

Article

ESG Controversies and Firm Investment Efficiency: Impact and Mechanism Examination

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Abstract: In the context of increasingly severe global climate change, both companies and investors are placing greater emphasis on investment philosophies centered around environmental protection, social responsibility, and corporate governance (ESG). This paper, based on data from 847 Chinese A-share listed companies over the period 2007–2022, employs a two-way fixed effects model to investigate the relationship between ESG controversies and firm investment efficiency. The results indicate that ESG controversies significantly reduce overall firm investment efficiency. Further analysis reveals that ESG controversies affect investment efficiency by exacerbating agency costs and reducing audit quality. Meanwhile, financing constraints and robust internal control quality mitigate these negative effects. Heterogeneity analysis shows that the impact is more pronounced for firms with higher pollution levels, non-state-owned enterprises, those with higher analyst coverage, and firms with lower levels of digitalization. The findings have significant implications for encouraging companies to fulfill their social responsibilities and promote high-quality economic development.

Keywords: ESG controversies; investment efficiency; corporate governance



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1. Introduction

Compared to traditional capital market indicators, Environmental, Social, and Governance (ESG) factors have garnered increasing attention in recent years (Krueger et al. 2024). ESG provides a framework for assessing a company's long-term sustainable development, focusing on its financial performance and environmental protection, social responsibility, and governance practices (Yang et al. 2024). Research indicates that ESG factors impact not only company value and financial performance but also labor productivity, green transformation, and governance (Bang et al. 2022; Cucari et al. 2018; Wang et al. 2023; Zhou et al. 2022). Strong CSR practices offer better access to capital while reducing risks and conflicts (Qian 2024). Therefore, effective ESG management is crucial for a company's long-term value and sustainable growth.

Investment has been a key driver of economic growth in China, and investment efficiency is crucial for assessing resource allocation and decision quality. However, inefficient investment remains common among Chinese firms (Mao et al. 2023). Many firms fail to fully evaluate the risks and returns of investment opportunities when making decisions, leading to significant amounts of inefficient investment. In situations of low investment efficiency, firms struggle to translate potential high-return investment opportunities into

actual outcomes. The existing literature has examined various factors influencing investment efficiency, including employee stock ownership, digital finance, and economic policy uncertainty (Adwan and Ahamed 2025; Ding et al. 2023; Wang et al. 2014). By optimizing investment decisions, firms can better adapt to market changes, enhance long-term competitiveness, and achieve sustainable development.

Current ESG evaluation systems emphasize positive performance but often overlook potential risks. This may not drive real improvements and can even encourage deceptive practices. For instance, some firms benefit from green finance and tax incentives while secretly facing penalties for major environmental violations. In contrast, ESG controversy scores, which reflect a company's risk exposure, can address this gap. ESG controversies reflect behavioral misalignments in a company's ESG practices, indicating ethical deficiencies and a lack of capability to meet stakeholders' expectations (Vargas-Santander et al. 2025). ESG controversy events are often accompanied by negative news and public attention, which can significantly damage a company's reputation, leading to economic consequences. Existing research focuses on their impact on reputation, financial performance, and firm value (Aouadi and Marsat 2018; Nirino et al. 2021; Tamayo-Torres et al. 2019). Studies show that ESG controversies lower stock prices, erode investor confidence, raise capital costs, and trigger strong stakeholder reactions (Nicolas et al. 2024). They can also weaken a firm's financing ability, prompting creditors and shareholders to demand higher returns or withdraw capital (Zhang et al. 2024). Focusing on ESG controversies can reveal how firms can mitigate adverse effects by optimizing ESG management and providing scientific evidence for companies, investors, and policymakers to help them develop more effective strategies to address potential future ESG risks.

Previous studies highlight the importance of ESG ratings in corporate investment performance (Elili 2022). However, investors and consumers are more sensitive to adverse events than positive disclosures, making a negative perspective on ESG and investment more insightful. Prior research often examines controversial events' impact on investment efficiency through a single dimension, such as ownership disputes or litigation (Annen 2009; Peng et al. 2025), while ESG controversies are inherently complex and multidimensional. To address this, we use ESG controversy scores to measure corporate controversies comprehensively. The existing literature mainly focuses on controversies' financial and governance consequences (Nirino et al. 2021; Yu et al. 2022), with limited attention to investment efficiency. This study fills that gap by analyzing the effects of ESG controversies on investment efficiency. Additionally, prior research lacks an in-depth exploration of the mechanisms linking ESG to investment efficiency, particularly internal governance factors. To bridge gaps in prior research, we analyze agency costs and audit quality as mediators and financing constraints and internal control quality as moderators.

This study offers several key insights that contribute to ESG research. First, it provides empirical evidence that ESG controversies significantly reduce investment efficiency, expanding the relevant literature and offering new perspectives for both theory and practice. Second, it highlights the mediating role of corporate governance mechanisms (agency costs and audit quality) and the moderating effects of internal control quality and financing constraints. These findings help explain how ESG controversies affect investment efficiency and enrich the understanding of ESG practices in developing countries, offering valuable guidance for firms committed to sustainable development. Finally, by conducting a heterogeneity analysis based on pollution intensity, ownership structure, analyst coverage, and digitalization level, this study presents a contextualized view of how different firms respond to ESG controversies. These insights contribute to improving ESG risk management and guiding firms toward more rational investment decisions.

This study is structured into six sections. Section 2 presents the theoretical framework and research development. Section 3 discusses the research methodology and sample selection, including measuring ESG controversies and investment efficiency, along with summary statistics. Sections 4 and 5 present the main results and further analyses. Finally, Section 6 provides conclusions and policy recommendations.

2. Theoretical Analysis and Research Hypotheses

2.1. Theoretical Background

This study's theoretical framework is built upon several key theories and structures. It aims to provide a comprehensive understanding of the impact of ESG controversies on investment efficiency and their underlying mechanisms.

First, according to stakeholder theory, firms should consider the interests of all stakeholders in decision-making rather than solely pursuing short-term profit maximization (Donaldson and Preston 1995). When a company faces ESG controversies, deficiencies in its ESG practices can trigger stakeholder dissatisfaction and reactions, affecting its reputation and long-term interests (Schwoy et al. 2023). Moreover, the interaction between a company and its stakeholders is bidirectional, as stakeholder behavior and attitudes directly influence corporate decision-making. During ESG controversies, firms may encounter pressure from various sources, including consumers, investors, employees, and government entities (Onbhuddha et al. 2024). These responses can distort resource allocation, reduce capital efficiency, and sometimes lead to reckless or high-risk investments (Oladele et al. 2024).

Furthermore, according to information asymmetry theory, corporate managers typically possess more internal management information than external investors, hindering the latter's ability to accurately assess a company's value and future performance, thereby reducing investment efficiency (Bergh et al. 2019). When a company faces ESG controversies, this information asymmetry may become more pronounced, as firms may fail to fully disclose ESG-related risks and mitigation measures fully, making it difficult for investors to assess the company's actual operations and potential risks, ultimately impairing investment decision-making efficiency (Khan et al. 2025). Additionally, investors may lose trust in the firm, fearing weaknesses in its governance structure, which could increase capital liquidity risk and financing costs (Woo 2022). Due to information asymmetry, a company's remedial actions may fail to alleviate market concerns about its future performance. Instead, they could heighten market uncertainty, leading to more conservative or inefficient capital allocation and further diminishing investment efficiency (Li 2020).

Finally, according to the agency theory, management prioritizes personal interests over maximizing shareholder value, leading to agency costs due to misaligned incentives and goal divergence (Eisenhardt 1989). In the context of ESG controversies, agency problems may become more pronounced as managers, in response to external pressure, may engage in overinvestment, allocating excessive funds to short-term crisis management and brand rehabilitation while neglecting long-term strategic investments (Chen et al. 2024). Such overreactions can result in resource misallocation, ultimately reducing investment efficiency (Mao et al. 2023). Moreover, ESG controversies often trigger scrutiny of corporate governance structures, prompting investors to demand greater transparency and stricter oversight, which increases agency costs. As a result, heightened governance pressures may cause managers to adopt a more cautious approach, potentially missing valuable investment opportunities (Di and Li 2023).

