The Impact of ESG on AI Firm Performance

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Abstract: The ESG framework represents an innovative approach to integrating environmental stewardship, social accountability, and governance practices to foster sustainable growth within organizations, with artificial intelligence (AI) firms playing a pivotal role in advancing emerging sectors. Utilizing data from A-share AI companies spanning 2009 to 2023, this study empirically investigates how ESG performance influences the operational success of AI enterprises, incorporating the mediating factor of corporate financing constraints to elucidate the underlying mechanisms. Findings indicate that superior ESG performance is associated with enhanced corporate outcomes. Mechanism analysis reveals that robust ESG practices contribute to improved firm performance by mitigating financial limitations. Additional analysis demonstrates that the positive impact of ESG performance on AI firm outcomes is more pronounced in non-state-owned enterprises and those situated in eastern regions.

Keywords: ESG; Artificial Intelligence Firms; Firm Performance; Financing Constraints

1. Introduction

The 2025 governmental policy document explicitly emphasizes the sustained implementation of the "Artificial Intelligence +" initiative, advocating for the accelerated advancement of next-generation smart devices. These include intelligent connected new-energy vehicles, AI-enabled smartphones and computers, autonomous robots, and sophisticated manufacturing systems. This strategic direction offers robust policy backing and expansive opportunities for the swift evolution and broad adoption of AI technologies. In this context, the rapid progression and pervasive integration of AI have introduced novel perspectives and approaches for businesses aiming to bolster their long-term sustainability. As a hallmark of societal advancement and technological innovation, artificial intelligence has emerged as a pivotal driver of a new wave of scientific breakthroughs and industrial transformation. It has fundamentally reshaped enterprises' internal operational frameworks and production processes while exerting a profound and far-reaching influence on societal dynamics [1]. Presently, numerous organizations have embedded AI technologies within their strategic management and operational frameworks. The integration of AI significantly enhances operational convenience and markedly boosts efficiency. Based on the framework developed in Yao Jiaquan [2] in Management World, this research uses listed company annual reports from 2009 to 2023, accessed through data from Juchao Information Network, to measure AI adoption. Using the usage frequency of 73 AI-related terms, we define those enterprises with high term frequencies as "AI enterprises." The ESG framework, across Environmental, Social, and Governance aspects, is a strategic investment and assessment model that foregrounds a company's commitment to ecological sustainability, human well-being, and good governance above financial indicators. ESG ratings are a central tool in measuring a company's ESG effectiveness through a mix of quantitative and qualitative metrics to assess environmental, social, and governance progress. Using this methodology, investors gain a holistic overview of a company's non-financial impacts and bring an evolutionary approach to minimizing business risks and enhancing long-term sustainability[3]. Over recent years, increasing challenges to company security through unexpected events such as catastrophic weather, international trade conflicts, and employee disputes, threaten corporate stability. Such disturbances not only damage short-term profitability but also jeopardize long-term operating resilience. In parallel, China's pursuit of becoming carbon peak by 2030 and carbon-neutral by 2060, together with policies championing development through a focus on "high-quality development," have elevated ESG

to a cornerstone of sustainable progress. ESG values guide corporations in balancing corporate responsibility, social equity, and corporate governance with economic ends. In support of China's vision for carbon neutrality, good governance, and global community-building, ESG is an overarching indicator of corporate resilience, serving also as a "supplementary financial report" for listed corporations. ESG is a key measure in assessing corporate sustainability, serving also as a "supplementary financial report" for listed corporations. It is a driver of financial institutions' decision-making, investors', and other parties' decisions [4]. Through heightened publicity to non-financial indicators, ESG gives power to investors to identify enterprises best in the field in terms of environment, society, and governance, thereby allowing informed strategy-based investment decisions.

The integration of artificial intelligence (AI) with ESG frameworks has become a prominent topic in scholarly research. Extensive studies have explored the relationship between corporate ESG performance and business outcomes, with many affirming that AI adoption strengthens ESG results [5]. A well-documented positive correlation also exists between ESG performance and financial success [6]. However, the specific influence of ESG performance on the operational achievements of AI-centric firms remains largely unexamined, revealing a significant research gap that warrants deeper exploration. Do effective ESG practices enhance the performance of AI firms, and what mechanisms underpin this contribution? Answering these questions is vital for encouraging AI enterprises to adopt and operationalize sustainable ESG strategies.

