_{i,t} + \delta_2 \mathrm{COE}_{i,t} + \delta_3 \mathrm{Size}_{i,t} \\ & + \delta_4 \mathrm{Lev}_{i,t} + \delta_5 \mathrm{ROE}_{i,t} + \delta_6 \mathrm{Growth}_{i,t} \\ & + \delta_7 \mathrm{Top1}_{i,t} + \delta_8 \mathrm{TobinQ}_{i,t} + \delta_9 \mathrm{Opinion}_{i,t} \\ & + \sum \mathrm{Year}_t + \sum \mathrm{Industry}_i + \xi_{i,t}. \end{aligned} \tag{4}$$

Interaction Effect Model for COE:

$$\begin{aligned} \mathrm{ESGSTD}_{i,t} = {} & \theta_0 + \theta_1 \mathrm{CCD}_{i,t} + \theta_2 \mathrm{COE}_{i,t} \\ & + \theta_3 (\mathrm{CCD}_{i,t} \times \mathrm{COE}_{i,t}) + \theta_4 \mathrm{Size}_{i,t} + \theta_5 \mathrm{Lev}_{i,t} \\ & + \theta_6 \mathrm{ROE}_{i,t} + \theta_7 \mathrm{Growth}_{i,t} + \theta_8 \mathrm{Top1}_{i,t} \\ & + \theta_9 \mathrm{TobinQ}_{i,t} + \theta_{10} \mathrm{Opinion}_{i,t} + \sum \mathrm{Year}_t \\ & + \sum \mathrm{Industry}_i + \epsilon_{i,t}. \end{aligned} \tag{5}$$

Table 1: Definition of main variables

Variables	Symbol	Measurement	Type
Corporate charitable donations	CCD	Logarithm of the donation amount plus 1	Independent
ESG uncertainty	ESGSTD	Measured by the standard deviation of standardized rating indices from different rating agencies	Dependent
CEO overseas education experience	COE	An indicator variable for COE (1 if present, 0 otherwise)	Moderating
CEO green experience	CGE	An indicator variable for CGE (1 if present, 0 otherwise)	Moderating
CEO academic background	CAE	An indicator variable for CAE (1 if present, 0 otherwise)	Moderating
Firm size	Size	Firm size is typically measured by the natural logarithm of total assets	Control
Leverage	Lev	Leverage is measured by the ratio of total debt to total assets	Control
Return on equity	ROE	ROE is calculated as net income divided by shareholders' equity	Control
Growth	Growth	Growth is measured by the percentage increase in total revenue from the previous year	Control
Largest shareholder ownership	Top1	The ownership percentage of the largest shareholder	Control
Tobin's Q	TobinQ	Calculated as the market value of a firm divided by the replacement cost of the firm's assets	Control
Audit opinion	Opinion	An indicator variable for audit opinion (1 if clean, 0 otherwise)	Control

Direct Moderation Model for CGE:

$$\begin{aligned} \text{ESGSTD}_{i,t} = {} & \delta_0 + \delta_1 \text{CCD}_{i,t} + \delta_2 \text{CGE}_{i,t} + \delta_3 \text{Size}_{i,t} \\ & + \delta_4 \text{Lev}_{i,t} + \delta_5 \text{ROE}_{i,t} + \delta_6 \text{Growth}_{i,t} \\ & + \delta_7 \text{Top1}_{i,t} + \delta_8 \text{TobinQ}_{i,t} + \delta_9 \text{Opinion}_{i,t} \\ & + \sum \text{Year}_t + \sum \text{Industry}_i + \xi_{i,t}. \end{aligned} \tag{6}$$

Interaction Effect Model for CGE:

$$\begin{aligned} \text{ESGSTD}_{i,t} = {} & \theta_0 + \theta_1 \text{CCD}_{i,t} + \theta_2 \text{CGE}_{i,t} \\ & + \theta_3 (\text{CCD}_{i,t} \times \text{CGE}_{i,t}) + \theta_4 \text{Size}_{i,t} + \theta_5 \text{Lev}_{i,t} \\ & + \theta_6 \text{ROE}_{i,t} + \theta_7 \text{Growth}_{i,t} + \theta_8 \text{Top1}_{i,t} \\ & + \theta_9 \text{TobinQ}_{i,t} + \theta_{10} \text{Opinion}_{i,t} + \sum \text{Year}_t \\ & + \sum \text{Industry}_i + \epsilon_{i,t}. \end{aligned} \tag{7}$$

Direct Moderation Model for CAE:

$$\begin{aligned} \text{ESGSTD}_{i,t} = {} & \delta_0 + \delta_1 \text{CCD}_{i,t} + \delta_2 \text{CAE}_{i,t} + \delta_3 \text{Size}_{i,t} \\ & + \delta_4 \text{Lev}_{i,t} + \delta_5 \text{ROE}_{i,t} + \delta_6 \text{Growth}_{i,t} \\ & + \delta_7 \text{Top1}_{i,t} + \delta_8 \text{TobinQ}_{i,t} + \delta_9 \text{Opinion}_{i,t} \\ & + \sum \text{Year}_t + \sum \text{Industry}_i + \xi_{i,t}. \end{aligned} \tag{8}$$

Interaction Effect Model for CGE:

$$\begin{aligned} \text{ESGSTD}_{i,t} = {} & \theta_0 + \theta_1 \text{CCD}_{i,t} + \theta_2 \text{CAE}_{i,t} \\ & + \theta_3 (\text{CCD}_{i,t} \times \text{CAE}_{i,t}) + \theta_4 \text{Size}_{i,t} + \theta_5 \text{Lev}_{i,t} \\ & + \theta_6 \text{ROE}_{i,t} + \theta_7 \text{Growth}_{i,t} + \theta_8 \text{Top1}_{i,t} \\ & + \theta_9 \text{TobinQ}_{i,t} + \theta_{10} \text{Opinion}_{i,t} + \sum \text{Year}_t \\ & + \sum \text{Industry}_i + \epsilon_{i,t}. \end{aligned} \tag{9}$$

These models allow us to comprehensively investigate the moderating effects of CEO characteristics on the relationship between CCD and ESG uncertainty.

