Article

State-Owned Equity Participation and Corporations' ESG Performance in China: The Mediating Role of Top Management Incentives

Ting Qian[1*], Caoyuan Yang[1]

[1.] Economic and Management College, Beijing University of Technology, Beijing 100124, China; qianting@bjut.edu.cn; 1805662748@qq.com

* Correspondence: qianting@bjut.edu.cn

Abstract: This study examines the unique circumstances surrounding state-owned equity participation in non-state-controlled enterprises in China. Specifically, this study examines the impact of state-owned equity participation on the environmental, social, and governance (ESG) performance of non-state-controlled enterprises. Focusing on A-share listed firms on the Shanghai and Shenzhen Stock Exchanges and using data from 2013 to 2021, empirical testing shows that state-owned equity participation can significantly improve the ESG performance of non-state-controlled enterprises, with this conclusion remaining reliable after a series of robustness tests. Top management incentives is a mediating mechanism for state-owned equity participation in enhancing ESG performance. This study also finds that when state-owned equity participates in large enterprises or companies with a high degree of digital transformation, the effect on ESG performance is greater than that of small to medium-sized enterprises (SMEs) or enterprises with a low level of digital transformation. The findings of this study add to the current body of the existing field of research on the factors influencing corporate ESG performance and the impact of state-owned equity on corporate non-financial performance.

Keywords: ESG; State-owned equity; Top management incentives; Sustainability; Digital transformation

1. Introduction

As interest in corporations' level of sustainability continues to grow, the ESG score metric, which includes the three aspects of environmental, social responsibility, and corporate governance, has emerged as an important tool for evaluating corporations' non-financial performance [1,2]. The ESG score was originally intended to be concerned with stakeholder interests and long-term value of firms rather than short-term economic advantages. However, ESG scores have now become a key indicator of concern for an increasing number of investors, enhancing ESG performance has been empirically proven to not only boost firm value [3] but also increase stock prices [4] and reduce debt costs [5], all of which are beneficial for enterprises in the short run. Therefore, promoting sustainable social development and improving enterprises' self-value requires extensive research on the elements that influence corporations' ESG performance.

In the existing literature, many environmental factors, such as environmental uncertainty [6], and firm related factors, such as female directors [4] and board size [7], have been found to be related to corporations' ESG performance. Corporate ownership structures are important factors influencing ESG performance, with the existing literature indicating that foreign ownership may also enhance ESG performance [8]. Conversely, it has been found that insider holdings may dampen ESG performance [3]. Concerning institutional ownership, some researchers believe that this can improve ESG performance [9], while other scholars have presented evidence to the contrary [8].

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Although state-owned equity is a common type of equity, it has not yet been researched as a potential factor influencing ESG performance. It is widely held that state-owned equity provides enterprises with competitive benefits such as increased legitimacy, resource support, and priority in policymaking [10]. State-owned equity plays a significant role in managing strategic industries, rescuing companies from bankruptcy risk, and fostering company growth [11]. As a result, it has become a useful tool for governments in emerging economies China, Russia, Vietnam, and Brazil to influence economic activities [12]. Moreover, state-owned shareholders naturally pay more attention to public interest [13], which is similar in nature to the underlying logic of the ESG score. This causes state shareholders to have a significant influence on enterprises' ESG performance. Therefore, empirical research on the relationship between state-owned equity and ESG performance is clearly necessary.

In practice, there are two types of state-owned equity. In the first case, the state can be the owner or controlling stakeholder of an enterprise, making the enterprise either a state-owned or state-controlled enterprise. In the second instance, state-owned equity can take the role of minority shareholders rather than controlling shareholders in non-state-controlled enterprises. Although the equity does not have the control over the companies, it will still have the influence on those companies as the proportion of state-owned equity in the corporations rises. This second case condition, denoted as state-owned equity participation, is discussed at length in this study. China provides an ideal context for research on state-owned equity participation among non-state-controlled enterprises. Since China proposed the development of a mixed-ownership economy in 2013, state-owned equity participation in non-state-controlled enterprises has emerged as an increasingly common phenomenon in China. State-owned equity participation has thus become an emerging topic in research on ownership structures in Chinese enterprises.

This study aims to determine the relationship between state-owned equity participation in non-state-controlled enterprises and the enterprises' ESG performance. Using data on listed companies in China from 2013 to 2021, this study finds that state-owned equity participation can significantly improve ESG performance. Additionally, to clarify why state-owned equity affects ESG performance, this study examines the mediating role of top management incentives in this relationship. The results show that state-owned equity participation can enhance top management incentives, which leads to improved ESG performance. This study also analyzes how heterogeneity within enterprises may influence the relationship between state-owned equity participation and ESG performance. The results show that state-owned equity participation in firms with larger and higher degrees of digital transformation has a more significant effect on ESG performance.