To investigate the connection between ESG performance and AI firm performance, this study leverages ESG rating data from the CSI ESG system, focusing on A-share AI listed companies from 2009 to 2023. The analysis examines the association between these firms' return on net assets (ROE) and their ESG composite scores and ratings, deriving evidence-based recommendations to bolster ESG practices within AI enterprises.

2. Theoretical Analysis

2.1 ESG and Corporate Performance

There are various measures of firm performance in the existing literature, such as return on net assets (ROE), return on total assets (ROA), Tobin's Q, total factor productivity and other related financial indicators, and market value indicators. In this paper, return on equity is used as an indicator to measure corporate performance. According to stakeholder theory, each stakeholder pays for the enterprise in different ways, and with their support, the enterprise can continue to survive and develop Enterprises can not only focus on the interests of shareholders, but also consider the interests of all stakeholders in a comprehensive manner, so that the overall interests are optimized, and through the efforts of all parties to continue to improve the performance of the enterprise[7]. Good ESG performance can enhance AI enterprise performance from three paths around stakeholder rights and interests: from the perspective of environmental performance, in today's digital era, data centers have become a key infrastructure to support the functioning of society, but the accompanying problem is that the operation of related equipment consumes a large amount of electricity and produces a large amount of carbon emissions. AI enterprises that proactively embrace environmental responsibilities can leverage AI algorithms to forecast data traffic and equipment loads, enabling optimized capacity planning. This approach reduces energy consumption, lowers operational costs, and sets a precedent for environmental stewardship, fostering trust and support from stakeholders while enhancing organizational legitimacy [8]. Regarding social performance, AI firms that prioritize responsibilities toward shareholders, creditors, employees, suppliers, and other stakeholders strengthen their social capital and institutional credibility. These actions reduce future dangers, promote good press, and uphold company reputation, thereby enhancing enterprise performance [9]. From a governance viewpoint, sound corporate governance offers a framework underpinning sustainable development. Companies with good governance principles place stakeholder interests at the center of strategy development, creating multilateral value for everyone concerned [10]. Based on the foregoing analysis, the study develops the following hypotheses.

H1: Good ESG performance contributes to AI firm performance.

2.2 Financing Constraint Alleviation Effect of ESG

ESG performance enhances the depth of corporate disclosure so that in addition to traditional financial indicators, it includes non-financial indicators, such as social responsibility, governance practice, and environmental stewardship. Non-financial indicators are key metrics to measure a company's future operating prospects, thus allowing investors to form a more integrated understanding of its well-being. Firms that perform well based on ESG are often characterized by increased information disclosure and low levels of earnings manipulation. Such increased openness draws increased attention from analysts, thus improving corporate information clarity and reducing investors' decision-making uncertainty [11]. On the other hand, good ESG performance is an effective signaling device, sending positive signals regarding a company's operations [12]. First, good ESG performance is a demonstration of a company's social responsibility, building the confidence of investors, especially those with a preference for corporate sustainability and value towards ethics. Secondly, good ESG performance communicates a company's resilience and likelihood of sustainable future cash streams, enhancing investors' expected returns. Thirdly, it underscores the presence of effective governance structures, which safeguard investor interests. Furthermore, in the context of China's robust endorsement of the "AI+ initiative," AI firms that proactively embrace social responsibilities can forge stronger governmental connections, securing access to subsidies and financial support [13]. Collectively, superior ESG performance diminishes both informational and financial risks for investors, facilitating improved access to capital and lowering capital costs for enterprises. Therefore, this paper proposes the research hypothesis:

H2: ESG performance of AI enterprises enhances corporate performance by alleviating corporate financing constraints.

3. Research Design

3.1 Benchmark Model and Mediation Effect Model Setting

Based on the theoretical analysis of this paper, the following benchmark model is constructed to test the impact of ESG performance of AI companies on corporate performance:

$$ROE_{i,t} = c + \beta 1 ESG_{i,t} + \beta 2 Controls_{i,t} + \varepsilon_{i,t} \quad (1)$$

In the model, subscript i denotes an AI enterprise, t indicates the year, c represents the constant term, β1 andβ2 signify the regression coefficients for each respective factor, Controls encompasses the model's control variables, and ε denotes the random error term.