4 Results and Discussion

4.1 Descriptive Statistics

Descriptive statistics for the main variables are presented in Table 2. The mean value of CCD is 11.001, with a standard deviation of 5.496, indicating considerable variation in donation levels across firms. The average ESGSTD is 19.373, with substantial variability (SD = 12.788), reflecting differences in ESG ratings across firms. COE, CAE, and CGE are relatively rare, with mean values of 0.028, 0.239, and 0.004, respectively. Firm size (Size) averages 22.851, leverage (Lev) 0.452, and ROE 0.065, suggesting a range of financial profiles. Growth exhibits an average of 0.168, indicating diverse revenue changes. The largest shareholder ownership (Top1) averages 0.328, Tobin's Q 1.950, and audit opinion (Opinion) 0.958, highlighting variations in ownership concentration, market valuation, and audit quality.

4.2 Baseline Regression

To investigate the impact of CCD on ESGSTD, we conducted a baseline regression analysis. This analysis allows us to determine the direct effect of CCD on ESGSTD while controlling various firm-specific characteristics. The results of this regression are presented in Table 3.

The baseline regression results demonstrate that CCD significantly reduce ESGSTD. In column (1), the coefficient for CCD is −0.049 with a *p*-value of 0.020, indicating a statistically significant reduction in ESGSTD. In column (2), the coefficient for CCD is −0.068 with a *p*-value of 0.021, reinforcing the finding that higher CCD levels are associated

Table 2: Descriptive statistics

Variable	*N*	Mean	SD	Min	P25	P50	P75	Max
CCD	13,719	11.001	5.496	0.0	10.597	12.924	14.533	17.115
ESGSTD	13,719	19.373	12.788	0.003	9.575	17.887	26.591	97.879
COE	13,719	0.028	0.165	0.0	0.0	0.0	0.0	1.0
CAE	13,719	0.239	0.426	0.0	0.0	0.0	0.0	1.0
CGE	13,719	0.004	0.064	0.0	0.0	0.0	0.0	1.0
Size	13,719	22.851	1.39	19.976	21.849	22.661	23.623	26.43
Lev	13,719	0.452	0.199	0.054	0.296	0.449	0.602	0.906
ROE	13,719	0.065	0.157	−1.072	0.035	0.082	0.132	0.406
Growth	13,719	0.168	0.39	−0.66	−0.011	0.113	0.278	4.33
Top1	13,719	0.328	0.148	0.081	0.215	0.301	0.421	0.743
TobinQ	13,719	1.95	1.352	0.802	1.158	1.516	2.175	17.729
Opinion	13,719	0.958	0.2	0.0	1.0	1.0	1.0	1.0

Table 3: Baseline regression

Variables	(1) ESGSTD	(2) ESGSTD
CCD	−0.049**	−0.068***
	(0.020)	(0.021)
Size		−0.677***
		(0.103)
Lev		5.426***
		(0.721)
ROE		1.571*
		(0.831)
Growth		−0.458
		(0.296)
Top1		−0.746
		(0.760)
TobinQ		0.060
		(0.089)
Opinion		1.455**
		(0.598)
Constant	18.819***	30.350***
	(0.244)	(2.319)
Observations	13,719	13,719
R-squared	0.059	0.060
IND	FE	FE
YEAR	FE	FE

Note: ***, **, * report the significance level at 1, 5, and 10%, respectively.

with lower ESG rating uncertainty. This suggests that charitable donations enhance a firm's transparency and social responsibility, leading to more consistent ESG ratings across different agencies.

Firm size (Size) has a significant negative coefficient of −0.677 ($p < 0.01$), implying that larger firms, which have more resources for comprehensive ESG reporting, faceless rating variability. Leverage (Lev) has a positive coefficient of 5.426 ($p < 0.01$), indicating that highly leveraged firms encounter greater rating uncertainty, potentially due to financial instability concerns. ROE shows a positive coefficient of 1.571 ($p < 0.1$), suggesting that more profitable firms might experience varied ESG assessments due to their complex operations. These findings underscore the critical role of CCD in mitigating ESG rating uncertainty and highlight the significant influence of firm-specific characteristics such as size, leverage, and profitability. This is consistent with the findings of Jin et al. (2024b) and Shaikh (2022b).

4.3 Robustness Testing

The preceding results suggest that CCD may mitigate ESGSTD. However, these findings could be challenged due to potential robustness issues, such as endogeneity arising from omitted variables or reverse causality (e.g., firms with higher ESGSTD may face greater financial risks, which could influence their CCD behavior). To address these concerns and enhance the reliability of our conclusions, we conduct a series of robustness tests, including first-order difference models, sample size expansion, fixed effects, and generalized method of moments (GMM) estimation.

4.3.1 First-Order Difference Model

To address potential omitted variable bias, we employ a first-order difference model (Marrucci et al., 2022; Reim et al., 2022). This approach controls for time-invariant firm characteristics by examining changes in variables over time. The model is specified as follows:

$$\Delta \mathrm{ESGSTD}_{i,t} = \beta_0 + \beta_1 \Delta \mathrm{CCD}_{i,t} + \beta_2 \Delta \mathrm{Size}_{i,t} + \beta_3 \Delta \mathrm{Lev}_{i,t} + \beta_4 \Delta \mathrm{ROE}_{i,t} + \beta_5 \Delta \mathrm{Growth}_{i,t}. \quad (10)$$

The results indicate that the coefficient for $\Delta \mathrm{CCD}_{i,t}$ is −0.045 ($p < 0.05$), suggesting that changes in CCD significantly reduce ESG rating uncertainty. This finding aligns with our baseline results, reinforcing the robustness of the relationship.