The contributions of this study are threefold. First, existing research finds that ownership structure is a considerable factor influencing corporate ESG performance [3,8]. However, the results and mechanisms of different ownership structures produce different effects. This study examines the impact of the special form of ownership structure that is state-owned equity participation in non-state-controlled enterprises on ESG performance, and enriches the current body of research on ESG influencing factors. Second, although existing research has explored the effect of state-owned equity participation, it has not effectively examined how state-owned capital that embodies both public interests and private capital can emphasize a return on economic benefits to achieve effective synergy while also improving corporate sustainability goals. By studying the relationship between state-owned equity and ESG, this study supplements the relevant research on the economic consequences of state-owned equity, and deepens our understanding of the positive effect provided by state-owned equity. Moreover, this study analyzes the mediating effect of top management incentives on state-owned equity participation and ESG performance, and discusses the heterogeneity of the impact of state-owned equity participation on different types of enterprises. This serves to further enrich our collective understanding of why state-owned equity participation may benefit firms, and the specific contexts in which they may benefit.

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The remainder of this paper is structured as follows. Section 2 elaborates on the literature review and hypotheses development. Section 3 presents the research methodology and data. Section 4 summarizes the empirical findings, while Section 5 wraps up the paper.

2. Literature review and research hypothesis

2.1. State-owned equity participation and ESG performance

Many recent studies have examined whether state-owned equity participation benefits non-state-controlled enterprises. According to Li et al., state-owned equity encourages businesses to take strategic risks by alleviating financing constraints and improving corporate governance [14]. Yu et al. believe that state-owned equity enhances the capacity of private companies for innovation by providing additional R&D resources [15]. State-owned equity participation can increase the cash holdings of non-state-controlled enterprises by scaling up debt financing and reducing overinvestment [16]. State-owned equity also helps private businesses penetrate high-barrier industries [17]. However, the impact of state-owned equity on corporations' ESG performance has not yet been thoroughly researched.

Based on the existing literature, the following two theoretical approaches explain why state-owned equity can help firms develop. First, according to agency theory, owing to the information asymmetry and inconsistency of interests between major shareholders and small- and medium-sized shareholders, major shareholders tend to be opportunistic, which is detrimental to the development of businesses. Effective corporate governance can reduce proxy conflicts among major shareholders [18]. To balance other shareholders and safeguard the interests of the country they represent, state-owned shareholders have an incentive to effectively curb controlling shareholders to reduce the occurrence of tunneling and other such opportunistic behaviors [19], and to exert effective supervision on management to reduce the incidence of inefficient behaviors aimed at achieving personal gain [20]. According to the resource-based view (RBV), enterprises have a variety of resources and capabilities that may be developed into distinctive capabilities. It is these distinctive resources and capabilities in turn provide businesses a sustained competitive edge [21]. In addition to providing financial resources, state-owned equity has strengthened cooperation between enterprises and the government, owing to its intrinsic links with the state [22], which may boost businesses' resource bases [23] and alleviate enterprises' underinvestment [24]. This study breaks down the three components of ESG and explains how state-owned equity influences each of them.

First, state-owned equity participation can promote the green governance of enterprises. Rather than depending on external policies to encourage enterprises to give importance to environmental protection, corporate shareholders can influence enterprises from within the enterprise and cultivate awareness of independent environmental protection. Compared to other types of shareholders, state-owned shareholders are more concerned about the public interests represented by environmental issues [25]. Therefore, the greater the proportion of state-owned equity, the more influence it may have on businesses and push them to prioritize environmental preservation. Additionally, by removing resource limits on green innovation investments, state-owned equity can considerably increase firms' capacity for green innovation [12]. The improvement of green innovation capabilities will undoubtedly encourage enterprises to save resources and protect the environment, which will also reduce production costs and be conducive to sustainable development.

Second, state-owned equity participation can encourage enterprises to consciously assume social responsibility. Overemphasizing financial interests is a potential issue for private businesses and worsens when there is a lack of counterbalancing for controlling shareholders. This could result in disregard for other interests and the public interest as a whole [26]. State-owned capital focuses on both corporate profits and public interests. State-owned equity can enhance the social responsibility of non-state-controlled enterprises, and this effect is stronger when state-owned capital is involved in a company's

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investment decisions and leadership [27]. State-owned equity effectively counterbalances the tendency of controlling shareholders to neglect corporate social responsibility due to an excessive focus on financial gains [28]. Providing a greater resource base can also help non-state-controlled enterprises to assume greater social responsibilities.