The baseline model is formulated to evaluate the direct influence of ESG performance on the corporate performance of AI enterprises. To further elucidate the mechanisms through which ESG performance affects corporate outcomes, this study develops a mediation effect model to investigate the roles of financing constraints and net profit in mediating the relationship between ESG performance and corporate performance. The mediation effect model is structured as follows:

$$SA\ index_{i,t} = c + \beta 1 ESG_{i,t} + \beta 2 Controls_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$ROE_{i,t} = c + \beta 1 SA\ index_{i,t} + \beta 2 Controls_{i,t} + \varepsilon_{i,t} \quad (3)$$

Among them, the explanatory variable of regression model (2) is corporate ESG performance, which reflects the performance of corporate environmental, social and corporate governance; the explanatory variable of regression model (3) is corporate performance (ROE); and the SA index of corporate financing constraints (SA index) is the explanatory variable of regression model (2) and the mediator variable of regression model (3), respectively.

3.2 Main Research Variables

3.2.1 Explained variables

Domestic research examining the impact of ESG performance on firm performance from the perspective of artificial intelligence enterprises is limited, with most studies employing return on assets (ROA) as the performance metric, as referenced in [14]. In contrast, this study adopts return on equity (ROE), calculated as (net profit after tax / net assets) × 100%, as the primary indicator of performance for AI enterprises. ROE effectively captures a firm's ability to generate net income from its equity capital and serves as a central component of DuPont analysis, a financial framework that facilitates a comprehensive understanding of corporate performance.

3.2.2 Core explanatory variables

To enhance the precision of ESG performance measurement and streamline computational

analysis, this study adopts the ESG composite score as a quantitative metric. The ESG evaluation framework is derived from the CSI ESG evaluation system, which integrates publicly available data from listed companies, including periodic and ad-hoc disclosures, social responsibility and sustainability reports, government and regulatory websites, and news media sources. By constructing an industry-specific weighting matrix based on sector characteristics and referencing the Thomson Reuters importance matrix, the CSI ESG index system generates comprehensive scores, yielding nine rating tiers from C to AAA. To ensure robust empirical analysis, this study employs two ESG measurement approaches, producing two explanatory variables for correlation analysis: the first uses the ESG composite score directly as the variable ESG, while the second assigns numerical values (1 to 9) to the C-to-AAA rating tiers, creating a new variable, ESG*.

3.2.3 Control variables

The model accounts for several control variables, categorized into financial and corporate governance factors. Financial factors include the cash flow ratio, total asset turnover, and operating income growth rate, while governance factors encompass the shareholding proportion of the largest shareholder, executive compensation incentives, and the degree of equity checks and balances.

Financially, the cash flow ratio indicates a firm's short-term liquidity and solvency; a higher ratio signifies stronger financial health. The total asset turnover rate reflects the efficiency of a company's asset utilization, with higher turnover indicating faster asset cycling and superior operational capacity. The operating income growth rate measures a firm's revenue expansion and market competitiveness; elevated rates suggest robust operational quality, promising market prospects, and enhanced competitive positioning.

In terms of governance, the shareholding proportion of the largest shareholder influences corporate decision-making and operational oversight. A higher concentration of shares typically reduces agency costs by fostering centralized control [15]. Executive compensation incentives, calculated as the natural logarithm of total executive remuneration, impact both individual executive motivation and overall firm performance, directly shaping organizational competitiveness. The degree of equity checks and balances gauges the equilibrium of power among shareholders, serving as a key metric of governance structure. An optimal level of checks and balances supports effective and equitable decision-making, prevents dominance by a single shareholder, safeguards minority shareholder interests, and fosters stable corporate development.

3.2.4 Mediating variables

In this paper, the financing constraints of enterprises are selected as the mediating variables. Financing constraints refers to the constraints and limitations faced by enterprises when financing in the capital market, reflecting the degree of matching between the enterprise's financing ability and the external financing environment. The financing constraint SA index is a variable constructed by using the size and age of the enterprise, which is a better measure of the enterprise's financing constraints, and the larger the absolute value of the SA index is, the stronger the financing constraints faced by the enterprise. The related variables are defined as shown in Table 1.