4.3.2 Sample Size Expansion

To ensure that our findings are not driven by a specific subset of firms or periods, we expand the sample size by including additional years and firms. This approach, recommended by Duvaleix et al. (2021), enhances the generalizability of our results. The expanded sample yields a negative coefficient for CCD of −0.031 ($p < 0.05$), further confirming the robustness of our initial findings.

4.3.3 Fixed Effects Model

To control for unobserved heterogeneity, we incorporate both industry and year-fixed effects in our regression models. This approach accounts for time-invariant industry characteristics and temporal shocks that could influence ESGSTD. The results show that the coefficient for CCD remains negative and significant (−0.080, $p < 0.01$), validating the negative impact of CCD on ESGSTD.

4.3.4 GMM

To address potential endogeneity concerns, such as reverse causality and dynamic panel bias, we employ the GMM

estimator. The GMM approach is particularly suitable for our study because: ESGSTD may exhibit persistence over time, and GMM accounts for this by including lagged dependent variables as instruments and GMM uses internal instruments to mitigate endogeneity arising from simultaneity or omitted variables. The GMM model is specified as follows:

$$\begin{aligned} \mathrm{ESGSTD}_{i,t} = {} & \alpha_0 + \alpha_1 \mathrm{ESGSTD}_{i,t-1} + \alpha_2 \mathrm{CCD}_{i,t} + \alpha_3 \mathrm{Size}_{i,t} \\ & + \alpha_4 \mathrm{Lev}_{i,t} + \alpha_5 \mathrm{ROE}_{i,t} + \alpha_6 G. \end{aligned} \tag{11}$$

The results from the GMM estimation (Table 4) show that the coefficient for CCD is −1.033 ($p < 0.01$), consistent with our baseline findings. The Hansen J-test ($p > 0.10$) confirms the validity of the instruments, and the Arellano–Bond test for autocorrelation (AR(2), $p > 0.10$) supports the absence of second-order serial correlation.

4.3.5 Replace the Core Variable

To ensure robustness and address reliance on a single measure of ESGSTD, we adopt Avramov et al.'s (2022) rank-based method to compute an alternative ESG rating divergence (ESGSTD_New) using data from six agencies (Sino-Securities, SynTao Green Finance, Alipay, Wind, Bloomberg, FTSE Russell). This approach tests the consistency of CCD effect on rating divergence, aligning with our signaling and legitimacy framework.

Table 4 (Column 4) reports the results: CCD's coefficient on ESGSTD_New is −1.375 ($p < 0.01$), consistent with the baseline finding (−0.068, $p < 0.01$) that CCD reduces rating uncertainty. This reaffirms Hypothesis 1 across measurement approaches. However, the method assumes ranking consistency and may be sensitive to outliers due

Table 4: Robustness testing

	First-order difference model		Increasing sample size	Fixed effects	Replace the core variable	GMM model
Variables	D. ESGSTD	Variables	ESGSTD	ESGSTD	ESGSTD new	ESGSTD
D. CCD	−0.045**	CCD	−0.031**	−0.080***	−1.375***	−1.033***
	(0.023)		(0.016)	(0.021)	(0.022)	(0.020)
D. Size	−0.502	Size	−0.502***	−1.104***	−0.585***	Control
	(0.196)		(0.138)	(0.113)	(0.110)	
D. Lev	2.998**	Lev	2.997***	2.577***	3.018***	Control
	(1.106)		(0.718)	(0.773)	(0.770)	
D. ROE	−0.824	ROE	−0.824	1.317**	0.820	Control
	(0.853)		(0.603)	(0.834)	(0.703)	
D. Growth	0.030	Growth	0.030	−0.506*	0.699	Control
	(0.255)		(0.181)	(0.296)	(0.341)	
D. Top1	2.625**	Top1	2.625***	−0.587	3.488***	Control
	(1.231)		(0.870)	(0.789)	(0.650)	
D. TobinQ	0.154	TobinQ	0.154**	0.588***	0.890***	Control
	(0.101)		(0.072)	(0.096)	(0.080)	
D. Opinion	2.016***	Opinion	2.016***	1.841***	1.394***	Control
	(0.669)		(0.473)	(0.604)	(0.588)	
D. Constant	0.240**	Constant	0.169**	36.762***	40.828***	
	(0.122)		(0.086)	(2.807)	(2.705)	
Observations	13,719	Observations	26,798	13,719	13,719	13,719
R-squared	0.200	R-squared	0.030	0.040	0.060	0.686
Adj.R^2	0.190	Adj.R^2	0.032	0.036	0.060	0.686
IND	FE	IND	FE	FE	FE	FE
YEAR	FE	YEAR	FE	FE	FE	FE
Kleibergen-Paap rk LM						105.471***
Cragg-Donald Wald F						78.954
Sargan (P)						0.264

Note: ***, **, * report the significance level at 1, 5, and 10%, respectively.

to agency methodological differences. Despite these limitations, ESGSTD_New's linkage to signaling (signal credibility) and legitimacy (normative alignment) supports the robustness of our conclusions.

This alternative measure strengthens our analysis by connecting CCD's theoretical mechanisms to empirical outcomes, enhancing confidence in its role in reducing ESG rating uncertainty.

4.3.6 Group-Wise Regression

To further explore the heterogeneity in the relationship between CCD and ESGSTD, we conduct group-wise regressions based on firm size (Size) and governance quality (Governance Quality). These variables are selected based on their theoretical relevance to firms' capacity for ESG transparency and the credibility of CSR signals.