Finally, many studies have shown that state-owned equity can improve the governance of non-state-controlled enterprises. Shi et al. [29] found that that enterprises with higher levels of state-owned ownership had managerial agents that are less likely to commit securities fraud. Xu et al. [30] believe that the "one-man rule" of the controlling shareholders of family firms on the board of directors can be broken by the stationed directors of state-owned shares, and perform the governance role of the board of directors more equitably. Li et al. [31] believe that under a certain shareholding ratio, state-owned equity can curb the unreasonable investment of the largest shareholders of non-state-controlled enterprises. These conclusions show that state-owned equity optimizes the corporate governance of non-state-controlled enterprises and encourages them to pay more attention to sustainable and high-quality development.

In summary, this paper presents the following hypothesis.

Hypothesis 1 State-owned equity participation has a positive impact on corporate ESG performance.

2.2. Top management incentives, state-owned equity participation and ESG performance

Executive motivation is an important factor influencing executives' decision-making behavior, according to previous studies. [32]. Fair compensation incentives are an essential means of reducing agency conflicts between principals and agents. Top management incentives encourage top management to consider the overall interests of the enterprise and shareholders when making decisions. They can also promote company innovation because they harmonize the interests of shareholders and management and increase management's performance sensitivity [33]. With appropriate incentives, enterprises' top management are expected to become more diligent [34]. State-owned equity participation can bring more resources and funds to enterprises, enabling them to increase the remuneration provided to top management [35] and to develop a reasonable compensation structure. When compensation increases, the opportunity cost of top management turnover also increases. If top management wants to work for a company for a long time, it must pay more attention to the sustainability of the company rather than short-run benefits. Based on the above analysis, the following hypothesis is proposed:

Hypothesis 2 Top managements' incentives mediate the relationship between state-owned equity participation and corporate ESG performance.

2.3. Firm size, state-owned equity participation, and ESG performance

The size of an enterprise has a significant impact on the strategic decisions it makes. [36]. In general, large companies have more financial resources and human capital than small businesses; therefore, they may have more resources available through which to undertake social responsibilities [37]. Large companies also tend to have higher ESG scores because of their longer-term strategic planning and superior funding [38]. Therefore, for large companies, it is easier for providers of state-owned capital and other shareholders to reach an agreement to improve corporate ESG, thus allowing the maximum benefit to be extracted from the positive aspects of state-owned capital and promoting the ESG performance of large companies. Small businesses, on the contrary, have difficulty implementing the idea of sustainable growth because they lack operational experience and face a higher risk of failure. Because of the inherent difficulties in ensuring cooperation between state-owned and non-state-owned capital owing to the different nature of ownership [39], even if the providers of state-owned capital are willing to promote ESG investment, it is difficult to change the will of other shareholders. In fact, it is more likely to cause conflicts between shareholders owing to different interest demands, thus partially offsetting the positive role that state-owned capital should play. Based on the above analysis, this study proposes the following hypothesis:

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Hypothesis 3 Compared with small and medium-sized enterprises, state-owned equity participation has a more significant effect on the promotion of large enterprises' ESG performance.

2.4. Digital transformation, state-owned equity participation and ESG performance

Recently, digital transformation has become an important topic in the study of corporate strategy [40]. The outbreak and continuation of the COVID-19 pandemic has further accelerated the process of digitalization. According to studies, businesses that experienced significant digital transformation typically have stronger innovation skills [41] and higher operational efficiency [42]. Their share price is more likely to remain relatively stable and the risk of a crash is less likely [43]. According to the resource-based view, digital transformation is a technical resource that helps strengthen coordination and communication between departments [44] and improves corporate governance capabilities. Digital transformation can also filter out unnecessary resources in an organization, reduce resource waste, and promote the green development of firms. Therefore, high digital transformation enterprises tend to exhibit stronger ESG performance [45]. These characteristics are consistent with the requirements for the sustainable development of state-owned capital. Therefore, when state-owned equity participates in high digital transformation enterprises, promoting ESG performance for these enterprises is relatively easy because of their strong willingness and ability to pursue sustainability. Enterprises with a low degree of digital transformation, which may be due to an insufficient technology level or environment pollution, may lack the willingness to practice green governance. When state-owned equity assumes a stake in these enterprises, it can be challenging to reach an agreement with the original shareholders regarding green and sustainable growth, and cooperation between these parties can prove problematic. Thus, this study proposes the following hypothesis:

Hypothesis 4 In Compared with enterprises with low digital transformation, state-owned equity participation has a more positive effect on the ESG performance of enterprises with high digital transformation.