2.2. Research Hypotheses

2.2.1. ESG Controversies and Investment Efficiency

ESG controversies, as adverse events, can lead to significant losses for firms in areas such as reputation, financing costs, and investment returns (Galletta and Mazzu 2023), which, in turn, severely negatively impacts investment efficiency. According to stakeholder theory, when companies face pressure from stakeholders, they often adopt short-term measures, leading to irrational or inefficient investment decisions. Specifically, companies with poor reputations often struggle to attract external investment (Fernandez-Perez et al. 2022), experience reduced stock price liquidity, and face negative impacts on expected future returns (de Franco 2020). When a company encounters ESG controversies, it may face strong reactions from various stakeholders, including loss of consumer trust, investor uncertainty, lower employee morale, and more stringent regulatory scrutiny (Turban and Greening 1997; Zhang et al. 2021). These combined reactions tend to increase the company's capital costs, limit financing channels, and weaken the company's investment capacity (La Rosa and Bernini 2022). In this context, management may adopt overinvestment strategies, leaning toward increasing short-term investments, overspending, or engaging in high-risk investments. Overinvestment behavior may waste resources and reduce investment efficiency. Based on the above analysis, the following hypothesis is proposed:

H1. *ESG controversies significantly reduce a firm's investment efficiency.*

2.2.2. The Mediating Effect of Agency Costs

According to the agency theory, there is an asymmetry of interests between corporate management and shareholders, where management may make decisions that are not aligned with the best interests of shareholders based on their interests (Dharwadkar et al. 2000). ESG controversies often exacerbate agency costs, affecting a firm's investment efficiency. When responding to ESG controversies, the goals and preferences of shareholders and management may diverge (Kakhbod et al. 2023). Shareholders may seek to enhance the firm's long-term value through rational and efficient investment decisions. At the same time, management may be more inclined to adopt measures that can quickly restore the public image, leading to decision-making biases (Chen et al. 2024). Furthermore, additional regulatory pressure may force the firm to increase oversight costs on management, such as strengthening internal audits and compliance checks (Gou and Li 2025). The rise in agency costs leads to missed higher-return investment opportunities, thereby reducing investment efficiency (Liu et al. 2021). Based on the above analysis, the following hypothesis is proposed:

H2. *Agency costs mediate the impact of ESG controversies on investment efficiency.*

2.2.3. The Mediating Effect of Audit Quality

As a key component of corporate governance, audit quality plays a crucial role in effectively supervising and constraining managerial behavior (Dharwadkar et al. 2000). However, ESG controversies often lead firms to focus excessively on reputation repair and emergency responses in the short term while neglecting their long-term governance structure and audit quality (Mertzanis et al. 2024). According to the agency theory, low-quality decisions made by management can negatively affect the firm's investment efficiency (Kwon et al. 2014). Specifically, when a firm is involved in ESG controversies, management may, under external pressure, attempt to conceal potential ESG-related issues by manipulating financial reports or reducing audit quality to avoid further negative publicity or regulatory scrutiny (Lee and Raschke 2023). A decline in audit quality raises investor concerns about a company's financial transparency and governance structure, exacerbating

information asymmetry and undermining trust in the capital market (Kuo et al. 2023). Based on the above analysis, the following hypothesis is proposed:

H3. *Audit quality mediates the impact of ESG controversies on investment efficiency.*

2.2.4. The Moderating Effect of Financing Constraints

Financing constraints refer to situations where firms may be unable to obtain the necessary external funds for investment or face higher costs when acquiring funds (Whited and Wu 2006). In the context of ESG controversies, financing constraints significantly impact corporate investment decisions by limiting funding sources and potentially forcing firms to adjust their investment strategies (Xu et al. 2023). Higher financing constraints make firms more cautious in investment decisions, avoiding high-risk or unnecessary investments, thereby partially mitigating the adverse impact of ESG controversies on investment efficiency (Zhang et al. 2020). As firms face difficulties accessing external funding, they may prefer stable, low-risk projects, avoiding capital waste caused by overreactions or short-term decisions (Ma et al. 2021). Financing constraints compel firms to prioritize long-term value, emphasizing sustainability and stability while preventing overinvestment or short-term measures in response to ESG controversies (Xiao et al. 2021). Based on the above analysis, the following hypothesis is proposed:

H4. *High financing constraints can mitigate the negative impact of ESG controversies on investment efficiency.*

2.2.5. The Moderating Effect of Internal Control Quality

A firm's internal control system is a key mechanism for ensuring the accuracy of financial reporting, compliance with laws and regulations, and effective management of operational risks (Cheng et al. 2024). According to information asymmetry theory, a strong internal control system enhances transparency, strengthens governance, and improves decision efficiency, helping mitigate risks from information gaps, errors, or strategic misalignment (Chen et al. 2021). When a firm faces ESG controversies, the quality of its internal controls plays a crucial role in reducing the likelihood of irrational or inefficient investment decisions under pressure (Wang 2019). Furthermore, a robust internal control system establishes a clear and transparent decision-making framework, reinforcing oversight mechanisms and enabling management to remain rational and compliant under external pressure (Mesa-Perez 2024), helping prevent overreactions or inefficient investments in response to ESG controversies. Specifically, firms with strong internal controls possess excellent risk management capabilities, effectively identifying and mitigating risks associated with controversial events (Chen et al. 2022). Based on the above analysis, the following hypothesis is proposed:

H5. *Strong internal control quality can mitigate the negative impact of ESG controversies on investment efficiency.*

Based on the above hypotheses, this study demonstrates that ESG controversies directly undermine corporate investment efficiency and indirectly influence it through various mechanisms, as illustrated in Figure 1.

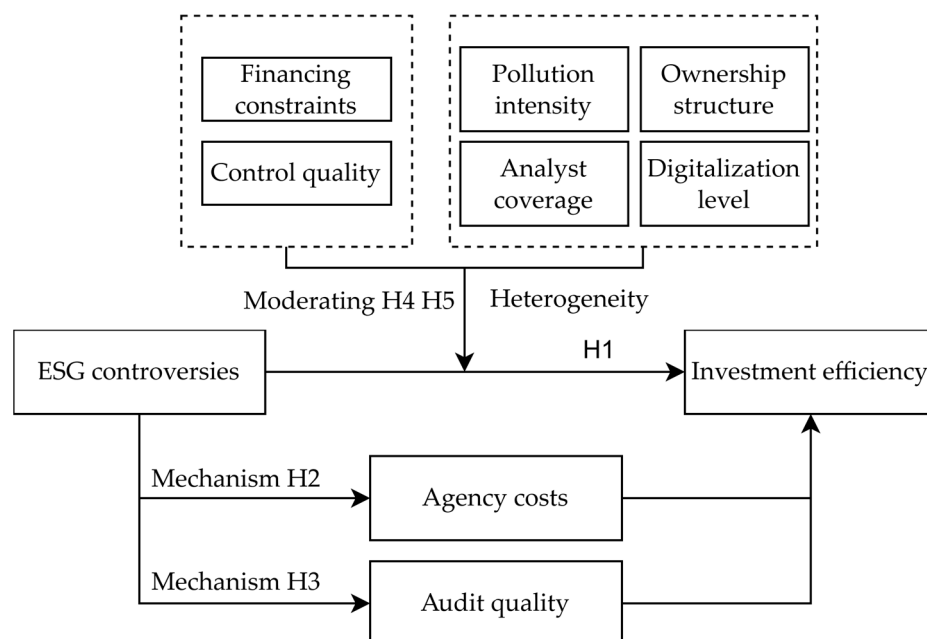


Figure 1. Conceptual Framework.