Table 1. List of Variable Definitions

Variable name	symbol	type	Variable definition
Return on Equity	ROE	Explanatory Variable	(Net profit after tax/net assets)×100%
ESG Composite Score	ESG	Explanatory Variable	Based on the CSI ESG evaluation system, which is a comprehensive score for the environmental, social and corporate governance performance of listed companies
ESG rating assignment	ESG*		Based on the ESG composite score to get C~AAA nine ratings, and then C~AAA nine ratings are assigned 1~9 respectively
Financing constraint	SA index	Mediating variable	Absolute value of SA index, the larger the absolute value, the stronger the financing constraints faced by the enterprise

Cashflow ratio	Cashflow	control variable	Net cash flow from operating activities/total assets
Total Asset Turnover	ATO		Operating Income/Average Total Assets
Operating Income Growth	Growth		Current year's operating income/previous year's operating income-1
Percentage of shares held by the largest shareholder	Top1		Equity concentration indicator, equal to the number of shares held by the largest shareholder/total number of shares
Executive Compensation Incentive	Pay		The natural logarithm of management's total annual compensation
Shareholding checks and balances	Balance		Sum of shareholdings of the second to fifth largest shareholders / shareholdings of the first largest shareholder

3.3 Data Sources and Descriptive Statistics

To examine the influence of ESG ratings on the performance of AI firms in recent years, this study utilizes annual data from A-share AI firms spanning 2009 to 2023 as the research sample. Firms under special treatment or exhibiting significant data irregularities were excluded to ensure data integrity. Additionally, to account for the influence of macroeconomic conditions and other time-varying factors that could affect firm value, the model incorporates time fixed effects to control for these external dynamics, yielding a final dataset of 47,053 firm-year observations. ESG data are sourced from the CSI ESG ratings within the WIND database, the Financing Constraints SA index is obtained from the Mark database, and all other variables are drawn from the CSMAR database.

Table 2. Results of Descriptive Statistics for Variables

Variables	Sample size	Mean	Standard deviation	Minimum	Median	Maximum
ROE	45996	0.058	0.147	-0.765	0.072	0.371
ESG	47053	73.139	5.003	57.390	73.350	84.200
ESG*	47053	4.125	1.032	1.000	4.000	6.000
Cashflow	47029	0.045	0.072	-0.185	0.045	0.249
ATO	47026	0.624	0.438	0.026	0.533	2.572
Growth	47029	0.161	0.435	-0.599	0.095	2.809
Top1	47029	0.337	0.149	0.082	0.313	0.742
Pay	47025	15.346	0.788	13.306	15.333	17.442
Balance	47029	0.766	0.621	0.029	0.603	2.829

Table 2 presents the descriptive statistics for the primary variables, with all continuous variables winsorized at the 1% and 99% percentiles to mitigate the impact of outliers. Regarding financial performance, the sample firms exhibit a mean ROE of 0.058, with a standard deviation of 0.147, ranging from a minimum of -0.765 to a maximum of 0.371. This wide range underscores significant variability in corporate performance across firms, with some demonstrating strong outcomes and others facing substantial challenges. The mean Cashflow is 4.5%, with a maximum of 24.9%; the mean Asset Turnover (ATO) is 62.4%, peaking at 257.2%; and the mean Operating Income Growth rate is 0.161, with a maximum of 2.809. These figures highlight considerable disparities in financial health and operational efficiency among the enterprises.

In terms of corporate governance, the average shareholding ratio of the largest shareholder (Top1) is 33.7%, suggesting concentrated ownership in AI firms, which facilitates decisive control over corporate decisions and enhances decision-making efficiency. The standard deviation of management compensation incentives (Pay) is 0.788, indicating relatively consistent remuneration levels across AI firms' management. The equity checks and balances metric (Balance) has a mean of 0.766, reflecting a balanced power distribution among shareholders, which helps prevent the dominance of major shareholders and promotes prudent decision-making.

For ESG performance, the mean ESG composite score is 73.139, and the mean ESG* value is 4.125, corresponding to the fourth rating tier (ESG scores between 70–75 points). This suggests that the ESG performance of A-share AI listed companies is generally moderate,

positioned at a mid-level range.