3. Research design

3.1. Sample Selection and Data Sources

In 2013, China proposed developing a mixed-ownership economy. Therefore, this study uses data on A-share listed companies in Shanghai and Shenzhen from 2013 to 2021. A-share companies are domestic Chinese companies that issue stocks in China's domestic stock market. The data samples used were processed as follows. (1) Samples were selected in which the controlling shareholder was not state-owned at the time of listing. (2) Listed companies in the Special Treatment and *ST categories were removed to exclude the potential for unusual results brought on by financial hardship. (3) Samples from the financial industry were excluded. (4) Samples with missing data from the main variables were omitted. (5) In order to avoid the influence of extreme values, continuous variables were winsorized.

The ESG score data in this article comes from the Sino-Securities (SNSI) ESG Index using the WIND Financial Terminal. The information on state equity participation and strategic change is obtained from the China Stock Market and Accounting Research (CSMAR) database. Other data provided is also obtained from CSMAR.

3.2. Variable Definition and Measurement

3.2.1. Dependent Variable

ESG performance (ESG) is the dependent variable. Drawing on the research of Chang [46] and Li et al. [47], this study uses the SNSI ESG rating system published by the Sino-Securities Index Information Service (Shanghai, China) as the dependent variable in the regression model. The establishment of the ESG index system of Sino-Securities refers to

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the mainstream ESG evaluation framework used internationally and combines the characteristics of various listed companies with the actual situation in China's capital market to identify 26 key indicators. It also adopts the industry-weighted average method for ESG evaluation, which is updated quarterly, and includes all listed companies, with good reliability. The ESG evaluation index of Sino-Securities is AAA, AA, A, BBB, BB, B, CCC, CC, and C, accounting for nine levels in total. Accordingly, this study assigns a corresponding value from 9 to 1 as an ESG score. The higher the score, the better the corporate ESG performance. Because of the lag in the timeliness of enterprise ESG scores, the need for a certain period of time to affect enterprises after state-owned equity participation and to avoid the endogeneity problem of mutual causation, this study utilizes a one-period lagged process to manipulate the dependent variable.

3.2.2. Independent Variables

State-owned equity participation is the study's independent variable. Drawing on the research of Guo [28] and Luo et al. [48], this study defines shareholders identified as "state-owned legal persons" or "states" as state-owned shareholders, and uses two indicators to measure the level of state-owned equity. First, the shareholding ratio of state-owned equity (State1), that is, the sum of the shareholding ratios of state-owned equity among the top ten shareholders. The second is the equity balance (State2), that is, the ratio of state-owned equity shareholding ratio to non-state-owned equity shareholding ratio among the top ten shareholders of an enterprise.

3.2.3. Mediating Variable

Top management incentives is the mediating variable. Drawing on the research of Zhou et al. [49], this study measures top management incentives (Salary) using the natural logarithm of the total monetary compensation of the top three levels of management, including directors, supervisors, and senior management.

3.2.4. Control Variables

Citing the body of literature on state-owned equity participation [28,48,50], this study controls for the influence of the following factors: enterprise size (Size), enterprise age (Age), enterprise growth (Growth), assets-liabilities ratio (Lev), largest shareholding ratio (First), and equity incentive (Inc). Considering the concept of ESG is related to the level of economic development of enterprises, the consideration of whether enterprises are located in the eastern region (East) of China as a control variable because the economic development level of China's eastern region is higher than that of other regions. Because the ratio of control and ownership held by the actual controller affects the degree of its decision-making regarding the enterprise, the difference between control and ownership (Sep) is added to the control variable. Furthermore, as ESG performance is inseparable from corporate strategic planning, this study references the work of Zhang and Rajagopalan [51] by using financial leverage, advertising investment intensity, R&D investment intensity, fixed asset ratio, period expense ratio, and inventory level to measure the degree of strategic change in an enterprise (Tra). The variance （$\sum[t_i$-T]2 /[n-1] ） of each of the above indicators is measured over a period of 5 years （T-1， T+3）. The annual variance obtained is then normalized based on the industry. The above six standardized indicator values are added together to obtain the annual strategic change index of each enterprise. The annual fixed effects and industry fixed effects are also controlled for, with the specific variable definitions shown in Table 1.