3. Data and Methodology

3.1. Data and Sample

This study uses Chinese A-share listed companies as the research sample, with a study period spanning from 2007 to 2022. The ESG controversy scores are sourced from the Thomson Reuters DataStream database, the internal control index is derived from the DIB database, and other data are obtained from the Guotai An database. To ensure the robustness and reliability of the results, companies classified as ST or *ST, as well as those with significant missing financial data, are excluded from the sample. In total, 3267 valid observations from 847 listed companies are included for empirical analysis.

3.2. Variables

3.2.1. Dependent Variable

This study adopts the following model proposed by Richardson (2006) to measure firm investment efficiency:

$$\text{Inv}_t = \alpha_0 + \alpha_1 \text{Growth}_{t-1} + \alpha_2 \text{Lev}_{t-1} + \alpha_3 \text{Cash}_{t-1} + \alpha_4 \text{Age}_{t-1} + \alpha_5 \text{Size}_{t-1} + \alpha_6 \text{Ret}_{t-1} + \alpha_7 \text{Inv}_{t-1} + \sum \text{Industry} + \sum \text{Year} + \varepsilon \quad (1)$$

Here, Inv_t represents the firm's actual new investment expenditure in year t , Growth_{t-1} denotes the firm's growth opportunities in the previous year, Age_{t-1} indicates the firm's age in the previous year, Lev_{t-1} refers to the firm's financial leverage in the previous year, Cash_{t-1} reflects the firm's cash flow position in the previous year, Size_{t-1} represents the firm's asset size in the previous year, Ret_{t-1} denotes the firm's stock return in the previous year, Inv_{t-1} indicates the firm's new investment expenditure in the previous year, $\sum \text{Industry}$ represents the industry dummy variables and $\sum \text{Year}$ refers to the year dummy variables.

An annual OLS regression is performed on Model (1) to obtain the residuals, where the absolute value of the residuals, denoted as Misinv , represents the degree of inefficient investment in the firm. A more significant absolute residual indicates a higher level of inefficient investment, implying lower investment efficiency. In this study, two variables, *Over* and *Under*, are defined as follows: when the residual from Model (1) is greater than zero, *Over* equals the value of the residual, indicating overinvestment; when the residual

from Model (2) is less than zero, Under equals the negative of the residual, indicating underinvestment.

3.2.2. Independent Variables

The independent variable in this study is the ESG controversy score (ESGc), sourced from the Thomson Reuters ESG database. It is considered the most reliable and widely used indicator in the literature (Dorfleitner et al. 2020). ESG controversies provide a balanced and comprehensive assessment of a company's ESG performance based on publicly available data and global media reports on ESG-related incidents. The score encompasses 23 ESG-related controversial topics, including anti-competitive behavior, business ethics, intellectual property, tax fraud, privacy, environmental issues, diversity, and opportunities. The score is expressed as a percentile, reflecting the extent to which a company is involved in controversies during a fiscal year.

3.2.3. The Mediating Variable

This study draws on the measurement of agency costs by Samet and Jarboui (2017) and Treepongkaruna et al. (2024), using a firm's free cash flow as an indicator of agency costs (Agency). Firms with high free cash flow are more susceptible to agency problems, as managers may misuse excess cash for non-value-maximizing purposes. This conflict is especially severe in low-growth firms. We measure agency costs using the logarithm of free cash flow, calculated as net income plus depreciation and amortization minus capital expenditures. Higher free cash flow often misaligns with shareholder interests, hampers corporate growth, and signals agency issues, reducing investment efficiency.

Audit quality is crucial for ensuring a firm's financial information's accuracy, completeness, and reliability. Following the approach of (Dechow et al. 1995), this study uses the degree of earnings management as a proxy for audit quality (AQ) and employs the modified Jones model for empirical analysis:

$$\frac{TA_{i,t}}{A_{i,t-1}} = \beta_0 \frac{1}{A_{i,t-1}} + \beta_1 \frac{\Delta REV_{i,t} - \Delta REC_{i,t}}{A_{i,t-1}} + \beta_2 \left(\frac{PPE_{i,t}}{A_{i,t-1}} \right) + \varepsilon_{i,t} \quad (2)$$

The ordinary least squares (OLS) regression method estimates Model (2). Earnings management DA is represented by the estimated residual of Model (2), where a lower DA indicates lower earnings management and, consequently, higher audit quality. In the model, $TA_{i,t}$ represents total accruals, $\Delta REV_{i,t}$ denotes the change in operating revenue in year t , and $\Delta REC_{i,t}$ represents the change in accounts receivable in year t . $PPE_{i,t}$ stands for the net value of fixed assets, $A_{i,t-1}$ represents total assets at the end of year $t - 1$ to control for scale effects, and $\varepsilon_{i,t}$ is the residual term.

3.2.4. The Moderating Variable

Building on the approach of Kaplan and Zingales (1997), this study constructs the KZ index using a sample of Chinese listed companies to measure firm financing constraints (KZ). The KZ index reflects the level of financing constraints a company faces based on indicators such as operating cash flow, cash dividends, cash holdings, leverage, and Tobin's Q. Its advantage lies in its ability to integrate multiple financial indicators, providing a comprehensive assessment of a company's financing constraints. A higher KZ index value indicates more significant financing constraints. The specific model is shown in Equation (3):

$$KZ = -1.001909 \frac{OCF}{Asset} + 3.139193 Lev - 39.3678 \frac{Dividends}{Asset} - 1.314759 \frac{Cash}{Asset} + 0.2826389 TobinQ \quad (3)$$

where OCF, Dividends, and Cash represent operating net cash flow, dividends, and cash holdings, all of which are standardized by total assets at the beginning of the period.

This study follows the measurement of internal control quality by [Cao et al. \(2023\)](#) and uses the internal control quality (IC) from the DBI Dibo database as the moderating variable. Firms with high internal control quality typically have robust corporate governance mechanisms, enabling adequate supervision and constraint of managerial behavior, thereby alleviating agency conflicts and issues.

3.2.5. Control Variables

To account for potential factors affecting corporate investment efficiency and enhance the accuracy and robustness of the results, this study incorporates a set of control variables based on the methodologies of [Lian and Weng \(2024\)](#) and [Ellili \(2022\)](#). These control variables cover both firm characteristics and financial attributes. Size is the natural logarithm of total assets, reflecting firm size. Lev represents the ratio of total debt to total assets, indicating the level of financial leverage. Cash is the ratio of cash holdings to total assets, capturing short-term liquidity. Tangibility is the ratio of net tangible assets to total assets, assessing asset tangibility. Age is the natural logarithm of the firm's years since its establishment, representing operational longevity. Mtb is the ratio of total assets to market value, reflecting market expectations of the firm's prospects. Roa measures profitability as the ratio of net income to total assets.

The definitions and descriptive statistics of all variables are presented in Table 1.

Table 1. Variable definitions.

Variable Type	Variable Name	Symbol	Variable Definition
Dependent Variable	Degree of Inefficient Investment	Misinv	The absolute value of the residual from Model (1) regression
	Overinvestment	Over	The absolute value of the residual greater than zero from Model (1) regression
	Underinvestment	Under	The absolute value of the residual less than zero from Model (1) regression
Independent Variable	ESG Controversies	ESGc	Overall company rating based on negative media coverage
Mediating Variable	Agency Costs	Agency	Log of firm's free cash flow
	Audit Quality	AQ	The residual estimates are derived from the modified Jones model
Moderating Variable	Financing Constraints	KZ	KZ index reflecting the firm's financing constraints
	Internal Control Quality	IC	Internal control quality index from the DBI Dibo database
Control Variable	Firm Size	Size	Natural logarithm of total firm assets
	Leverage	Lev	Total liabilities to total assets ratio
	Cash Holdings	Cash	Cash and cash equivalents to total assets ratio
	Asset Tangibility	Tangibility	(Total assets – net intangible assets)/total assets
	Firm Age	Age	Natural logarithm of the firm's years since establishment
	Market-to-Book Ratio	Mtb	Total assets to market value ratio
	Return on Assets	Roa	Net profit to total assets ratio

3.3. Model Setting

We employ the following regression model to examine the relationship between ESG controversies and firm investment efficiency:

$$\text{Ineff}_{i,t} = \alpha_0 + \alpha_1 \text{ESG}_{i,t} + \beta \text{Control}_{i,t} + \sum \text{Year} + \sum \text{Industry} + \varepsilon_{i,t} \quad (4)$$

Here, $\text{Ineff}_{i,t}$ represents firm investment inefficiency, including the degree of inefficient investment (Misinv), overinvestment (Over), and underinvestment (Under). $\text{ESG}_{i,t}$ denotes the ESG controversy scores for firm i in year t . $\text{Control}_{i,t}$ refers to the seven control variables mentioned above, and we also control for year-fixed effects (YearFE) and industry-fixed effects (IndustryFE). ε represents the error term.