Large firms typically possess greater financial and managerial resources to implement structured CSR initiatives (Beck et al., 2005), which may enhance the visibility and consistency of their ESG practices (Postiglione et al., 2024). Conversely, smaller firms may face resource constraints, leading to fragmented ESG strategies that amplify rating discrepancies. Following prior studies (Musa et al., 2024), we measure firm size as the natural logarithm of total assets. Firms are categorized into High Size (above median) and Low Size (below median) groups.

Governance quality reflects the effectiveness of internal oversight mechanisms, such as board independence and audit committee rigor, which are critical for aligning CSR activities with stakeholder expectations (Efunniyi et al., 2024). We construct a composite governance index using principal component analysis (PCA) of three proxies: (1) board independence (ratio of independent directors), (2) audit committee size, and (3) shareholder rights score (from the CNRDS database). Firms are divided into High Governance Quality (top tercile) and Low Governance Quality (bottom tercile) groups.

Table 5 presents the group-wise regression results. Notably, CCD exhibits differential impacts across subgroups: The coefficient for CCD is 1.766 ($p < 0.01$) in the High Size group and 0.820 ($p < 0.01$) in the Low Size group. Contrary to expectations, CCD in larger firms is associated with higher ESGSTD, potentially reflecting skepticism among rating agencies toward strategic donations by dominant firms, which may be perceived as "greenwashing." Smaller firms, however, show a weaker positive relationship, possibly due to limited resources to amplify CSR signals. In the High Governance Quality group, CCD significantly increases ESGSTD (2.396, $p < 0.01$), whereas the effect diminishes in the Low Governance Quality group (0.738, $p < 0.01$).

Table 5: Group-wise regression results

Variables	High size ESGSTD	Low size ESGSTD	High governance quality ESGSTD	Low governance quality ESGSTD
CCD	1.766***	0.820***	2.396***	0.738***
	(0.010)	(0.015)	(0.016)	(0.010)
Controls	YES	YES	YES	YES
Constant	4.632***	5.881***	4.276***	4.158***
	(0.301)	(0.485)	(0.372)	(0.490)
Observations	6,859	6,858	6,858	6,859
R-squared	0.060	0.068	0.055	0.080
Adj. R^2	0.061	0.070	0.056	0.081
IND	FE	FE	FE	FE
YEAR	FE	FE	FE	FE

Note: ***, **, * report the significance level at 1, 5, and 10%, respectively.

This counterintuitive result suggests that stringent governance frameworks may inadvertently heighten scrutiny of firms' philanthropic motives, exacerbating rating inconsistencies. Alternatively, governance structures in high-quality firms may prioritize compliance over substantive CSR integration, leading to superficial alignment with ESG criteria (Xu et al., 2025). The results underscore the nuanced role of firm characteristics in moderating CCD's impact on ESG uncertainty. While large firms and those with strong governance theoretically possess advantages in CSR execution, their donations may trigger divergent interpretations by rating agencies, particularly when motives are questioned. These findings align with legitimacy theory, where institutional pressures and stakeholder expectations shape the credibility of CSR signals (Shahid, 2025). Future research should explore contextual factors, such as industry norms and regional regulatory environments, to refine the interpretation of these heterogeneities.

4.4 Endogeneity Testing

4.4.1 PSM Testing

PSM is employed to control for potential selection bias and endogeneity arising from observable firm characteristics that influence both the likelihood of making CCD and ESGSTD. By matching firms with similar characteristics, PSM helps to create a more balanced comparison between firms with and without CCD. The PSM results show an even

stronger negative coefficient for CCD (−1.353, $p < 0.01$), suggesting that after controlling selection bias, the impact of CCD on reducing ESGSTD remains significant. The results of the endogeneity tests are presented in Table 6.

4.4.2 Substitution Variables

Drawing on previous related studies (Chang & Chen, 2019; Liu et al., 2019), we replace the continuous measure of CCD with a binary variable. The new measure assigns a value of 1 if the firm has engaged in CCD and 0 if it has not. This substitution helps to verify the robustness of our results by examining whether the observed relationship holds when using a different operationalization of CCD. In the substitution variables test, the coefficient for CCD remains negative and significant (−0.779, $p < 0.01$), indicating that the relationship between CCD and ESG rating uncertainty is robust to different operationalizations of CCD. The results of the endogeneity tests are presented in Table 6.

Table 6: Endogeneity test results

Variables	Substitution of core variables ESGSTD	PSM ESGSTD	Changing the sample range ESGSTD
CCD	−0.779***	−1.353***	−0.087***
	(0.288)	(0.173)	(0.028)
Size	−0.642***	−0.950***	−0.516***
	(0.102)	(0.078)	(0.149)
Lev	5.340***	1.638***	5.394***
	(0.727)	(0.555)	(1.011)
ROE	1.561*	−0.978	0.801
	(0.842)	(0.709)	(1.182)
Growth	−0.474	0.912***	−0.096
	(0.297)	(0.211)	(0.421)
Top1	−0.726	0.374	−1.905*
	(0.764)	(0.604)	(1.081)
TobinQ	0.064	−0.030	0.191
	(0.090)	(0.075)	(0.171)
Opinion	1.235**	2.031***	5.056***
	(0.609)	(0.504)	(0.934)
Constant	29.898***	37.063***	23.674***
	(2.337)	(1.789)	(3.310)
Observations	13,719	13,719	7,268
R-squared	0.006	0.013	0.010
Adj. R^2	0.005	0.012	0.009
IND	FE	FE	FE
YEAR	FE	FE	FE

Note: ***, **, * report the significance level at 1, 5, and 10%, respectively.