4. Analysis of Empirical Results

4.1 Benchmark model Regression Results

Table 3 reports the direct impact of AI firms' ESG performance on corporate performance. Column (1) shows that the coefficient of ESG is significantly positive at the 1% level, indicating that for every 1-point increase in the ESG composite score of AI firms, the return on corporate NAV will increase by 0.7%; Column (2) shows that the ESG coefficient is still significantly positive at the 1% level after the addition of the control variables, which suggests that in the AI industry, ESG is positively correlated with its performance, i.e., for every 1 unit increase in the ESG score, the return on corporate NAV will increase by 0.7%. unit, the firm's return on equity will increase by 0.5%. Columns (3) and (4) show that the coefficient of ESG rating is also significantly positive at the 1% level, and under the influence of control variables, for every 1-point increase in the ESG rating score of AI firms, firms' return on equity will increase by 2.3%. This shows that good ESG performance can significantly improve corporate performance, thus supporting hypothesis H1.

Table 3. Benchmark Model Regression Results

	(1)	(2)	(3)	(4)
	ROE	ROE	ROE	ROE
ESG	0.007***	0.005***		
	(30.599)	(24.444)		
ESG*			0.034***	0.023***
			(29.752)	(23.877)
Cashflow		0.520***		0.521***
		(37.263)		(37.336)
ATO		0.036***		0.036***
		(15.169)		(15.096)
Growth		0.068***		0.068***
		(30.891)		(30.833)
Top1		0.145***		0.147***
		(16.850)		(17.013)
Pay		0.027***		0.028***
		(20.923)		(21.662)
Balance		0.021***		0.021***
		(10.637)		(10.696)
_cons	-0.477***	-0.845***	-0.083***	-0.589***
	(-26.594)	(-37.375)	(-15.713)	(-29.536)
N	45996.000	45989.000	45996.000	45989.000
R^2_a	0.075	0.252	0.071	0.250
year	Yes	Yes	Yes	Yes

t-statistics in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Same table below.

4.2 Endogeneity Analysis

To strengthen the analytical rigor, this study implements two approaches to tackle potential econometric challenges. Initially, a two-way fixed effects model is utilized to address omitted variable bias. By integrating firm-specific fixed effects to capture time-varying and unobservable factors, the model supersedes the "industry + time" fixed effects of the baseline regression. The findings, presented in columns (1) and (2) of Table 4, reveal that controlling for time-invariant firm attributes reduces the standard errors of most coefficient estimates relative to the baseline model. Furthermore, the ESG and ESG* coefficients remain positive and statistically significant at the 1% level, indicating enhanced model precision and fit, thereby corroborating hypothesis H1.

Second, the issue of reverse causality is addressed by incorporating lagged explanatory variables. While the baseline regression demonstrates that superior ESG performance enhances AI firm performance, this relationship could be confounded by reverse causality, where thriving AI development provides technological

support for improved ESG performance, leading to endogeneity concerns. To mitigate this, the study uses ESG performance lagged by one, two, four, and six periods (LESG, L2ESG, L4ESG, L64ESG) as explanatory variables, as lagged ESG is less likely to be influenced by current-period ROE. The regression results, presented in columns (3) through (6) of Table 4, show that the ESG coefficients across all lag periods remain positive and significant at the 1% level, indicating that ESG performance exerts a sustained, long-term positive effect on firm performance, further supporting hypothesis H1.

Table 4. Two-Way Fixed Effects Model Regression Results

	(1)	(2)	(3)	(4)	(5)	(6)
	ROE	ROE	ROE	ROE	ROE	ROE
ESG	0.003***					
	(13.245)					
ESG*		0.013***				
		(12.694)				
LESG			0.004***			
			(18.001)			
L2ESG				0.003***		
				(13.749)		
L4ESG					0.002***	
					(8.411)	
L6ESG						0.002***
						(5.298)
controls	Yes	Yes	Yes	Yes	Yes	Yes
_cons	-0.918***	-0.757***	-0.833***	-0.831***	-0.831***	-0.846***
	(-23.025)	(-20.236)	(-35.220)	(-32.879)	(-28.922)	(-24.046)
N	45989.000	45989.000	40769.000	35920.000	27670.000	20873.000
R^2_a	0.194	0.193	0.240	0.231	0.220	0.219
individual	Yes	Yes	No	No	No	No
year	Yes	Yes	Yes	Yes	Yes	Yes

4.3 Robustness Tests

To ensure robustness, this study conducts additional tests by modifying corporate performance metrics and accounting for specific temporal effects. Initially, the analysis substitutes the return on assets (ROA) for the return on equity (ROE) as a proxy for corporate performance to further evaluate the influence of ESG performance on AI firm outcomes. The regression results, presented in Table 5, utilize these metrics as explanatory variables. Columns (1) through (4) show that the coefficients for ESG and ESG* are consistently positive and significant at the 1% level, aligning with findings by Qi Dianwei et al. [14]. This reinforces the conclusion that ESG performance in AI firms enhances corporate performance, thereby supporting hypothesis H1.