Next, based on Model (4), we construct the following model to test the mediating effects of agency costs and audit quality.

$$\text{Mediator}_{i,t} = \alpha_0 + \alpha_1 \text{ESG}_{i,t} + \beta \text{Control}_{i,t} + \sum \text{Year} + \sum \text{Industry} + \varepsilon_{i,t} \quad (5)$$

$$\text{Ineff}_{i,t} = \alpha_0 + \alpha_1 \text{ESG}_{i,t} + \alpha_2 \text{Mediator}_{i,t} + \beta \text{Control}_{i,t} + \sum \text{Year} + \sum \text{Industry} + \varepsilon_{i,t} \quad (6)$$

To test the moderating effects of financing constraints and internal control quality, this study constructs Model (7):

$$\text{Ineff}_{i,t} = \alpha_0 + \alpha_1 \text{ESG}_{i,t} + \alpha_2 \text{Moderator}_{i,t} + \alpha_3 \text{ESG}_{i,t} * \text{Moderator}_{i,t} + \beta \text{Control}_{i,t} + \sum \text{Year} + \sum \text{Industry} + \varepsilon_{i,t} \quad (7)$$

3.4. Descriptive Statistical Analysis

The results in Table 2 show that the mean ESG controversy score for firms is 89.0792, ranging from 5 to 100, and a standard deviation of 6.0040, indicating substantial variation among companies. Further examination of firm investment efficiency reveals that out of 3267 samples, 1806 exhibit underinvestment, suggesting that most firms face underinvestment issues. The investment efficiency median is 0.0193, which is lower than the mean of 0.0329, indicating significant variation, with more than half of the firms failing to meet the mean standard. The statistical distribution of the remaining control variables is reasonable and generally consistent with existing research.

Table 2. Descriptive statistical results of the main variables.

Variable Type	Variables	N	Mean	Std	Min	Max
Dependent Variable	Misinv	3267	0.0329	0.0616	0.00002	2.2668
	Over	1461	0.0388	0.0639	0.00002	0.8158
	Under	1806	0.0281	0.0593	0.00002	2.2668
Independent Variable	ESGc	3267	89.0792	6.0040	5	100
Mediating Variable	Agency	2076	21.0119	1.7183	13.5401	26.2543
	AQ	3229	0.0106	0.0914	−0.9803	2.1071
Moderating Variable	KZ	3247	1.2435	2.1890	−10.7214	7.8771
	IC	3215	675.4902	124.3284	0	995.36
Control Variable	Size	3267	24.2361	1.3267	20.98	28.64
	Lev	3267	0.4811	0.1930	0.0143	1.3124
	Cash	3267	0.0905	0.1103	−1.7586	2.8712
	Tangibility	3267	0.9348	0.0892	0.2680	1
	Age	3267	14.6525	7.5374	0	31
	Mbt	3267	0.6690	0.3396	0.0300	2.0245
	Roa	3267	0.0605	0.0701	−0.5860	0.6444

4. Results

4.1. Baseline Regression

Table 3 reports the regression results of the impact of corporate ESG controversy scores on inefficient investment. Column (1) presents the results without control variables and fixed effects, which are statistically significant at the 10% level. Column (2) includes control variables, Column (3) controls for year effects, and Column (4) controls for both year and industry-fixed effects. Columns (5) and (6) show the results where the dependent variables are overinvestment and underinvestment, respectively. All results indicate a significant positive correlation between ESG controversy scores and inefficient investment, suggesting that the more ESG controversies a company faces, the lower its investment efficiency, thereby confirming Hypothesis 1.

Table 3. Baseline regression results.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Misinv	Misinv	Misinv	Misinv	Over	Under
ESGc	0.0004 *	0.0004 ***	0.0004 **	0.0004 ***	0.0007 **	0.0002 *
	(1.71)	(2.60)	(2.55)	(2.63)	(2.01)	(1.69)
Size		0.0021 **	0.0015	0.0012	0.0020	0.0008
		(2.30)	(1.64)	(1.25)	(1.02)	(1.01)
Lev		0.0218 ***	0.0212 ***	0.0290 ***	0.0506 ***	0.0072
		(3.78)	(3.68)	(4.79)	(4.07)	(1.51)
Cash		0.1228 ***	0.1258 ***	0.1183 ***	0.1802 ***	0.0067
		(12.79)	(13.05)	(12.12)	(11.03)	(0.72)
Tangibility		−0.0652 ***	−0.0648 ***	−0.0762 ***	−0.0946 ***	−0.0549 ***
		(−7.44)	(−7.40)	(−8.12)	(−5.05)	(−7.49)
Age		−0.0006 ***	−0.0006 ***	−0.0006 ***	−0.0008 ***	−0.0005 ***
		(−5.56)	(−5.35)	(−5.45)	(−3.49)	(−5.02)
Mbt		−0.0197 ***	−0.0188 ***	−0.0170 ***	−0.0196 ***	−0.0146 ***
		(−5.57)	(−5.25)	(−4.58)	(−2.61)	(−5.08)
Roa		−0.0358 **	−0.0411 **	−0.0299 *	−0.0142	0.0104
		(−2.13)	(−2.43)	(−1.72)	(−0.42)	(0.73)
Cons	−0.0048	−0.0003	0.0135	0.0265	−0.0029	0.0472 *
	(−0.22)	(−0.01)	(0.46)	(0.80)	(0.05)	(1.94)
Year	No	No	Yes	Yes	Yes	Yes
Industry	No	No	No	Yes	Yes	Yes
Obs	3267	3267	3267	3267	1461	1806
F	2.92	50.53	50.22	46.33	32.58	17.83
R-squared	0.0009	0.1104	0.1187	0.1382	0.2051	0.1366

Note: T-statistics in parentheses; *** $p < 0.01$, ** $p < 0.05$; * $p < 0.1$.

Furthermore, the coefficient for overinvestment is the largest, indicating that the negative impact of ESG controversies on investment efficiency is primarily reflected in overinvestment. In conclusion, companies may face short-term financial losses or reputational risks when addressing ESG controversies. Management may fail to fully consider the company's resources and long-term development needs, potentially leading to overinvestment strategies that reduce capital allocation efficiency.

4.2. Robustness Analysis

4.2.1. Instrumental Variables Method (2SLS)

A firm's investment efficiency and ESG controversies may have a causal relationship. Firms with low investment efficiency may experience poor governance and hindered financial development, which could lead to ESG controversies (Wan and Lee 2023). We employ the instrumental variable approach to mitigate potential endogeneity issues. Specifically,

firms within the same industry may be subject to similar external economic environments and policy conditions correlated with their ESG controversy scores. Moreover, this variable is unrelated to the target firm's investment efficiency, ensuring substantive exogeneity. Therefore, this study adopts the industry-year average ESG controversy score of other firms in the same industry as an instrumental variable (ESGc_IV). This approach ensures that the instrumental variable is uncorrelated with changes in corporate investment efficiency while maintaining its relevance to the firm's ESG controversy scores, thereby effectively addressing endogeneity concerns.

