
**Top Management Team Heterogeneity and Corporate ESG Performance:
Evidence from China**

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Abstract

This study investigates the connection between Top Management Team (TMT) heterogeneity and Environment, Social, and Corporate Governance (ESG) performance, employing data from China's A-share listed companies spanning 2011 to 2022. The multiple linear regression models' findings suggest that TMT heterogeneity can significantly promote corporate ESG performance. Investor attention has a significantly positive moderating effect on the connection between TMT heterogeneity and corporate ESG performance. Further analysis indicates that the impact of TMT heterogeneity on a firm's ESG performance exists in property rights and regional heterogeneity. This study has implications for improving enterprise ESG performance in emerging market countries.

Key words: TMT heterogeneity, Corporate ESG performance, Investor attention

1. Introduction

Economic and social development is often accompanied by complex problems such as climate change, environmental pollution, and resource depletion (Zhang et al., 2024). These issues, which are closely related to human survival and social development, have become global political and economic issues. Therefore, countries have gradually begun to pay attention to environmental protection and climate change issues. In turn, sustainable development has become one of the most important issues in current social development. Government agencies, international organizations, and other institutions actively seek approaches for attaining long-term development.

The United Nations Global Compact first proposed the concept of environment, social, and corporate governance (ESG) in 2004. ESG is used to measure the ability of enterprises to engage in social responsibility and their own long-term development. Subsequently, in 2006, the United Nations established an international network of financial institutions, which established the Principles of Responsible Investment. For the first time, these principles clearly put forward the concept of linking ESG to responsible investment and advocated "incorporating ESG factors into investment decisions and investment strategies and practices of active ownership." Since then, ESG has rapidly developed worldwide. The Governance Standards for Listed Companies were updated by the China Securities Regulatory Commission in June 2018 and for the first time

specifically mandated that listed companies provide ESG information. As of June 2024, A total of 2,124 Chinese A-share listed companies have released 2023 ESG reports, accounting for about 39.88% of the total. China's proposed "dual carbon" strategy has led to rapid ESG development over the past three years. However, China's ESG development is still somewhat immature when compared with developed countries.

As enterprise managers and decision-makers, senior executives are an enterprise's key human resources. They are responsible for resource allocation and play an important role in exploring development strategies and improving enterprise competitiveness (Huang and Yao, 2024). The TMT needs to make appropriate decisions, including those related to ESG, at the critical moment of determining an enterprise's future development direction (Zeng et al., 2023). "Top echelon theory" proposes that the TMT members' varied traits (e.g., gender, education level, overseas background, etc.) affect their values (Hambrick and Mason, 1984). A TMT's heterogeneity may lead to contradictions. On the one hand, heterogeneity leads to a trend toward diversification and extensive enterprise information exchange. On the other hand, large differences of opinion in an enterprise's decision-making process will aggravate conflicts, lead to confusion in an enterprise's operation decisions, and affect the enterprise TMT's subsequent behavior and strategy choices.

Prior research has examined how TMT heterogeneity affects firm performance (Pham and Lo, 2023), total factor productivity (Huang and Yao, 2024), stock price crash risk (Li et al., 2022), and the moral hazard of equity pledges (Yuan, 2023). Studies have also explored how the TMT's functional diversity impacts corporate ESG performance (Zhang and Zhang, 2024). However, research about the impact of TMT heterogeneity on corporate ESG performance is lacking. This paper examines the connection between TMT heterogeneity and corporate ESG performance using Chinese A-share listed companies as the research sample, covering the period from 2011 to 2022. The results show that TMT heterogeneity significantly promotes corporate ESG performance. Regarding the connection between TMT heterogeneity and corporate ESG performance, investor attention has a significantly positive moderating effect.

This study's main contributions are twofold. First, a new research idea is applied to study TMT heterogeneity, broadening the scope of research from the behavior of a single market to the multidimensional unity of ESG. Second, the study results offer some solutions for enterprises in China and other emerging market countries where ESG development is relatively immature, such as improving the TMT's heterogeneity and recruiting executives with diverse backgrounds to join the team.