3.3. Model building

In order to verify hypothesis H1, model (1) is constructed below:

$$ESG_{i+1,t} = \alpha_0 + \alpha_1 State1/State2 + \sum \alpha_j Controls_{i,t} + Year + Ind + \varepsilon \quad (1)$$

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This study develops mediating effect models (2) and (3) to test Hypothesis H2, which examines the mediating role of top management incentives in the mechanism of state-owned equity to promote ESG performance:

$$Salary_{i,t} = \beta_0 + \beta_1 State1/State2 + \sum \beta_j Controls_{i,t} + Year + Ind + \varepsilon \quad (2)$$

$$ESG_{i+1,t} = \gamma_0 + \gamma_1 State1/State2 + \gamma_2 Salary/Fre + \sum \gamma_j Controls_{i,t} + Year + Ind + \delta \quad (3)$$

Among them, i and t represent the enterprise and year respectively, Controls represents all control variables in the model, j represents the number of control variables, $\alpha_0$represent constant terms, $\alpha_1$represent the regression coefficients of each variable, α_j represent the coefficients of the control variables, and ε and δ represent random error terms.

Table 1. Description of variables.

Type	Variable name	Symbol	Measure
Dependent Variable	ESG performance	ESG	According to the evaluation system of SNSI ESG, it is assigned a score of "9" - "1" from high to low
Independent variables	State-owned shareholding	State1	The proportion of state-owned equity in the top ten shareholders
	Equity balance degree	State2	The ratio of state-owned shares to non-state-owned shares among the top ten shareholders
Mediating Variable	Top management incentives	Salary	The natural logarithm of the total compensation of the top three executives
Control variables	Enterprise size	Size	The natural logarithm of the total asset
	Enterprise age	Age	The natural logarithm of the current year minus the year the company went public
	Assets-liabilities ratio	Lev	The ratio of total liabilities to total assets
	Enterprise growth	Growth	The growth rate of enterprise sales revenue
	Separation of Ownership and Control	Sep	The difference between the control and ownership held by the actual controller
	The first shareholding ratio	First	Direct controlling shareholder shareholding/total number of shares *100
	Equity incentives	Inc	If there is an equity incentive plan in the current year, the value is 1, otherwise it is 0
	Strategic Change Index	Tra	The sum of the six indicators related to strategic change
	Regional nature	East	The place of incorporation belongs to the eastern region is 1, otherwise it is 0
	Industry	Ind	Industry dummy variables
	Year	Year	Year dummy variable

4. Empirical results and analysis

4.1. Descriptive Statistics

Table 2 reports the results of the descriptive statistics of the main variables. The average ESG score of an enterprise is 4.027, which indicates that there is much potential for improvement in the overall ESG performance level of Chinese enterprises. The ESG score ranges from 1 to 8, with 1 being the lowest and 8 being the highest. As a result, there are significant disparities in the ESG scores among listed businesses, with these variations offering a favorable setting for this study. The mean values of state-owned equity and equity balance are 0.033 and 0.041, and the standard deviation is 0.069 and 0.099, respectively. This shows that while state-owned equity participation in enterprises is typically not high, it varies greatly between enterprises.

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Table 2. Descriptive statistics of main variables.

Variable	N	Mean	SD	Min	p50	Max
ESG	14758	4.027	1.156	1	4	8
State1	14758	0.0330	0.0690	0	0	0.380
State2	14758	0.0410	0.0990	0	0	0.612
Salary	14758	14.44	0.689	12.79	14.41	16.42
Size	14758	21.81	1.086	19.69	21.69	25.27
Age	14758	2.839	0.334	1.386	2.890	4.143
Lev	14758	0.370	0.191	0.0500	0.352	0.866
Growth	14758	0.348	0.840	-0.776	0.138	6.078
Sep	14758	5.645	7.708	0	0.985	29.32
First	14758	40.86	16.21	10.75	39.39	80.35
Inc	14758	0.326	0.469	0	0	1
Tra	14758	-0.0860	2.516	-3.396	-0.786	12.31
East	14758	0.767	0.423	0	1	1

4.2. Hypothesis testing

4.2.1. Main Regression Results

Column (1) of Table 3, which presents the regression results with only the control variables, shows that most control variables significantly affect ESG performance. This demonstrates that the control variables were carefully selected. Columns (2) and (3) present the results obtained when including state-owned equity as an independent variable in the regression model. As can be observed from the data, the coefficients of state1 and state2 are both significantly positive, indicating that state-owned equity can significantly improve ESG scores. State1 has a coefficient of 0.3171, indicating that the ESG score of non-state-controlled enterprises with large state-owned shareholders is 0.81% higher than non-state-controlled enterprises without large state-owned shareholders. Thus, H1 was verified.