In Column (1) of Table 4, the coefficients of both the instrumental and independent variables are significantly negative, indicating that the selected instrumental variable is valid and strongly correlated with the key variable. In the regression results presented in Columns (2), (3), and (4), the coefficients of the ESG controversy scores remain significantly positive. This finding further validates research Hypothesis 1, confirming that firms with higher ESG controversies exhibit significantly lower investment efficiency after controlling for relevant variables.

Table 4. Robustness analysis: Two-Stage Least Squares (2SLS).

Variables	(1)	(2)	(3)	(4)
	ESGc	Misinv	Over	Under
	First Stage	Second Stage	Second Stage	Second Stage
ESGc		0.0051 ** (2.33)	0.0106 (1.22)	0.0025 ** (2.17)
ESGc_iv	−0.3679 *** (−5.61)			
Size	−0.7718 *** (−9.13)	0.0049 ** (2.45)	0.0093 (1.40)	0.0027 ** (2.18)
Lev	1.0334 * (1.93)	0.0238 *** (3.42)	0.0532 *** (3.34)	0.0016 (0.29)
Cash	−0.8091 (−0.94)	0.1229 *** (11.40)	0.1798 *** (8.67)	0.0115 (1.13)
Tangibility	−0.8184 (−0.99)	−0.0712 *** (−6.87)	−0.0863 *** (−3.57)	−0.0526 *** (−6.79)
Age	−0.0026 (−0.25)	−0.0006 *** (−4.83)	−0.0006 * (−1.72)	−0.0005 *** (−5.06)
Mbt	1.2907 *** (3.96)	−0.0231 *** (−4.75)	−0.0348 ** (−2.23)	−0.0171 *** (−5.20)
Roa	3.4363 ** (2.22)	−0.0475 ** (−2.34)	−0.0401 (−0.86)	−0.0005 (−0.30)
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Obs	3234	3234	1447	1786
F	31.49	39.24	20.95	16.17
Anderson				
canon. corr.	31.55			
LM				
Cragg-Donald				
Wald F	31.49			

Note: T-statistics in parentheses; *** $p < 0.01$, ** $p < 0.05$; * $p < 0.1$.

4.2.2. Using the T + 1 Period Dependent Variable

To eliminate the impact of short-term fluctuations and address the issue of reverse causality, we use the investment efficiency for the following year (T + 1) as the dependent variable in Equation (3) and perform the regression again. The regression results in Table 5 show that the coefficient for ESG controversies is significantly positive, and the key variables

are consistent with the previous results, supporting the hypothesis. The results indicate that ESG controversy scores significantly negatively impacted investment efficiency in the following year, with this adverse effect primarily manifested in overinvestment. This conclusion strengthens the robustness of the research findings.

Table 5. Robustness analysis: T + 1 period dependent variable.

Variables	(1)	(2)	(3)
	F.Misinv	F.Over	F.Under
ESGc	0.0004 ** (2.54)	0.0008 (1.38)	0.0003 ** (2.20)
Size	0.0007 (0.78)	0.0012 (0.74)	0.0001 (0.20)
Lev	0.0107 ** (1.96)	0.0069 (0.62)	0.0100 * (1.93)
Cash	0.0337 *** (3.91)	0.0372 *** (2.66)	0.0305 *** (3.01)
Tangibility	−0.0386 *** (−4.77)	−0.0305 * (−1.85)	−0.0438 *** (−5.78)
Age	−0.0005 *** (−4.65)	−0.0006 *** (−3.01)	−0.0005 *** (−4.51)
Mbt	−0.0186 *** (−5.45)	−0.0253 *** (−3.69)	−0.0133 *** (−4.08)
Roa	0.0049 (0.30)	−0.0186 (−0.54)	0.0164 (1.07)
Cons	0.0217 (0.81)	−0.0308 (−0.41)	0.0467 ** (1.96)
Year	Yes	Yes	Yes
Industry	Yes	Yes	Yes
Obs	2444	1053	1390
F	20.84	8.20	17.73
R-squared	0.1103	0.1376	0.1507

Note: T-statistics in parentheses; *** $p < 0.01$, ** $p < 0.05$; * $p < 0.1$.

4.2.3. Replace the Dependent Variable

This study adopts the investment efficiency model [Biddle et al. \(2009\)](#) proposed as an alternative. The Biddle model is presented as follows:

$$\text{Inv}_{i,t} = \beta_0 + \beta_1 \text{Growth}_{i,t-1} + \varepsilon \quad (8)$$

Here, $\text{Inv}_{i,t}$ represents total investment, and $\text{Growth}_{i,t-1}$ represents growth opportunities, measured by the percentage change in sales from year $t - 1$ to year t . Similarly, the absolute value of the residuals estimated from the model indicates inefficient investment; the more significant the value, the higher the degree of inefficient investment. Table 6 reports the relationship between corporate ESG controversies and investment inefficiency, overinvestment, and underinvestment, as calculated using the Biddle model. The results are consistent with the baseline regression, indicating that ESG controversies significantly reduce investment efficiency.

Table 6. Robustness analysis: Replace the dependent variable.

Variables	(1)	(2)	(3)
	Misinv-Biddle	Over-Biddle	Under-Biddle
ESGc	0.0007 *** (2.80)	0.0010 (1.00)	0.0004 ** (2.51)
Size	0.0010 (0.94)	0.0056 ** (2.31)	−0.0020 *** (−2.80)
Lev	0.0325 *** (4.82)	0.0782 *** (5.06)	0.0032 (0.72)
Cash	0.0814 *** (7.77)	0.1206 *** (6.31)	−0.0129 (−1.50)
Tangibility	−0.0462 *** (−4.63)	−0.1047 *** (−4.63)	−0.0126 * (−1.91)
Age	−0.0007 *** (−5.44)	−0.0012 *** (−4.09)	0.0001 (0.35)
Mbt	−0.0161 *** (−3.86)	−0.0422 *** (−4.37)	0.0056 ** (2.09)
Roa	−0.0333 * (−1.68)	−0.0847 * (−1.89)	0.0366 *** (2.78)
Cons	−0.0142 (−0.36)	−0.0819 (−0.67)	0.0478 ** (2.04)
Year	Yes	Yes	Yes
Industry	Yes	Yes	Yes
Obs	2614	1031	1583
F	23.71	17.58	3.68
R-squared	0.1339	0.2040	0.1391

Note: T-statistics in parentheses; *** $p < 0.01$, ** $p < 0.05$; * $p < 0.1$.

4.2.4. Replace the Explanatory Variable

This study substitutes the original explanatory variable, the ESG controversy scores, with the ESG controversy scores from the Wind database. These scores are generated using the Wind ESG rating methodology, which incorporates an assessment of management practices and controversial events to thoroughly reflect the effectiveness of ESG management (Feng et al. 2022). As shown in Table 7, the ESG controversy scores remain significantly positive at the 1% level, indicating that the substitution of the explanatory variable does not alter the primary conclusions of this study.

Table 7. Robustness analysis: Replace the explanatory variable.

Variables	(1)	(2)	(3)
	Misinv	Over	Under
Wind-ESGc	0.0182 *** (3.55)	0.0328 *** (3.43)	0.0003 (0.80)
Size	0.0023 ** (2.18)	0.0039 * (1.84)	0.0010 (1.20)
Lev	0.0195 *** (3.05)	0.0396 *** (3.03)	−0.0001 (0.10)
Cash	0.1387 *** (13.63)	0.2108 *** (12.16)	0.0144 (4.58)
Tangibility	−0.0580 *** (−5.79)	−0.0807 *** (−4.07)	−0.0358 *** (−4.78)
Age	−0.0006 *** (−5.09)	−0.0008 *** (−3.21)	−0.0005 *** (−5.09)
Mbt	−0.0168 *** (−4.38)	−0.0204 *** (−2.62)	−0.0142 *** (−5.03)
Roa	−0.0638 *** (−3.43)	−0.0805 ** (−2.12)	−0.0013 (−0.10)
Cons	−0.0222 (−0.71)	−0.0854 (−1.41)	0.0487 ** (2.02)
Year	Yes	Yes	Yes
Industry	Yes	Yes	Yes
Obs	2738	1240	1498
F	45.07	33.09	14.14
R-squared	0.1485	0.2227	0.1226

Note: T-statistics in parentheses; *** $p < 0.01$, ** $p < 0.05$; * $p < 0.1$.