Additionally, the study addresses the potential influence of extraordinary events by excluding data from 2020, the year marked by the COVID-19 pandemic. Columns (5) and (6) of Table 5 indicate that the coefficients for ESG and ESG* remain positive and significant, demonstrating that the positive effect of ESG performance on AI firm performance is robust and not driven by specific temporal anomalies. These results provide further evidence in support of hypothesis H1.

Table 5. Robustness Test

	(1)	(2)	(3)	(4)	(5)	(6)
	ROA	ROA	ROA	ROA	ROE	ROE
ESG	0.004***	0.003***			0.005***	
	(5.909)	(5.477)			(23.311)	
ESG*			0.019***	0.013***		0.023***
			(5.538)	(4.993)		(22.587)
Cashflow		0.340***		0.341***	0.513***	0.515***
		(13.482)		(13.506)	(36.301)	(36.386)

ATO		0.024***		0.024***	0.036***	0.036***
		(4.668)		(4.657)	(14.607)	(14.522)
Growth		0.041***		0.040***	0.067***	0.067***
		(7.468)		(7.444)	(29.433)	(29.360)
Top1		0.082***		0.083***	0.145***	0.147***
		(7.505)		(7.604)	(16.703)	(16.858)
Pay		0.008***		0.009***	0.028***	0.029***
		(2.802)		(2.995)	(21.339)	(22.094)
Balance		0.015***		0.015***	0.021***	0.021***
controls	Yes	Yes	Yes	Yes	(10.361)	(10.429)
_cons	-0.259***	-0.380***	-0.040***	-0.232***	-0.850***	-0.599***
	(-5.010)	(-4.186)	(-2.588)	(-3.607)	(-36.511)	(-29.526)
N	46263.000	46256.000	46263.000	46256.000	42052.000	42052.000
R^2_a	0.004	0.016	0.004	0.016	0.250	0.248
year	Yes	Yes	Yes	Yes	Yes	Yes

4.4 Mediation Effect Model Regression Results

Previous works establish that ESG performance in AI businesses contributes positively to corporate performance. To test the particular mechanisms behind this connection, this study investigates whether corporate financing constraints are a mediator in the positive correlation between ESG performance and firm performance, adopting the mediation effect test procedure presented by Wen Zhonglin et al. [16]. Results are reported in column (1) to (4) of Table 6. First, the direct influence of the explanatory variable (ESG) on the outcome variable (ROE) is studied. Column (1) exhibits a significant positive effect of ESG performance on AI firm performance. Then, the mediating role of corporate financing constraints in this relation is evaluated. The SA index is used in this study as a proxy measure of financing constraints in AI businesses. This study tests the effects of the explanatory variables (ESG, ESG*) on the mediating variable (SA index), and in columns (2) and (3), it is established that ESG performance weakens financing constraints in businesses. In addition, the impact of the mediating variable (SA index) on the outcome variable (ROE) is tested, and column (4) established that financing constraints had a significant negative effect on company performance.

These findings suggest that stronger ESG performance in AI firms correlates with reduced financing constraints, which in turn enhances corporate performance. Thus, financing constraints mediate the relationship between ESG performance and firm performance, supporting hypothesis H2. This indicates that ESG performance bolsters AI firm performance by mitigating financing constraints.