Table 3. Main Regression Results.

Variable	(1)	(2)	(3)
	ESG	ESG	ESG
State1		0.3171**	
		(2.2772)	
State2			0.2114**
			(2.1925)
Size	0.2238***	0.2211***	0.2216***
	(21.3944)	(21.0123)	(21.1055)
Age	-0.0425	-0.0496*	-0.0491*
	(-1.4455)	(-1.6775)	(-1.6607)
Lev	-1.2882***	-1.2875***	-1.2882***
	(-22.1416)	(-22.1293)	(-22.1408)
Growth	0.0389***	0.0393***	0.0393***
	(3.3240)	(3.3508)	(3.3514)
Sep	-0.0048***	-0.0050***	-0.0049***
	(-3.8717)	(-3.9768)	(-3.9648)
First	0.0089***	0.0092***	0.0092***
	(15.0227)	(15.1143)	(15.1114)
Inc	0.1633***	0.1645***	0.1647***
	(8.2519)	(8.3134)	(8.3212)
Tra	-0.0475***	-0.0475***	-0.0475***
	(-12.5548)	(-12.5540)	(-12.5540)
East	0.1110***	0.1144***	0.1142***
	(5.0133)	(5.1609)	(5.1515)
Constant	-0.8760***	-0.8256***	-0.8358***
	(-3.4559)	(-3.2447)	(-3.2888)
Year	Yes	Yes	Yes
Industry	Yes	Yes	Yes

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N	14758	14758	14758
R^2	0.1125	0.1128	0.1128

Note: * p < 0.1, ** p < 0.05, *** p < 0.01, the same below

4.2.2. Mediating effect: Top management incentives

Columns (1)– (4) of Table 4 show the results of the regression using top management incentives as the mediating variable, and following equations (2) and (3). Columns (1) and (3) show that when top management incentives are used as the dependent variable, the coefficients of State1 and State2 are significant at the 1% level. Additionally, when top management incentives are added to the benchmark regression model as a control variable, its coefficient is also significantly positive at the 1% level, suggesting that executive incentives may act as a mediating factor between state-owned equity and ESG performance. State-owned equity increases top management salaries, decreases top management self-interest, and puts greater emphasis on the long-term sustainability of the organization by bringing more money into the company.

Considering that there is a certain bias in the stepwise test regression coefficient method, with reference to the work of Hayes et al. [52], the Bootstrap (N=1000) method was used to test whether top management incentives have a mediating effect on state-owned equity participation and ESG performance, as summarized in Table 5. As rows (1) and (3) of Table 5 show, at the 95% confidence level, for either State1 or State 2, the confidence interval of the indirect effect of executive incentives does not contain 0, which once again proves the existence of the mediation effect, assuming that H2 is verified.

Table 4. Regression results of the mediating effect.

Variable	**Top management incentives**			
	(1)	**(2)**	(3)	(4)
	Salary	ESG	Salary	ESG
State1	0.4100***	0.2769**		
	(5.3909)	(1.9904)		
State2			0.2711***	0.1848*
			(5.0951)	(1.9185)
Salary		0.0982***		0.0983***
		(6.0225)		(6.0325)
Constants	7.4060***	-1.5527***	7.3924***	-1.5626***
	(53.7502)	(-5.5682)	(53.7065)	(-5.6121)
Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
N	14758	14758	14758	14758
R^2	0.3469	0.1151	0.3467	0.1150

Table 5. Mediating effect test based on Bootstrap method.

Variable name	Indirect effects	Coefficient		95% confidence interval	
		Effect	SD	Lower limit	Upper limit
State1	Salary	0.031	0.01	0.012	0.051
State2	Salary	0.021	0.006	0.008	0.034

4.3. The impact of state-owned equity participation and enterprise scale on ESG performance

The sample is divided into large, small, and medium-sized enterprises based on the annual industry median of company size to test hypothesis H3, which states that state-owned equity has a better effect on the promotion of large enterprises' ESG than small and medium-sized enterprises. Regression analysis was performed using Equation (1) after grouping the samples. The coefficient of State1 and State2 in large enterprises is signif-

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icantly positive at the 1% level, while the coefficient is not significant for small and medium-sized enterprises, as can be seen in columns (1) through (4). This suggests that in comparison to small and medium-sized enterprises, state-owned equity participation in large enterprises has a more pronounced impact on their ESG performance. Thus, H3 is verified.