5. Further Analysis

5.1. Mediating Effect

5.1.1. Agency Costs

Agency costs arise from information asymmetry and misalignment of objectives between management and shareholders. This study measures agency costs using a firm's free cash flow. Firms with high levels of free cash flow are more susceptible to managerial opportunism, which can lead to inefficient investment decisions. Such investments often conflict with shareholder interests, hinder the firm's long-term development, and reduce investment efficiency, exacerbating agency problems.

The regression results are presented in Table 8. Column (1) reports the regression results of ESG controversies on firm investment efficiency without including the mediating variable. Column (2) shows the regression results of ESG controversies on agency costs, with a significantly positive coefficient at the 1% level, indicating that ESG controversies increase agency costs. In Column (3), the mediating variable is added to the model in Column (1), and the coefficient for agency costs is significantly positive at the 1% level, indicating a mediating effect. Specifically, ESG controversies reduce investment efficiency by increasing agency costs. Columns (4) and (5) report the mediating effect of agency costs in the contexts of overinvestment and underinvestment. In both cases, the ESG controversy scores coefficient is significantly positive, and the agency cost is significantly positive, further supporting Hypothesis 2.

Table 8. Mediating Effect: Agency Costs.

Variables	(1) Misinv	(2) Agency	(3) Misinv	(4) Over	(5) Under
Agency			0.0020 *** (3.08)	0.0011 (0.84)	0.0023 *** (3.47)
ESGc	0.0004 *** (2.63)	0.0197 *** (2.85)	0.0003 * (1.69)	0.0007 (1.51)	0.0002 (1.27)
Size	0.0012 (1.25)	0.9750 *** (34.65)	−0.0015 (−1.43)	−0.0013 (−0.63)	−0.0017 (−1.57)
Lev	0.0290 *** (4.79)	0.0159 (0.09)	0.0137 ** (2.64)	0.0273 *** (2.62)	0.0033 (0.61)
Cash	0.1183 *** (12.12)	0.5220 (1.43)	0.0020 (0.18)	−0.0022 (−0.10)	0.0040 (0.36)
Tangibility	−0.0762 *** (−8.12)	−1.0523 *** (3.82)	−0.0637 *** (−7.93)	−0.1013 *** (−6.47)	−0.0369 *** (−4.38)
Age	−0.0006 *** (−5.45)	0.0064 * (1.86)	−0.0003 *** (−3.18)	−0.0001 (0.53)	−0.0005 *** (−4.48)
Mbt	−0.0170 *** (−4.58)	0.1012 (0.96)	−0.0186 *** (−6.05)	−0.0198 *** (−3.22)	−0.0156 *** (−4.88)
Roa	−0.0299 * (−1.72)	3.6565 *** (6.55)	0.0107 (0.65)	0.0458 (1.36)	−0.0065 (−0.38)
Cons	0.0265 (0.80)	−4.1049 *** (−3.99)	0.0564 * (1.88)	0.0542 (0.81)	0.0430 (1.44)
Year	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes
Obs	3267	2076	2076	801	1273
F	46.33	258.59	18.93	8.90	11.77
R-squared	0.1382	0.5847	0.1313	0.2047	0.1598

Note: T-statistics in parentheses; *** $p < 0.01$, ** $p < 0.05$; * $p < 0.1$.

5.1.2. Audit Quality

Audit quality is a key factor in ensuring the reliability of financial information. High-quality audits effectively identify and report potential risks, providing investors and management with accurate and transparent financial data. In this study, audit quality is measured using the residual estimates from the modified Jones model, where a lower DA indicates higher audit quality. When firms face ESG controversies, poor audit quality exacerbates information asymmetry, undermining investor confidence and decision-making and ultimately reducing investment efficiency.

The regression results are presented in Table 9. Column (1) reports the regression of ESG controversies on corporate investment efficiency without the mediating variable. Column (2) shows the regression of ESG controversies on audit quality, with a significantly positive coefficient at the 1% level, indicating that ESG controversies reduce audit quality. In Column (3), the mediating variable is introduced into the model from Column (1), and the coefficient of audit quality remains significantly positive at the 1% level, confirming the presence of a mediation effect. Specifically, ESG controversies reduce investment efficiency by lowering audit quality. Columns (4) and (5) report the mediation effect of audit quality in cases of overinvestment and underinvestment. In both cases, the ESG controversy scores and audit quality coefficients remain significantly positive, further supporting Hypothesis 3.

Table 9. Mediating Effect: Audit Quality.

Variables	(1)	(2)	(3)	(4)	(5)
	Misinv	AQ	Misinv	Over	Under
AQ			0.1401 *** (10.60)	0.1645 *** (7.65)	0.0181 (1.28)
ESGc	0.0004 *** (2.63)	0.0007 *** (2.47)	0.0004 ** (2.00)	0.00078 (1.71)	0.0003 * (1.65)
Size	0.0012 (1.25)	0.0004 (0.33)	0.0009 (0.98)	0.0017 (0.85)	0.0006 (0.76)
Lev	0.0290 *** (4.79)	0.0016 (0.20)	0.0290 *** (4.85)	0.0529 *** (4.34)	0.0072 (1.49)
Cash	0.1183 *** (12.12)	−0.6185 *** (−47.81)	0.2034 *** (16.08)	0.2595 *** (13.46)	0.0186 (1.25)
Tangibility	−0.0762 *** (−8.12)	0.0425 *** (3.34)	−0.0858 *** (−9.03)	−0.1131 *** (−5.93)	−0.0571 *** (−7.56)
Age	−0.0006 *** (−5.45)	−0.0003 * (−1.83)	−0.0006 *** (−5.03)	−0.0007 *** (−3.00)	−0.0005 *** (−5.02)
Mbt	−0.0170 *** (−4.58)	0.0007 (0.14)	−0.0167 *** (−4.54)	−0.0198 *** (−2.66)	−0.0143 *** (−4.87)
Roa	−0.0299 * (−1.72)	1.0367 (45.15)	−0.1726 *** (−7.87)	−0.1647 *** (−4.21)	−0.0101 (−0.46)
Cons	0.0265 (0.80)	−0.1091 *** (−2.47)	0.0427 (1.29)	0.0166 (0.26)	0.0482 * (1.75)
Year	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes
Obs	3267	3229	3229	1445	1782
F	46.33	398.58	54.30	36.19	15.84
R-squared	0.1382	0.5132	0.1631	0.2291	0.1361

Note: T-statistics in parentheses; *** $p < 0.01$, ** $p < 0.05$; * $p < 0.1$.

5.2. Moderating Effect

5.2.1. Financing Constraints

Financing constraints refer to firms' limitations in accessing external financing when making investment decisions. These constraints affect a firm's ability to obtain funds and the cost of acquiring capital, which encourages management to be more cautious when addressing ESG controversies, focusing on efficiently utilizing limited resources to resolve the issues. This study uses the KZ index to measure financing constraints directly. The regression results are presented in Table 10, where the coefficient for ESG controversies on inefficient investment is significantly positive at the 1% level. The interaction term is also significantly positive, indicating that financing constraints influence the relationship between ESG controversies and investment efficiency. The consistent results for both over-investment and underinvestment indicate that higher financing constraints can mitigate the negative impact of ESG controversies on investment efficiency, further supporting Hypothesis 4.

Table 10. Moderating Effect: Financing Constraints.