4.4.3 Changing the Sample Range Testing

Major external events can impact firms' investment and financing behaviors, potentially interfering with the findings of this study. During the sample period, significant events such as the 2015 stock market crash in China and the COVID-19 pandemic in late 2019 likely influenced firms' behaviors. To address this, we exclude the samples from 2015 to 2020 onward and re-run the regression analysis based on equation (1). This approach aims to ensure that our findings are not unduly affected by these external shocks. The results from the changing sample range test reveal a consistent negative relationship between CCD and ESGSTD (−0.087, $p < 0.01$), even when excluding periods affected by major external shocks. This robustness check confirms that our findings are not driven by specific events such as the 2015 stock market crash or the COVID-19 pandemic, thereby enhancing the validity of our conclusions. The results of the endogeneity tests are presented in Table 6.

4.4.4 IV Testing

To *a priori* identify and address potential endogeneity concerns and strengthen the causal inference of our results, we employ an IV approach. Specifically, we use the average CCD of other firms within the same industry and year as an instrument for a firm's CCD. This approach, inspired by the methodology of Awaysheh et al. (2020) and Hille et al. (2020), helps us to isolate the exogenous variation in CCD that is not correlated with the unobserved factors affecting ESG rating uncertainty. The results of the IVs testing are presented in Table 7.

The first-stage regression results show that the IV (industry-year average CCD) is strongly correlated with the individual firm's CCD, as evidenced by the coefficient of −0.862 ($p < 0.01$). The Cragg-Donald Wald F statistic of 38.339 indicates that the instrument is not weak, thus providing confidence in the validity of the instrument. In the second-stage regression, the coefficient for CCD remains negative and statistically significant (−0.439, $p < 0.01$), confirming that CCD reduce ESG rating uncertainty. The use of an IV addresses potential endogeneity concerns, reinforcing the robustness of our findings. This result suggests that the observed relationship between CCD and ESG rating uncertainty is not merely driven by reverse causality or omitted variable bias but reflects a genuine causal effect.

Table 7: IV testing results

Variables	First stage CCD	Second stage ESGSTD
CCD_M	−0.862***	
	(0.054)	
CCD		−0.439***
		(0.160)
Size	1.091***	−1.411***
	(0.044)	(0.209)
Lev	−0.676**	2.764***
	(0.306)	(0.788)
ROE	2.960***	0.147
	(0.329)	(0.982)
Growth	0.090	−0.533**
	(0.117)	(0.297)
Top1	−2.351***	0.308
	(0.311)	(0.882)
TobinQ	−0.067	0.081
	(0.038)	(0.097)
Opinion	0.218	1.742***
	(0.239)	(0.606)
Constant	22.037***	41.375***
	(1.245)	(3.478)
Observations	13,719	13,719
R-squared	0.187	0.040
Adj. R^2	0.183	0.035
IND	FE	FE
YEAR	FE	FE
Cragg-Donald Wald F	38.339	

Note: ***, **, * report the significance level at 1, 5, and 10%, respectively.

4.5 Moderation Effect Testing

To rigorously investigate the mechanisms underlying the influence of CCD on ESGSTD, this study examines the moderating effects of CGE, COE, and CAE. The detailed regression results are presented in Table 7.

In columns (1) and (2), the coefficient for CCD remains consistently negative and significant, indicating that higher levels of CCD continue to reduce ESG rating uncertainty. Specifically, the interaction term CCD_CGE is significant at −0.780 ($p < 0.01$), suggesting that CGE amplify the positive impact of CCD on reducing ESG rating uncertainty. This is consistent with prior studies that highlight the role of environmentally conscious leadership in enhancing corporate sustainability practices (Ahmad et al., 2021). Columns (3) and (4) focus on the moderating role of COE. The significant coefficient for COE at −1.039 ($p < 0.01$) and the interaction term CCD_COE at −0.302 ($p < 0.01$) indicate that CEOs with international educational backgrounds strengthen the effect of CCD on reducing ESGSTD. This aligns with findings from Lu and Wang (2021), who suggest that international experience brings diverse perspectives and innovative practices to corporate governance. In columns (5) and (6), the results show that the CAE also significantly moderates the relationship between CCD and ESG rating uncertainty. The significant coefficients for CAE at −1.173 ($p < 0.01$) and the interaction term CCD_CAE at −0.163 ($p < 0.01$) imply that CEOs with strong academic credentials enhance the effectiveness of CCD in reducing ESGSTD. This supports the arguments made by researchers in a previous study about the strategic decision-making capabilities of academically accomplished CEOs.

The findings of this study have direct implications for corporate ESG management. Specifically, CGE or COE are more proficient in aligning CCD with long-term ESG objectives. Companies can enhance their leadership teams through internal promotions or external recruitment to strengthen ESG integration. Additionally, ESG funds can track CCD scale and CEO characteristics to identify investment targets with stable ESG ratings.

For example, this study finds that a one-unit logarithmic increase in CCD corresponds to a 7.2% reduction in ESG uncertainty, offering a useful screening indicator for constructing low-volatility ESG portfolios. Companies should prioritize quantifiable donation initiatives that align with their core business to enhance signal credibility. A case in point is a photovoltaic company that was recognized by MSCI ESG ratings for “environmental leadership” after strategically donating solar power facilities to mountainous regions. Consequently, its ESG rating discrepancies were significantly lower than the industry average (Table 8).

4.6 Heterogeneity Testing

To explore the variability of the impact of CCD on ESGSTD across different contexts, we conduct heterogeneity tests, examining firm characteristics such as state ownership, geographic location, CEO duality, and CEO gender. The results of the heterogeneity testing results are presented in Table 9.

The heterogeneity tests reveal significant differences in the impact of CCD on ESGSTD across various subgroups. For SOEs, CCD reduces ESGSTD by −0.059 ($p < 0.05$), compared to −0.049 ($p < 0.01$) for non-SOEs, indicating a stronger effect in non-SOEs. Geographic differences show CCD effects are more pronounced in the Western (−0.148, $p < 0.05$) and Northeastern (−0.100, $p < 0.05$) regions compared to the Eastern region (−0.042, $p < 0.1$). CEO duality results indicate a greater reduction in ESGSTD for firms without CEO duality (−0.080, $p < 0.01$) compared to those

with duality (−0.035, $p < 0.05$). CEO gender also influences results, with female-led firms showing a larger reduction (−0.128, $p < 0.01$) than male-led firms (−0.073, $p < 0.01$). These findings highlight the importance of firm-specific and contextual factors in understanding the impact of CCD on ESG rating uncertainty.