2. Theoretical analysis and research hypotheses

TMT heterogeneity refers to a team's degree of differentiation in dimensions like demographic characteristics, functions, and backgrounds; these characteristics significantly impact team collaboration and strategy formulation (Alexiev et al., 2010). According to hierarchy and branding theories, the TMT's demographic characteristics and personal experiences are closely related to individual recognition, values, and judgment and ultimately have an important impact on corporate behavior through information processing, resource utilization, and decision-making.

First, highly heterogeneous management teams have more complex social networks and more extensive information acquisition channels, which affects information processing (Talke et al., 2010). Rich information enables enterprises to quickly perceive changes in the external market environment, cater to social needs, and improve their ESG concept. Second, in terms of resource utilization, a heterogeneous management team has more diverse social capital and experiences than a highly homogeneous management team (Sarto et al., 2019). This diversity can provide enterprises that engage in ESG with a variety of internal and external resources. Finally, when TMT members are highly homogeneous, team decision-making can tend toward extremes. However, when team members are highly heterogeneous, their perspectives and concerns differ due to their richer set of knowledge, ideas, and skills. Consequently, they are less likely to overly rely on original paths and more likely to think outside the box when making decisions (Díaz-Fernández et al., 2020). Therefore, when making ESG decisions, their market judgment tends to be more sophisticated and their decision-making skills are more diversified. This leads to Hypothesis 1:

H1: TMT heterogeneity has a significantly positive correlation with corporate ESG performance

With the openness and transparency of corporate information disclosure, and increasingly more supervision and attention from external stakeholders, investor attention has become an important factor in decisions about corporate activities (Chen et al., 2024). Stakeholder theory proposes that a company's development and investment decisions are closely related to the input and participation of various stakeholders. Thus, as stakeholders, investors can impact an enterprise's ESG performance. Meanwhile, resource dependence theory suggests that establishing good relationships between enterprises and external investors can effectively improve an enterprise's ability to obtain external resources. As important participants in capital markets, individual investors have a strong capital advantage. To maximize their investment returns, as rational economic beings, they will choose to invest in enterprises with good ESG performance and sustainable development ability. As the attention from public investors increases, enterprises will also begin actively demonstrating to the public their actions in environmental preservation, social responsibility fulfillment, and corporate governance and improve their ESG performance (Zhang and Zhang, 2024). As ESG performance can convey a positive firm image to outsiders, corporate executives are forced to make decisions to invest more resources in ESG. This strongly affects their behavioral choices and decision-making preferences (Liu et al., 2024). Some scholars have found that investor attention is influenced by the TMT's background characteristics (Wang et al., 2022). Thus, we propose Hypothesis 2:

H2: Investor attention has a significantly positive moderating effect on the connection between TMT heterogeneity and corporate ESG performance.

3. Research design

3.1 Data and sample selection

The study's hypotheses are tested using data from China's A-share listed companies spanning 2011 to 2022. 2011 is chosen as the sample period's starting year because investor attention data first became available that year. The following types of enterprises are excluded from the sample: (1) financial and insurance companies, (2) those with ST, *ST, and PT designations, and (3) companies with missing or abnormal data. Additionally, to improve the ESG data's authenticity and reliability, enterprises that did not continuously disclose relevant data were excluded. After screening, 23,316 observations were obtained.

The Wind, China Stock Market Accounting Research (CSMAR), and Resset databases provided the original data for all companies in this study. Incomplete firm executive information in the databases is manually supplemented using the annual reports disclosed by Sina Finance, CNINFO, and Eastmoney networks, and official websites of the listed companies. Before beginning the empirical analysis, all continuous variables were winsorized at the 1% level to eliminate the impact of extreme data.

3.2 Model construction

A multiple linear regression model is constructed to examine the effect of TMT heterogeneity on corporate ESG performance. First, the model was used to examine how TMT heterogeneity affects corporate ESG performance. Then, an interaction term was established to examine the moderating effect of investor attention on the connection between TMT heterogeneity and ESG performance. The regression models in Eqs. (1) and (2) are used to test hypotheses 1 and 2, respectively:

$$ESG = \beta_0 + \beta_1 Het + \beta_2 Controls + Year + Ind + \varepsilon \quad (1)$$

$$ESG = \beta_0 + \beta_1 Het + \beta_2 AT + \beta_3 Het * AT + \beta_4 Controls + Year + Ind + \varepsilon \quad (2)$$

where the explained variable *ESG* is corporate ESG performance, the explanatory variable *Het* is the TMT heterogeneity, and the moderating variable *AT* is investor attention. *Controls* are control variables, and *Ind* and *Year* are industry and year dummy variables, respectively.