Variables	(1)	(2)	(3)
	Misinv	Over	Under
ESGc	0.0012 *** (3.42)	0.0006 ** (2.32)	0.0019 ** (2.31)
KZ	0.0387 ** (2.55)	0.0161 (1.12)	0.0549 * (1.89)
KZ × ESGc	−0.0004 ** (−2.35)	−0.0002 (−1.05)	−0.0005 * (−1.81)
Size	0.0019 ** (2.04)	0.0012 (1.64)	0.0029 (1.49)
Lev	0.0038 (0.50)	−0.0037 (−0.64)	0.0284 * (1.79)
Cash	0.1589 *** (13.21)	0.0236 ** (2.03)	0.2119 *** (10.54)
Tangibility	−0.0666 *** (−7.20)	−0.0433 *** (−6.08)	−0.0896 *** (−4.87)
Age	−0.0006 *** (−5.49)	−0.0005 *** (−5.23)	−0.0008 *** (−3.33)
Mbt	−0.0133 *** (−3.61)	−0.0137 *** (−4.84)	−0.0163 ** (−2.18)
Roa	−0.0242 (−1.38)	0.0091 (0.66)	−0.0214 (−0.62)
Cons	−0.0782 * (−1.72)	−0.0106 (−0.31)	−0.1474 (−1.53)
Year	Yes	Yes	Yes
Industry	Yes	Yes	Yes
Obs	3247	1796	1451
F	40.67	13.94	27.76
R-squared	0.1484	0.1403	0.2156

Note: T-statistics in parentheses; *** $p < 0.01$, ** $p < 0.05$; * $p < 0.1$.

5.2.2. Internal Control Quality

Corporate governance quality is an important factor influencing investment efficiency. Firms with high internal control quality typically have well-established governance mechanisms, enabling adequate supervision and constraint of managerial behavior, thereby alleviating agency conflicts and issues. This study uses the internal control quality index from the DBI Dibo database as the moderating variable. The regression results are

presented in Table 11. The coefficient for ESG controversies on inefficient investment is significantly positive. In contrast, the coefficient for the interaction term is significantly negative, indicating that internal control quality affects the relationship between ESG controversies and investment efficiency. The results for overinvestment and underinvestment are consistent, with higher internal control quality leading to less inefficient investment resulting from ESG controversies. This conclusion supports Hypothesis 5.

Table 11. Moderating Effect: Internal Control Quality.

Variables	(1)	(2)	(3)
	Misinv	Over	Under
ESGc	0.0004 ** (2.42)	0.0005 * (1.68)	0.0002 * (1.78)
IC	−0.0169 ** (−2.24)	−0.0233 (−1.62)	−0.0123 * (−1.91)
IC × ESGc	−0.0002 *** (−3.00)	−0.0003 ** (−2.30)	−0.0001 ** (−2.34)
Size	0.0024 ** (2.40)	0.0027 (1.35)	0.0023 *** (2.98)
Lev	0.0217 *** (4.40)	0.0411 *** (3.74)	0.0025 (0.57)
Cash	0.1135 *** (13.03)	0.1700 *** (11.79)	0.0080 (0.93)
Tangibility	−0.0569 *** (−6.71)	−0.0609 *** (−3.64)	−0.0470 *** (−6.84)
Age	−0.0006 *** (−5.78)	−0.0007 *** (−3.67)	−0.0004 *** (−5.11)
Mbt	−0.0154 *** (−4.58)	−0.0159 ** (−2.33)	−0.0154 *** (−5.73)
Roa	0.0033 (0.20)	0.0326 (1.05)	0.0288 ** (2.06)
Cons	0.0043 (0.15)	−0.0144 (−0.26)	0.0145 (0.62)
Year	Yes	Yes	Yes
Industry	Yes	Yes	Yes
Obs	3215	1427	1788
F	43.41	30.40	16.81
R-squared	0.1540	0.2328	0.1432

Note: T-statistics in parentheses; *** $p < 0.01$, ** $p < 0.05$; * $p < 0.1$.

5.3. Heterogeneity Analysis

This study employs heterogeneity analysis to examine whether the impact of ESG controversies on investment efficiency varies across different firm characteristics or external environments, thereby uncovering this effect's underlying mechanisms and boundary conditions. By identifying which types of firms are more vulnerable to the negative impact of ESG controversies, the heterogeneity analysis enhances the study's explanatory power and practical relevance.

5.3.1. Pollution Intensity

Heavily polluting firms typically face higher regulatory pressure and compliance costs (Tang et al. 2020), and when confronted with ESG controversies, they often experience more significant reputational damage. This study classifies the sample into heavily polluting and non-heavily polluting firms based on the 2012 revised 'Guidelines for the Industry Classification of Listed Companies by the China Securities Regulatory Commission (CSRC) and performs a grouped regression. The results of Table 12 show that the negative impact of ESG

controversies on investment efficiency is more pronounced for heavily polluting firms, suggesting that ESG controversies in these firms may further exacerbate their agency costs and inefficient audit quality, thereby amplifying the negative impact on investment efficiency.

Table 12. Heterogeneity Analysis: Pollution Intensity and Ownership Structure.

Variables	(1)	(2)	(3)	(4)
	High Pollution	Low Pollution	Soe	Non-Soe
ESGc	0.0010 * (1.70)	0.0007 *** (2.62)	0.0004 ** (2.22)	0.0013 *** (2.60)
Size	−0.0006 (−0.23)	0.0018 (1.63)	−0.0001 (−0.60)	0.0067 *** (3.20)
Lev	0.0348 * (1.94)	0.0269 *** (4.08)	0.0066 (1.17)	0.0396 *** (3.51)
Cash	0.1239 *** (3.56)	0.1191 *** (11.59)	0.0195 * (1.65)	0.1783 *** (11.87)
Tangibility	−0.0939 *** (−2.61)	−0.0708 *** (−7.10)	−0.0639 *** (−7.34)	−0.0853 *** (−4.96)
Age	−0.0003 (−1.14)	−0.0007 *** (−5.48)	−0.0002 (−1.45)	−0.0008 *** (−3.33)
Mbt	−0.0062 (−0.60)	−0.0187 *** (−4.54)	−0.0140 *** (−4.23)	−0.0176 ** (−2.45)
Roa	0.0152 (0.26)	−0.0407 ** (−2.18)	0.0350 * (1.84)	−0.0964 *** (−3.36)
Cons	0.0112 (0.12)	−0.0142 (−0.36)	0.0485 (1.57)	−0.1817 ** (−2.52)
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Obs	480	2767	1676	1557
F	5.01	41.39	14.83	29.96
R-squared	0.1416	0.1479	0.1557	0.1866

Note: T-statistics in parentheses; *** $p < 0.01$, ** $p < 0.05$; * $p < 0.1$.

5.3.2. Ownership Structure

State-owned enterprises (SOEs) respond to national policies and align their ESG practices with national development directions. In contrast, non-state-owned enterprises (NSOEs) focus more on stakeholder needs (Lian et al. 2023). In this study, firms are classified into two categories based on ownership structure: state-owned and non-state-owned. The results of Table 12 show that the negative impact of ESG controversies on investment efficiency is more significant for non-state-owned enterprises. This suggests that when facing ESG controversies, NSOEs focus on quickly responding to market pressures, restoring shareholder trust, and enhancing corporate image. However, such overreactions often fail to effectively improve the firm's long-term competitiveness and financial returns, leading to a decline in investment efficiency. In contrast, state-owned enterprises are generally influenced by government strategic objectives and have a more cautious decision-making process, resulting in a minor impact of controversies on their investment efficiency.

5.3.3. Analyst Coverage

Analyst attention and research on a firm can significantly influence investor evaluations and investment decisions (Li et al. 2023). This study uses analyst attention as a measure, categorizing companies with analyst coverage above the sample median as high analyst attention companies and the rest as low analyst attention companies. The results of Table 13 show that the negative impact of ESG controversies on investment efficiency

is more significant for companies with high analyst attention. High analyst coverage increases investor attention to the company. When companies with high analyst coverage face ESG controversies, investor reactions are often more intense, quickly influencing market sentiment and investment decisions, exacerbating financing costs, and reducing investment efficiency.