4.7 Further Analysis: ESG Fund Holdings

To deepen our understanding of the mechanisms through which CCD impact ESGSTD, it is essential to consider the role of external pressures and incentives, particularly from ESG-focused investment funds. ESG fund holdings represent a significant source of influence on corporate behavior, as companies with higher ESG fund ownership may face greater scrutiny and expectations regarding their ESG practices (Kim & Yoon, 2023). The rationale for this further analysis lies in the potential for ESG funds to reinforce the positive effects of CCD on reducing ESG rating uncertainty. Prior research has shown that institutional investors, particularly those focused on ESG criteria, play a crucial role in shaping corporate policies and enhancing transparency (Liu et al., 2023b). By examining the interaction between CCD and ESG fund holdings, we can assess whether the presence of these investors amplifies the impact of CCD on ESGSTD.

Table 8: Moderation effect regression results

Variables	(1) ESGSTD	(2) ESGSTD	(3) ESGSTD	(4) ESGSTD	(5) ESGSTD	(6) ESGSTD
CCD	−0.067***	−0.071***	−0.068***	−0.070***	−0.062***	0.050***
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.023)
CGE	−1.001**	−7.420**				
	(0.500)	(3.249)				
CCD_CGE		−0.780***				
		(0.291)				
COE			−1.039***	−2.503***		
			(0.297)	(0.492)		
CCD_COE				−0.302***		
				(0.098)		
CAE					−1.173***	−1.207***
					(0.258)	(0.608)
CCD_CAE						−0.163***
						(0.048)
Size	−0.677***	−0.684***	−0.681***	−0.682***	−0.640***	−0.627***
	(0.103)	(0.103)	(0.103)	(0.103)	(0.104)	(0.104)
Lev	5.426***	5.406***	5.421***	5.420***	5.294***	5.157***
	(0.721)	(0.721)	(0.721)	(0.721)	(0.721)	(0.722)
ROE	1.571*	1.573*	1.562*	1.561*	1.433*	1.403*
	(0.831)	(0.831)	(0.831)	(0.831)	(0.831)	(0.831)
Growth	−0.459	−0.448	−0.459	−0.461	−0.456	−0.445
	(0.296)	(0.296)	(0.296)	(0.296)	(0.296)	(0.296)
Top1	−0.746	−0.731	−0.756	−0.755	−0.398	−0.358
	(0.760)	(0.760)	(0.760)	(0.760)	(0.764)	(0.764)
TobinQ	0.060	0.056	0.060	0.061	0.059	0.061
	(0.089)	(0.089)	(0.089)	(0.089)	(0.089)	(0.089)
Opinion	1.455**	1.440**	1.472**	1.470**	1.410**	1.393**
	(0.598)	(0.598)	(0.598)	(0.598)	(0.597)	(0.597)
Constant	30.350***	30.476***	30.440***	30.427***	29.267***	29.455***
	(2.320)	(2.320)	(2.320)	(2.320)	(2.330)	(2.330)
Observations	13,719	13,719	13,719	13,719	13,719	13,719
R-squared	0.006	0.006	0.006	0.006	0.005	0.005
Adj. R^2	0.006	0.006	0.005	0.005	0.005	0.005
IND	FE	FE	FE	FE	FE	FE
YEAR	FE	FE	FE	FE	FE	FE

Note: ***, **, * report the significance level at 1, 5, and 10%, respectively.

Table 9: Heterogeneity testing results

Variables	SOE = 1 ESGSTD	SOE = 0 ESGSTD	Eastern ESGSTD	Western ESGSTD	Northeastern ESGSTD	Central ESGSTD	Duality = 1 ESGSTD	Duality = 0 ESGSTD	SEX = 0 ESGSTD	SEX = 1 ESGSTD
CCD	−0.059**	−0.049***	−0.042*	−0.148**	−0.100**	−0.063**	−0.035**	−0.080***	−0.073***	−0.128***
	(0.028)	(0.032)	(0.025)	(0.060)	(0.051)	(0.032)	(0.018)	(0.021)	(0.022)	(0.034)
Size	−0.693***	−0.333*	−0.579***	−1.313***	−1.835***	−0.024	−0.147	−0.731***	−0.747***	−0.859***
	(0.133)	(0.187)	(0.121)	(0.290)	(0.620)	(0.338)	(0.203)	(0.107)	(0.111)	(0.168)
Lev	5.184***	5.744***	5.361***	5.891***	−7.098*	1.981	1.161	5.655***	5.398***	6.548***
	(0.893)	(1.219)	(0.884)	(1.805)	(4.043)	(1.936)	(1.472)	(0.748)	(0.774)	(1.174)
ROE	1.632*	0.602	1.839**	2.560	2.755	−3.926	1.930	1.689***	1.751*	1.719
	(0.964)	(1.704)	(0.978)	(2.435)	(4.185)	(2.383)	(1.580)	(0.857)	(0.893)	(1.342)
Growth	−0.438	−0.687	−0.157	−1.342	2.197*	−0.866	−0.685	−0.494	−0.588*	−0.098
	(0.355)	(0.533)	(0.380)	(0.714)	(1.166)	(0.727)	(0.576)	(0.303)	(0.316)	(0.568)
Top1	−1.138	1.871	0.361	1.336	4.646	−2.940	−1.601	−0.750	−0.828	−0.355
	(0.988)	(1.279)	(0.924)	(2.010)	(3.874)	(2.123)	(1.533)	(0.783)	(0.817)	(1.501)
TobinQ	0.054	0.091	0.175	−0.262	−1.584***	0.156	0.088	(0.058)	0.038	0.168
	(0.102)	(0.189)	(0.108)	(0.233)	(0.505)	(0.240)	(0.161)	(0.093)	(0.097)	(0.145)
Opinion	1.741***	−0.407	0.344	2.601	0.963	7.027***	0.635	1.265**	1.051	1.726
	(0.670)	(1.527)	(0.687)	(1.792)	(3.581)	(2.082)	(1.161)	(0.614)	(0.641)	(1.184)
Constant	30.612***	22.683***	28.773***	41.569***	63.802***	12.298***	22.264***	31.503***	31.336***	33.525***
	(2.963)	(4.401)	(2.708)	(6.400)	(13.857)	(4.765)	(4.538)	(2.396)	(2.481)	(3.868)
Observations	13,719	13,719	9,529	1,675	432	2,078	3,925	9,794	882	12,837
R-squared	0.009	0.007	0.005	0.022	0.073	0.055	0.007	0.010	0.008	0.007
Adj.R^2	0.007	0.005	0.004	0.015	0.049	0.050	0.006	0.009	0.010	0.006
IND	FE	FE	FE	FE	FE	FE	FE	FE	FE	FE
YEAR	FE	FE	FE	FE	FE	FE	FE	FE	FE	FE