3.3 Variable definitions

3.3.1 Explanatory variable

This study's explanatory variable is TMT heterogeneity (*Het*). The senior managers that make up a TMT are in charge of business operations and strategic decision-making; they influence and determine the enterprise's performance and development (Lin et al., 2014). Based on a review of related literature, education level, gender, and overseas background were selected to describe *Het* (Yuan, 2023). Since these are all categorical variables, the Herfindal-Hirschman coefficient was used to represent the proportion of team members with different characteristics. The average value was then computed. The variable has a range of 0 to 1; the TMT's degree of heterogeneity increases with value (Su et al., 2021).

3.3.2 Explained variable

The study's explained variable is corporate ESG performance (*ESG*). At present, most studies use third-party ESG ratings as a proxy to measure the degree to which an enterprise fulfills its ESG responsibilities. ESG performance has been measured with a variety of ESG rating systems, which differ in their evaluation criteria, reference indicators, coverage, and so on. Following previous practice, the Sino-Securities ESG Rating System is used to measure corporate ESG performance (Liu and Wan, 2023).

3.3.3 Moderating variable

The study's moderating variable is investor attention (*AT*). In China, the Baidu index directly indicates the frequency of keyword searches, which can reflect investors' attention to relevant information (Gu, 2024). Due to differences in the sample companies' scale and popularity, their Baidu search volume may fluctuate greatly. Therefore, referring to previous studies, the Baidu search volume of listed companies is used to measure *AT*. The variable is calculated as the natural logarithm of a company's search volume plus 1 (Gu, 2024).

3.3.4 Control variables

Following previous research, relevant factors that could affect corporate ESG performance were controlled (Liu et al., 2024, Zhang and Zhang, 2024). Table A1 lists the precise control variable, along with all variables' descriptions and specific measurements.

4. Empirical analysis

4.1 Descriptive statistics

Table 1 presents the descriptive statistics for the study's primary variables. Our statistical results show that between 2011 and 2022, the maximum and minimum values of the sample firms' ESG performance are 8 and 1, respectively, and the mean and median values are 4.061 and 4, respectively. These values indicate that although there is a gap among enterprises in their ESG performance, China's listed companies have upper-middle-class ESG performance. The maximum and minimum values and standard deviation of *Het* are 0.583, 0.222, and 0.080, respectively. These values indicate that a large gap exists in the heterogeneity of the sample enterprises' executive teams.

Table 1 Descriptive statistics.

Variables	N	Mean	SD	Min	Median	Max
ESG	23316	4.061	1.100	1	4	8
Het	23316	0.388	0.080	0.222	0.380	0.583
E-het	23316	0.884	0.082	0.667	0.889	1
G-het	23316	0.212	0.182	0	0.245	0.500
O-het	23316	0.069	0.136	0	0	0.490
AT	23316	12.769	0.672	11.343	12.707	14.795
Roa	23316	0.030	0.065	-0.280	0.031	0.198
Age	23316	2.509	0.638	0.693	2.639	3.367
Cent	23316	0.337	0.149	0.082	0.314	0.740
Dual	23316	0.218	0.413	0	0	1
Size	23316	22.454	1.356	19.625	22.299	26.414
TMTSize	23316	6.947	2.731	1	7	39
Super	23316	4.020	1.416	3	3	9
Indepr	23316	0.377	0.065	0.250	0.364	0.600
CF	23316	0.200	0.356	-0.607	0.128	1.856
Tato	23316	0.627	0.453	0.062	0.523	2.696
Growth	23316	0.156	0.373	-0.347	0.077	2.639

4.2 Baseline regression

To examine how the Het impacts corporate ESG performance, hypothesis 1 was tested using multiple linear regression; the results are reported in Table 2. Our results showed a significantly positive correlation between Het and corporate ESG performance, indicating that Het is beneficial to improving corporate ESG performance, supporting Hypothesis 1. Specifically, the TMT's education level (*E-het*) and corporate ESG performance showed a positive correlation but were non-significant. The TMT's gender heterogeneity (*G-het*) and corporate ESG performance showed a significantly positive correlation, indicating that *G-het* is beneficial to improving corporate ESG performance. The TMT's overseas background heterogeneity (*O-het*) and corporate ESG performance also showed a significantly positive correlation, indicating that *O-het* is beneficial to improving corporate ESG performance.