4.4. The impact of state-owned equity participation and enterprise digital transformation on the ESG performance

To test H4, the variable "Degree of digital transformation" (DT) was used in the CSMAR database. This was measured by tracking the frequency of terms associated with this variable in a company's annual report. This involved taking the median degree of digital transformation of the entire sample and dividing the enterprises into high and low digital transformation enterprises according to the median. Formula (1) was selected once more for the regression. Columns (5) to (8) show that in the high digital transformation group, both state1 and state2 had coefficients that were significantly positive at the 5% level, whereas in the low digital transformation group, the coefficients for both variables were not significant. This indicates that when state-owned equity participates in enterprises with high digital transformation, ESG improvements becomes more obvious.

Table 6. Analysis of heterogeneity.

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
	Big enterprise		Small and medium-sized enterprises		High DT		Low DT	
	ESG	ESG	ESG	ESG	ESG	ESG	ESG	ESG
State1	0.5188***		-0.0537		0.6059**		0.1797	
	(2.9203)		(-0.2432)		(2.3264)		(1.0980)	
State2		0.3345***		-0.0283		0.4229**		0.1154
		(2.7766)		(-0.1796)		(2.3303)		(1.0228)
Constants	-1.8111***	-1.8344***	-0.9148*	-0.9121	-2.2283***	-0.2076	-2.2481***	-0.2137
	(-3.8555)	(-3.9082)	(-1.6485)	(-1.6445)	(-4.6718)	(-0.6716)	(-4.7208)	(-0.6922)
Controls	YES	YES	YES	YES	YES	YES	YES	YES
Ind	YES	YES	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES	YES	YES
N	7339	7339	7419	7419	4918	9840	4918	9840
R^2	0.1001	0.0999	0.1344	0.1344	0.1263	0.1148	0.1263	0.1148

4.5. Endogeneity and robustness test

4.5.1. Propensity score matching method (PSM)

To eliminate systematic differences in the observable control variables between enterprises with and without state-owned equity participation, the propensity score matching method (PSM) was adopted. The control variables in this study are consistent with the benchmark regression model. The observation value that includes state-owned equity was used as the treatment group, with the observation value that did not include state-owned equity used as the control group. Radius matching (r=0.01) was the approach used for matching. The empirical findings of the regression analysis employing the matched samples are shown in columns 1 and 2 of Table 7. The fact that State1 and State2's coefficients are statistically positive shows that the sample selectivity bias did not significantly affect the findings, and confirms that state-owned equity can boost ESG performance.

4.5.2. Instrumental variable (IV) regression

Considering the possibility of causation between state-owned equity participation and ESG performance, or the absence of significant variables in the model, this study used an instrumental variable to examine the main hypotheses. The two-stage least squares method is used for regression, and the average shareholding ratio of private Chinese listed companies in the same industry and year was chosen as the instrumental variable of state-owned equity. The results of the first-stage coefficients are shown in columns 3 and 5 of

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Table 7. The mean (state-m) of state-owned equity is significant at the 1% level. The results shown in columns (4) and (6) of Table 7 show that the coefficients of State1 and State2 are significantly positive, and the signs are consistent with the results of the benchmark regression. The first-stage regression weak instrumental variable test also yielded findings greater than 10, rejecting the null hypothesis that there were no weak instrumental variables. These findings demonstrate that the conclusions of this study remain valid even after employing instrumental factors to address potential endogeneity issues.

Table 7. Endogenous test.

Variable	PSM		IV			
	(1)	(2)	First	Second	First	Second
	ESG	ESG	State1	ESG	State2	ESG
State-m						
State1	0.3097**		-1.3259***	5.0347***	-1.922***	
	(2.2235)		(0.117)	(1.529)	(0.168)	
State2		0.2080**				3.473***
		(2.1570)				(1.055)
Constant	-0.789***	-0.798***	-0.1079***	-0.0764	-0.1162***	-0.2161
	(-3.093)	(-3.13)	(-0.015)	(0.352)	(0.022)	(0.324)
Controls	YES	YES	YES	YES	YES	YES
Ind	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES
Under-identification			P=0.00			
Weak-identification			129.148>16.38		131.517>16.38	
N	14726	14726	14,758	14758	14758	14,758
R^2	0.112	0.112	0.124	0.089	0.089	0.043

4.5.3. Robustness test

First, owing to the bias of the (ordinary least squares) OLS regression model, it was also necessary to apply other models to ensure robust results. Referring to the work of Yang et al. [53], the primary hypothesis was re-regressed using the Poisson regression model because the ESG score is a counting variable, and the value does not contain 0. Columns (1) and (2) of Table 8 show that State1 and State2 are both significantly positive, once again proving the main hypothesis.