Note: ***, **, * report the significance level at 1, 5, and 10%, respectively.

The results presented in Table 10 highlight the significant moderating effect of ESG fund holdings on the relationship between CCD and ESG rating uncertainty. In both columns (1) and (2), the coefficients for CCD remain negative and statistically significant, indicating that CCD continues to reduce ESGSTD. Notably, the interaction term CCD_ESG fund holdings in column (2) is significant at −0.087 ($p < 0.05$), suggesting that the presence of ESG-focused investors enhances the effectiveness of CCD in reducing ESG rating uncertainty. These findings align with previous studies that emphasize the role of institutional investors in promoting corporate transparency and accountability (Alda, 2021). ESG funds, by their nature, demand higher standards of ESG performance and reporting, thereby pushing firms to adopt more consistent and transparent practices. The significant negative coefficient for ESG fund holdings (−1.038, $p < 0.01$) further supports the notion that firms with higher ESG fund ownership face reduced ESG rating uncertainty due to the rigorous monitoring and expectations of these investors.

5 Further Mechanism Testing

5.1 CR

CR is a critical mechanism through which CCD may reduce ESG rating uncertainty. Reputation acts as a bridge between a firm's CSR activities and external evaluations (Cai et al., 2024), as it reflects the collective perception of stakeholders – including investors, customers, and rating agencies – regarding the firm's commitment to social and environmental responsibility (Xu et al., 2024b).

Drawing on signaling theory, CCD serves as a costly and credible signal of a firm's CSR commitment. By engaging in substantial and strategic donations, firms demonstrate their dedication to societal welfare, which enhances their reputation among stakeholders. A strong reputation, in turn, reduces information asymmetry between firms and rating agencies, leading to more consistent ESG evaluations. For instance, firms with high reputational capital are perceived as more transparent and reliable, which encourages rating agencies to align their assessments

Table 10: Impact of ESG fund holdings

Variables	(1) ESGSTD	(2) ESGSTD
CCD	−0.071***	−0.109***
	(0.021)	(0.027)
ESG fund holdings	−0.510***	−1.038***
	(0.097)	(0.200)
CCD_ESG fund holdings		−0.087**
		(0.041)
Size	−0.696***	−0.522***
	(0.104)	(0.114)
Lev	5.387***	5.242***
	(0.727)	(0.728)
ROE	1.418*	1.824**
	(0.845)	(0.852)
Growth	−0.461	−0.398
	(0.297)	(0.298)
Top1	−0.646	−0.865
	(0.765)	(0.766)
TobinQ	0.060	0.154*
	(0.090)	(0.093)
Opinion	1.241	1.313**
	(0.609)	(0.609)
Constant	30.964***	26.817***
	(2.349)	(2.570)
Observations	13,719	13,719
R-squared	0.006	0.006
Adj. R^2	0.007	0.006
IND	FE	FE
YEAR	FE	FE

Note: ***, **, * report the significance level at 1, 5, and 10%, respectively.

with stakeholder expectations (Conte et al., 2023; Reber et al., 2022).

To operationalize CR, we use the Reputation Index from the Wind database, which aggregates media coverage, analyst reports, and stakeholder surveys to provide a comprehensive measure of a firm's public image (Sun et al., 2024b). This index is widely used in CSR and ESG research due to its robustness and alignment with theoretical constructs.

As shown in Table 11, CCD has a significant positive effect on CR ($\beta = 0.617$, $p < 0.001$), supporting the hypothesis that CCD enhances a firm's public image. This, in turn, mediates the relationship between CCD and ESG rating uncertainty, as firms with higher reputational capital experience less variability in their ESG ratings.

5.2 Media Attention (MA)

MA is another pivotal mechanism linking CCD to ESG rating uncertainty. Media coverage amplifies the visibility of a firm's CSR activities (Hawn, 2021), shaping public perception and influencing the evaluations of external stakeholders, including rating agencies (Yang & Basile, 2021). From the perspective of legitimacy theory, MA serves as a legitimizing force that validates a firm's CSR efforts (Sorour et al., 2021). When firms engage in CCD, media coverage not only disseminates information about these activities but also frames them in a way that enhances the firm's legitimacy (Misra et al., 2025). This legitimacy, in turn, pressures rating agencies to adopt more consistent and favorable evaluation criteria.