Table 2 Baseline regression.

Variables	ESG	ESG	ESG	ESG
Het	0.404*** (4.69)			
E-het		0.054 (0.54)		
G-het			0.154*** (4.12)	
O-het				0.120** (2.38)
Roa	2.998*** (25.55)	3.005*** (25.60)	2.996*** (25.53)	3.008*** (25.62)
Age	-0.250*** (-18.97)	-0.253*** (-18.24)	-0.249*** (-18.89)	-0.246*** (-18.48)
Cent	0.095** (1.98)	0.083* (1.73)	0.090* (1.88)	0.093* (1.93)
Dual	-0.067*** (-4.01)	-0.061*** (-3.63)	-0.065*** (-3.89)	-0.064*** (-3.82)
Size	0.244*** (40.99)	0.243*** (40.85)	0.246*** (41.07)	0.242*** (40.44)
TMTSize	0.017*** (6.19)	0.019*** (5.95)	0.020*** (7.17)	0.020*** (7.14)
Super	-0.019*** (-3.76)	-0.021*** (-4.13)	-0.020*** (-3.89)	-0.020*** (-3.91)
Indepr	1.225*** (11.80)	1.238*** (11.92)	1.222*** (11.77)	1.232*** (11.87)
CF	0.062*** (3.05)	0.064*** (3.15)	0.064*** (3.13)	0.062*** (3.03)
Tato	-0.038** (-2.53)	-0.040*** (-2.68)	-0.038** (-2.51)	-0.041*** (-2.71)
Growth	-0.151*** (-8.02)	-0.150*** (-7.95)	-0.150*** (-7.99)	-0.151*** (-8.01)
Ind/Year	Yes	Yes	Yes	Yes
_cons	-1.407*** (-10.74)	-1.285*** (-8.80)	-1.335*** (-10.41)	-1.232*** (-9.74)
N	23316	23316	23316	23316
adj.R ²	0.151	0.150	0.151	0.150

* p < 0.1; ** p < 0.05; *** p < 0.01.

Next, model 2 is used to test the second hypothesis regarding AT's moderating effect on the relationship between Het and corporate ESG performance. The test results are presented in Table 3. Our results showed a significantly positive correlation between corporate ESG performance and the cross-multiplicative term of Het and AT, supporting Hypothesis 2. This result indicates that more intense AT increases the positive effect of Het on corporate ESG performance.

Specifically, corporate ESG performance and the cross-multiplicative term of the E-het and AT showed a positive correlation but were non-significant. Corporate ESG performance and the cross-multiplicative term of the G-het and AT showed a significantly positive correlation. Thus, more intense AT significantly strengthens the positive role of the relationship between the G-het and corporate ESG performance. Corporate ESG performance and the cross-multiplicative term of the O-het and AT showed a positive correlation, but non-significant.

Table 3 Moderating effects regression.

Variables	ESG	ESG	ESG	ESG
Het	-6.858*** (-4.31)			
Het*AT	0.570*** (4.57)			
E-het		-2.442 (-1.56)		
E-het*AT		0.198 (1.60)		
G-het			-3.144*** (-4.45)	
G-het*AT			0.259*** (4.67)	
O-het				-0.708 (-0.78)
O-het*AT				0.065 (0.91)
AT	-0.206*** (-4.07)	-0.156 (-1.42)	-0.038** (-2.15)	0.013 (0.89)
Controls	Yes	Yes	Yes	Yes
Ind/Year	Yes	Yes	Yes	Yes
_cons	1.303** (2.04)	0.800 (0.57)	-0.795*** (-3.74)	-1.289*** (-7.50)
N	23316	23316	23316	23316
adj.R ²	0.152	0.150	0.151	0.150