Second, considering that the ESG score of enterprises has a certain lag in timeliness, even under the premise of lagging the dependent variable by one period, because the effect of state-owned equity participation cannot be accurately quantified, there may still be mutual causation problems regarding the ESG score of the next period. At the same time, to explore whether the effect of ESG score improvement after 2-3 years of state-owned ownership participation is more obvious, ESG data with lag 1 and lag 2 was used for regression, with the results shown in columns (3) to (6) of Table 8. The results shown in Table 8 show that the coefficients of State1 and State2 are significantly positive at the 1% level, which indicates that after state-owned equity participation, the improvement effect on ESG performance is more obvious over time. This further proves the robustness of the main conclusions of this study.

Table 8. Robustness test.

Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	Poisson		The lag regression results			
	ESG	ESG	ESG(*t-1*)	ESG(*t-1*)	ESG(*t-2*)	ESG(*t-2*)
State1	0.0780**		0.5257***		0.7318***	
	(2.2212)		(3.2949)		(3.9471)	
State2		0.0520**		0.3372***		0.4573***
		(2.1392)		(3.0492)		(3.5523)
Constants	0.1623**	0.1597**	-0.2455	-0.2648	-0.2966	-0.3243
	(2.5340)	(2.4976)	(-0.8225)	(-0.8884)	(-0.8496)	(-0.9302)

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Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
N	14758	14758	11771	11771	9358	9358
R^2			0.0896	0.0894	0.0801	0.0798

5. Conclusions and implications

5.1. Research conclusions

This study empirically examines the effect of state-owned equity participation on ESG performance using data listed on A-share listed companies from 2013 to 2021 as the research object. It also discusses the intermediary mechanism of this path and the heterogeneity of the impact of state-owned equity on ESG when entering different types of enterprises. The following conclusions were reached.

First, state-owned equity can significantly improve enterprises' ESG performance. This conclusion remains valid after a series of endogeneity and robustness tests. Second, top management incentives mediate the relationship between state-owned equity participation and ESG performance. Third, the effect of state-owned equity on ESG performance is more significant in large and high digital transformation enterprises.

5.2. Managerial implications

First, because this study finds that state-owned equity can improve corporate ESG performance; this suggests that companies should consider introducing state-owned equity as a minority shareholder if they are aiming to be a more sustainable company. From the government's perspective, encouraging state equity participation can be an effective way to encourage more businesses to adopt ESG practices.

Second, top management incentives are an essential intermediary mechanism through which state-owned equity affects enterprises' ESG performance. When top management receive higher salary incentives, they are more likely to take the growth of the company and the company's long-term success into account, and to support ESG performance. Therefore, when state-owned capital invests in a company, it is necessary to adjust the compensation available to top management. This can provide the necessary breakthrough to improve internal management. If a company expects to improve its ESG performance but does not receive investment from state-owned capital, it can also achieve ESG enhancement by raising the salaries of top management.

Third, it is better for state-owned capital to choose large enterprises or high digital transformation enterprises as target companies for investment. State-owned equity may encounter less resistance from these two types of enterprises in promoting ESG and sustainable development; hence, they can play a more active role in impacting ESG performance.

5.3. Limitations and directions for future research

First, in addition to the size of the enterprise and its degree of digital transformation, other enterprise characteristics may also affect the role of state-owned equity in ESG performance. The positive impact of state-owned equity participation on the ESG performance of non-state-owned enterprises may not only be influenced by internal factors, but also by the macro-environmental factors surrounding these enterprises. This aspect could be a possible direction for future research. Secondly, besides increasing the remuneration of top managements, state-owned equity participation may have an impact on other unobserved factors that could potentially improve the ESG performance of non-state-owned enterprises. These factors might act as mediating variables, and testing for additional variables in future research could help to shed more light on this issue. Finally, corporate ESG scores have certain limitations when used as a measure of corporate sustainability. Some companies deliberately improve their ESG scores through donations, media publicity, and

so on; methods that may not in fact contribute to improved sustainability. Future researchers should focus on using more valid measurements when replicating the experiments carried out in this study.

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