Table 11: Mechanism of action channels

Variables	CR	MA
CCD	0.617***	0.380***
	(0.020)	(0.010)
Controls	YES	YES
Constant	3.449***	11.856***
	(0.338)	(0.690)
Observations	13,719	13,719
R-squared	0.120	0.125
Adj. R^2	0.121	0.125
IND	FE	FE
YEAR	FE	FE

Note: ***, **, * report the significance level at 1, 5, and 10%, respectively.

We measure MA using the Media Coverage Index from the CNRDS database, which tracks the volume and sentiment of news articles related to a firm's CSR activities. This index is particularly suitable for capturing the visibility and tone of CCD-related media coverage, which are critical for understanding how MA influences ESG ratings.

Table 11 shows that CCD significantly increases MA ($\beta = 0.380$, $p < 0.001$), confirming the role of media as a key channel through which CCD influences ESG rating uncertainty. Firms with higher media visibility experience less variability in their ESG ratings, as media coverage provides a supplementary source of information that aligns rating agencies' assessments.

6 Conclusion

6.1 Conclusion and Implication

This study investigates the impact of CCD on ESGSTD, and the moderating roles of CGE, COE, and CAE. Our findings provide robust evidence that CCD significantly reduces ESGSTD, thereby enhancing the consistency and reliability of ESG ratings across different agencies. This relationship

is further moderated by CEO characteristics, with CGE, COE, and CAE each playing a critical role in strengthening the effect of CCD on reducing ESG rating uncertainty.

The robustness of these findings is confirmed through several tests, including first-order difference models, extended sample sizes, and IVs, which address potential endogeneity concerns. PSM and substitution variable methods reinforce this robustness, demonstrating the significant negative impact of CCD on ESGSTD. Heterogeneity tests reveal that the effect of CCD varies across different contexts, being stronger in non-SOEs, in Western and Northeastern regions, in firms without CEO duality, and in female-led firms. Further analysis shows that the presence of ESG-focused investors amplifies the positive impact of CCD on reducing ESG rating uncertainty.

Our findings offer several actionable insights for corporate managers and policymakers.

For corporate managers, structuring philanthropic activities in a strategic manner is crucial for enhancing ESG rating stability. Firms should prioritize substantive, long-term donation initiatives that align with their core business objectives and sustainability goals. Transparent reporting and consistent donation practices not only bolster CR but also provide clear signals to rating agencies, reducing subjective biases in ESG assessments. Additionally, considering the significant moderating roles of CEO attributes, companies should systematically incorporate these characteristics into their leadership selection and development processes to optimize strategic outcomes related to ESG. For policymakers, designing incentive mechanisms – such as enhanced tax deductions for donations meeting predefined substantiality criteria – can further encourage firms to engage in strategic philanthropy. Specifically, governments can introduce differentiated tax deduction policies targeting donations in areas of high ESG relevance, thereby incentivizing impactful philanthropy. Drawing inspiration from the European Union's sustainable finance disclosure regulation, China could establish a standardized CCD Substantiality Assessment Framework, explicitly linking donation types and scale to ESG rating weightings, thus enhancing corporate accountability and transparency.

Furthermore, the state-owned assets supervision and administration commission could integrate CCD consistency into the performance evaluations of SOE executives. Central SOEs would then be required to transparently disclose how their charitable initiatives align with the United Nations sustainable development goals, mitigating symbolic gestures and ensuring substantive alignment with sustainability objectives.

Regional collaboration presents an additional avenue for policymakers. Given the pronounced ESG rating discrepancies among enterprises in Western China, local governments could partner with rating agencies to develop localized ESG indicators – such as a Rural Revitalization Donation Index – to harmonize regional ESG assessment standards. Establishing these region-specific frameworks would not only reduce evaluation inconsistencies but also strengthen the credibility of ESG ratings, thereby promoting sustainable development in economically disadvantaged regions.

Collectively, these insights provide comprehensive guidance for corporate managers, investors, and policymakers alike, facilitating informed decision-making, enhancing ESG rating consistency, and fostering broader sustainable development outcomes.

6.2 Limitations and Future Direction

This study elucidates the nexus between CCD and ESGSTD using Chinese A-share listed firms (2015–2023), yet several limitations highlight avenues for future inquiry. First, the sample's focus on China – characterized by state-driven CSR mandates like the 2016 Charity Law and 2021 Common Prosperity policy – may amplify CCD's effect on ESGSTD beyond market-centric contexts. This institutional specificity cautions against broad generalization, necessitating cross-national studies to disentangle market-driven vs regulatory influences on ESG consistency. Future research should investigate how varying regulatory environments, such as differences in government oversight, mandatory CSR disclosure requirements, or incentive policies, shape the relationship between corporate philanthropy and ESG rating stability.

Second, our quantitative approach, employing logarithmic CCD and *z*-score-standardized ESGSTD, robustly captures donation scale and rating dispersion, but overlooks qualitative nuances. Strategic vs symbolic donations – pivotal to distinguishing authentic CSR signals from "greenwashing" – are indirectly assessed via scale and CEO traits. Moreover, rating dispersion assumes normality and equal agency weighting, potentially missing alternative uncertainty facets. Future research could integrate qualitative methods – e.g., interviews with rating analysts – to probe motivational drivers and test proxies like pairwise correlations or rating ranges, despite data constraints limiting such analyses here.

Third, while CGE, COE, and CAE moderate the CCD-ESGSTD link, other attributes may further shape outcomes, especially in China's policy-driven landscape. Exploring these could refine our understanding of leadership's role

in ESG dynamics. Finally, external shocks may alter CCD efficacy, though robustness checks mitigate some concerns. Longitudinal analyses incorporating regulatory shifts could enhance insights into rating stability.

Future scholarship should broaden geographic scope, blend qualitative and quantitative methods, and examine diverse CEO traits and external factors – including the impact of varying regulatory environments – to validate and deepen our findings, thereby advancing CSR and ESG rating scholarship.

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