Table 13. Heterogeneity Analysis: Analyst Coverage and Digitalization Level.

Variables	(1)	(2)	(3)	(4)
	High Analyst Coverage	Low Analyst Coverage	High Digitalization	Low Digitalization
ESGc	0.0010 * (1.70)	0.0007 *** (2.62)	0.0004 ** (2.22)	0.0013 *** (2.60)
Size	−0.0006 (−0.23)	0.0018 (1.63)	−0.0001 (−0.60)	0.0067 *** (3.20)
Lev	0.0348 * (1.94)	0.0269 *** (4.08)	0.0066 (1.17)	0.0396 *** (3.51)
Cash	0.1239 *** (3.56)	0.1191 *** (11.59)	0.0195 * (1.65)	0.1783 *** (11.87)
Tangibility	−0.0939 *** (−2.61)	−0.0708 *** (−7.10)	−0.0639 *** (−7.34)	−0.0853 *** (−4.96)
Age	−0.0003 (−1.14)	−0.0007 *** (−5.48)	−0.0002 (−1.45)	−0.0008 *** (−3.33)
Mbt	−0.0062 (−0.60)	−0.0187 *** (−4.54)	−0.0140 *** (−4.23)	−0.0176 ** (−2.45)
Roa	0.0152 (0.26)	−0.0407 ** (−2.18)	0.0350 * (1.84)	−0.0964 *** (−3.36)
Cons	0.0112 (0.12)	−0.0142 (−0.36)	0.0485 (1.57)	−0.1817 ** (−2.52)
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Obs	480	2767	1676	1557
F	5.01	41.39	14.83	29.96
R-squared	0.1416	0.1479	0.1557	0.1866

Note: T-statistics in parentheses; *** $p < 0.01$, ** $p < 0.05$; * $p < 0.1$.

5.3.4. Digitalization Level

The level of digitalization within a firm provides the ability to analyze investment projects through technological and data-driven methods, significantly impacting investment efficiency (Lv and Xiong 2022). Firms with higher digitalization levels have more efficient information transmission, which helps reduce information asymmetry and transaction costs. This study follows the methodology of Shang et al. (2023) by using web scraping techniques to identify key terms related to a firm's digital transformation, calculating term frequency, and constructing a digital transformation index. Based on this index, the sample is divided into high- and low-level digitalization firms. The results of Table 13 show that the negative impact of ESG controversies on investment efficiency is more significant for firms with lower digitalization levels. This suggests that when responding to ESG controversies, these firms exhibit poor responsiveness due to a lack of adequate information management, resource optimization, and flexible decision-support systems, leading to the misallocation of capital.

6. Conclusions and Policy Recommendations

6.1. Conclusions

Existing sustainability research primarily focuses on the benefits firms derive from ESG engagement. However, relatively little is known about how firms mitigate the negative impact of ESG controversies, particularly in investment decision-making. An effective investment strategy requires firms to carefully assess ESG risks, as controversies increase uncertainty, raise financing costs, and disrupt capital allocation. Our study highlights

the critical role of corporate governance in shaping ESG outcomes and enhancing investment efficiency.

In summary, this study empirically examines the impact of ESG controversies on investment efficiency using a sample of A-share listed companies in China from 2007 to 2022. This research offers several key contributions. First, we find that ESG controversies significantly reduce corporate investment efficiency, primarily leading to overinvestment. Using ESG controversy scores, we overcome potential “greenwashing” biases inherent in traditional ESG rating methods (Yu et al. 2020). Existing ESG rating systems rely on corporate self-disclosure, making them susceptible to measurement inconsistencies and managerial manipulation, which may result in misleading ratings (Liu et al. 2024). By adopting ESG controversy scores, this study avoids self-reporting biases, providing a more objective and reliable assessment tool that accurately captures ESG-related risks and their implications for investment decisions.

Second, ESG controversies impair investment efficiency by exacerbating agency costs and reducing audit quality. Prior research has focused on the external effects of ESG controversies, such as their impact on corporate reputation and market performance (Baudot et al. 2020; Soschinski et al. 2024). In contrast, this study examines ESG controversies from an internal governance perspective, deepening our understanding of how they affect investment efficiency. By identifying the mechanisms through which ESG controversies influence corporate investment decisions, our research expands the existing literature and fills a critical gap in this field.

Moreover, financing constraints and internal control quality mitigate the adverse effects of ESG controversies on investment efficiency, providing valuable insights for managers and policymakers. While some studies have explored the relationship between ESG performance and financing constraints (Y. Yang and Han 2023), research examining the impact of ESG controversies on investment efficiency through the lens of financing constraints remains limited. Additionally, most of the existing literature emphasizes the moderating effects of external factors (Bilyay-Erdogan et al. 2024), with relatively little attention given to the role of internal governance mechanisms. Our study fills this gap by highlighting the moderating roles of financing constraints and internal control quality, contributing to theory and practice.

Finally, heterogeneity analysis shows that the negative impact of ESG controversies on investment efficiency is more substantial in high-pollution firms, non-state-owned enterprises, firms with high analyst coverage, and those with lower digitalization levels. While previous studies have primarily focused on heterogeneity in accounting information quality, marketization, and economic policy uncertainty (Braun et al. 2025; Hu et al. 2023; Tang et al. 2024), our study shifts the focus to corporate low-carbon development, marketization, and digital transformation. By extending the heterogeneity analysis, this research provides valuable insights into promoting ESG practices and improving investment efficiency across different corporate and market environments.

6.2. Policy Recommendations

Based on the research findings, this study provides the following policy implications:

First, enhancing ESG disclosure transparency and strengthening corporate governance is crucial for mitigating the risks associated with ESG controversies. Policies should encourage firms to provide detailed reports on ESG controversy events to reduce greenwashing practices and improve transparency in ESG risk management. By focusing on audit quality to deliver more reliable financial information, firms can enhance transparency and reduce market misjudgments caused by ESG controversies. Moreover, firms should establish

robust internal control systems and enhance risk management mechanisms to mitigate the adverse effects of agency costs and declining audit quality on investment efficiency.

Second, external regulation and financial support should be strengthened, particularly for high-pollution industries and non-state-owned enterprises. Regulatory frameworks should prioritize ESG risk management in these firms by providing financial incentives, subsidies, and policy support to facilitate their green transition and technological innovation. Additionally, strengthening internal governance structures and reducing agency costs will help ensure that managerial decisions align with long-term corporate value rather than short-term opportunism. Government oversight should focus on mitigating overinvestment driven by ESG-related risks and promoting responsible capital allocation.

Finally, facilitating corporate digital transformation and green innovation is essential for improving investment efficiency in response to ESG controversies. Given that firms with lower levels of digitalization exhibit weaker investment efficiency, policies should promote investment in green technologies, environmental management systems, and digital tools. Through tax incentives and financial support, governments can encourage firms to enhance their digital capabilities, enabling them to respond more effectively to ESG controversies while optimizing resource allocation and strategic decision-making.

However, this study has certain limitations. First, this study relies on third-party ESG controversy scores, which do not capture industry-specific reporting differences. Due to data constraints, we do not analyze individual ESG controversy pillars. Future research could explore ESG controversies across different markets and assess their impact on investment efficiency from a pillar-specific perspective. Second, this analysis is limited to Chinese A-share listed companies, which may restrict the generalizability of the results to other markets or non-listed firms. Future studies should expand the sample size to include companies from all emerging markets. Third, this study did not follow up on the subsequent efforts of firms after ESG controversy events occurred. Future longitudinal studies tracking the changes in ESG controversy events over time can provide deeper insights into the causal relationship between ESG activities and investment outcomes.

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