Table 6. Regression Results of the Mediating Effect Model

	(1)	(2)	(3)	(4)
	ROE	SA index	SA index	ROE
ESG	0.005***	-0.006***		
	(24.444)	(-10.025)		
ESG*			-0.026***	
			(-9.893)	
SA index				-0.018***
				(-4.688)
controls	Yes	Yes	Yes	Yes
_cons	-0.845***	4.677***	4.379***	-0.554***
N	45989	47014	47014	45989
R^2_a	0.252	0.230	0.229	0.228
year	Yes	Yes	Yes	Yes

4.5 Heterogeneity Analysis

4.5.1 The influence of property rights nature on ESG value effect

The ownership structure of enterprises shapes their incentives for improving ESG performance. Non-state-owned enterprises, operating as purely market-driven entities, primarily pursue ESG enhancements to secure economic gains. In contrast, state-owned enterprises (SOEs) balance dual roles as both market actors and instruments of state policy, prioritizing systemic, regulatory, and societal considerations over purely financial returns in their ESG initiatives [17]. Consequently, the focus of ESG practices varies by ownership type: non-state-owned firms emphasize stakeholder demands that yield economic benefits, whereas SOEs align their ESG efforts with national policy objectives. These divergent motivations and approaches

result in a more pronounced positive impact of ESG investments on corporate performance in non-state-owned enterprises compared to SOEs.

Further, the property rights attributes of enterprises affect the benefits of obtaining support from stakeholders such as governments and financial institutions through ESG practices. SOEs are usually able to obtain support from the government and state-owned banks more easily due to their inherent political relevance. Comparatively, non-SOEs lack the inherent connection with the government and state-owned banks, and therefore, in order to improve their viability and strength, non-SOEs have a strong incentive to seek political connections with the government and minimize the barriers to accessing resources[18]. As a result, the marginal benefits of improving through ESG practices in terms of accessing resources related to the government and state-owned banks are relatively low for SOEs and high for non-SOEs.

Corporate ownership structure influences stakeholders' expectations regarding ESG performance. The Third Plenary Session of the 18th CPC Central Committee emphasized that social responsibility fulfillment is a critical component of state-owned enterprise (SOE) reform. Consequently, SOEs face heightened public scrutiny and societal expectations for ESG performance compared to non-SOEs. From a stakeholder perspective, SOEs' adherence to social responsibilities is perceived as an inherent duty, resulting in muted stakeholder sensitivity to improvements in their ESG performance. This leads to a relatively subdued market response to ESG advancements by SOEs.

Based on this, the study hypothesizes that the positive impact of ESG performance on corporate performance is less pronounced in SOEs than in non-SOEs. To test this, the analysis employs a grouped regression approach, segmenting firms by ownership type, with results presented in columns (2) and (3) of Table 7. The findings reveal that the ESG coefficient for the SOE group (column 2) is significantly lower than that for the non-SOE group (column 3), confirming that ESG improvements in SOEs have a comparatively smaller effect on enhancing firm performance relative to non-SOEs.

4.5.2 Influence of location factors on ESG value effect

From the policy and economic perspectives, the eastern region usually has a more complete and positive ESG-related policy system, and the government may introduce more preferential policies to encourage enterprises to practice ESG concepts, such as tax breaks and financial subsidies, etc., which incentivize enterprises to increase their investment in environmental governance, social responsibility fulfillment and corporate governance optimization. At the same time, regulators in the eastern region have more stringent requirements for ESG disclosure, prompting companies to pay more attention to ESG management. In addition, the eastern region has a higher degree of market development, started to transform its economic model towards the path of sustainable development earlier, and the concept of corporate social responsibility is more developed[19], as well as being able to obtain more market opportunities and resource support from the higher level of economic development.

In addition, the social and cultural background and the allocation of human resources have a decisive impact on the degree of importance attached to the ESG concept by enterprises. The openness and inclusiveness of the social and cultural environment in the eastern region is high, and the degree of acceptance and recognition of the ESG concept is also relatively significant. This social and cultural atmosphere motivates enterprises to pay more attention to the construction of ESG, and regard it as a key strategy to enhance corporate image and competitiveness. At the same time, the presence of many higher education institutions and research institutes in the eastern region has attracted a lot of outstanding talents, which gives AI companies an advantage in recruiting and cultivating talents with ESG awareness and professional skills, and thus promotes their ESG practices and innovations more effectively.

Similarly, a company's own characteristics also affect its ESG performance. In the eastern region, AI companies generally exhibit larger scale and greater strength, with abundant resources and capabilities to carry out environmental, social and governance (ESG) related work. Companies in the eastern region excel in innovation, they are more internationalized, they have significant advantages in technological and business model innovation, they are able to explore new business growth opportunities through ESG practices, and as internationalized companies, they need to meet the ESG standards and requirements of the international market, which

motivates them to continuously improve their ESG performance. However, for AI companies in the central and western regions, especially small and medium-sized listed companies, the implementation of environmental, social and governance (ESG) disclosure may lead to an increase in the cost of capital due to their relatively low economic level and lagging technological conditions[20].

This study posits that the ESG performance of AI firms in eastern China exerts a stronger influence on improving corporate performance compared to their counterparts in other regions. To test this hypothesis, the analysis employs a grouped regression approach, dividing AI firms into two cohorts: those in the eastern region and those in non-eastern regions (central and western). The regressions assess the impact of ESG performance on the enterprise value of AI firms across these regions, with results presented in columns (4) and (5) of Table 7. The findings indicate that the ESG coefficient for the eastern firm group (column 4) is significantly higher than that for the non-eastern group (column 5), demonstrating that ESG performance has a more substantial effect on enhancing firm performance among AI enterprises in eastern China relative to those in non-eastern regions.

Table 7. Heterogeneity Analysis

variable	(1)	(2)	(3)	(4)	(5)
	full sample	SOEs	non-SOEs	east	non-east
	ROE	ROE	ROE	ROE	ROE
ESG	0.005***	0.003***	0.006***	0.005***	0.004***
	(24.444)	(11.081)	(22.038)	(21.357)	(11.753)
controls	Yes	Yes	Yes	Yes	Yes
_cons	-0.845***	-0.888***	-0.854***	-0.809***	-0.906***
	(-37.375)	(-25.410)	(-28.616)	(-30.167)	(-22.118)
N	45989.000	16737.000	29252.000	31787.000	13047.000
R^2_a	0.252	0.217	0.284	0.254	0.247
year	Yes	Yes	Yes	Yes	Yes

5. Conclusion and Insights

In recent years, the advancement of China's ecological civilization and "Beautiful China" initiatives has deeply embedded the principles of sustainable and green development in public consciousness. Consequently, the ESG practices of AI enterprises have garnered increasing scrutiny from stakeholders. Against this backdrop, this study leverages data from A-share AI listed companies spanning 2009 to 2023 to empirically assess the influence of ESG performance on corporate outcomes, incorporating the role of financing constraints. The findings indicate that stronger ESG performance correlates with enhanced corporate performance. Mechanistic analysis reveals that superior ESG practices alleviate financing constraints, thereby boosting firm performance. Further examination highlights that this positive effect is more pronounced in non-state-owned enterprises and AI firms located in eastern China.

Drawing on these results, the study proposes the following policy recommendations:

Firms at the enterprise level should focus on enhancing their ESG performance. First, AI enterprises should establish an "AI+ESG" framework to cultivate low-carbon, energy-efficient AI technology and actively address green responsibilities. Secondly, AI enterprises can utilize AI models to assess organizational performance, rationalize governance procedures, and increase information disclosure transparency through revamped reporting procedures. Third, AI enterprises should increase the use of smart technologies to promote innovation, provide AI-based solutions to social issues, and undertake social responsibilities. Based on the intensified ESG effect on performance in non-state-owned and eastern-oriented AI enterprises, therefore, the latter should ramp up ESG initiatives to win the support of investors, consumers, and the government. Improved AI firm performance will be capable of triggering positive economic spillovers, inducing technological innovation and industry development in the AI sector. Policymakers and government regulators at the national level must develop an enabling environment for AI companies' ESG efforts. First, sector-specific policies should be established to standardize ESG disclosure by AI listed entities with regard to outlining

requirements, technical benchmarks, and compliance thresholds in terms of environmental, social, and governance aspects. These should be adjusted according to the distinctive nature of AI subsectors, promoting alignment with international best practice standards to ensure quality and extent of disclosure. Secondly, to address AI algorithm-fostered data manipulation dangers, regulators must develop innovative oversight methods, such as third-party auditing of ESG reports to ensure credibility. Moreover, having a national AI safety monitoring platform would facilitate real-time evaluation of danger and adaptive regulation adjustments. Third, enforcing fiscal incentives, such as taxation exemptions, fiscal assistance to ESG-certified AI businesses, and inclusion of ESG considerations in government contracts and fiscal policies, would place high-performing ESG players in priority in high-stake initiatives. Through this strategy, a self-sustaining cycle of correlation is promoted between regulation, market dynamics, and policy landscapes.

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