** p < 0.05; *** p < 0.01.

4.3 Robustness test

As a robustness test, the Sino-Securities ESG rating data is replaced by data from other major ESG rating agencies in China. The test results are presented in Table 4. The sample period when using SynTao Green's ESG rating data ranges from 2015 to 2022 because that rating data is first available for 2015. The selection criteria for this sample period are also used for the Bloomberg ESG score, Rankins ESG score, and Wind ESG rating. The FTSE Russell ESG score is first available for 2018. However, due to numerous missing values in the 2018 score data, 2019 to

2022 is used as the FTSE Russell ESG score sample period. The data processing methods for the SynTao Green ESG rating, Wind ESG rating, and Sino-Securities ESG rating data are similar and all adopt quantitative processing. The ten grades for SynTao Green ESG ratings, which range from D to A+, are sequentially assigned from 1–10; for example, ESG equals 1 when the rating is D and 10 when the rating is A+. The nine grades for Wind ESG rating, which range from C to AAA, are sequentially assigned from 1–9; for example, ESG equals 1 when the rating is C and 9 when the rating is AAA. After the above treatment, the benchmark results remain valid.

Table 4 Robustness test.

Variables	SynTao Green ESG rating (2015-2022)	Bloomberg ESG score (2011-2022)	FTSE Russell ESG score (2019-2022)	Rankins ESG score (2019-2022)	Wind ESG rating (2018-2022)
Het	1.806 ^{***} (6.26)	5.266 ^{***} (5.75)	0.759 ^{***} (6.05)	1.529 ^{***} (4.77)	0.605 ^{***} (7.54)
Controls	Yes	Yes	Yes	Yes	Yes
Ind/Year	Yes	Yes	Yes	Yes	Yes
_cons	-0.991 ^{**} (-2.09)	-35.433 ^{***} (-24.69)	-3.577 ^{***} (-15.73)	-6.698 ^{***} (-11.98)	2.118 ^{***} (16.20)
N	2096	7932	2340	1404	15380
adj.R ²	0.240	0.601	0.207	0.244	0.106

** p < 0.05; *** p < 0.01.

4.4 Endogeneity test

In the benchmark regression, current measures are used for both the explanatory and explained variables; however, endogeneity problems may exist. As ESG performance improves, the TMT members are constantly optimized and adjusted; thus, the Het will eventually change. To alleviate this problem, Het, the explanatory variable, is first advanced by one to three periods. Second, corporate ESG performance, the explained variable, is lagged by one to three periods. The test results are reported in Table 5. The results remain consistent with the benchmark results after using a longer time series, regardless of the advancement or lag treatments.

Table 5 Endogeneity test

Variables	ESG	ESG	ESG	L1.ESG	L2.ESG	L3.ESG
F1.Het	0.446*** (4.93)					
F2.Het		0.443*** (4.60)				
F3.Het			0.466*** (4.72)			
Het				0.438*** (4.77)	0.429*** (4.36)	0.474*** (4.67)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Ind/Year	Yes	Yes	Yes	Yes	Yes	Yes
_cons	-1.506*** (-10.80)	-1.701*** (-11.34)	-1.504*** (-9.69)	-1.484*** (-10.52)	-1.419*** (-9.29)	-0.951*** (-5.96)
N	21373	19430	17487	21373	19430	17487
adj.R ²	0.151	0.153	0.124	0.142	0.136	0.124

*** p < 0.01.

4.5 Heterogeneity analysis

In Table 6, the sample is split into state-owned and non-state-owned enterprise subsamples based on their property rights. Subsamples are also created for firms in the Eastern and Midwest regions. The study’s findings indicate that there are differences in Het’s influence on corporate ESG performance depending on property rights. That is, compared to non-state-owned enterprises, Het has a bigger influence on corporate ESG performance in state-owned enterprises, indicating that the concepts and pursuits of executive teams in state-owned enterprises are relatively unified; they aim to achieve both the company’s profit goals and the government’s assigned non-profit goals. When political power intervenes, the problems caused by the Het are more easily processed internally, which is more conducive to improving a firm’s ESG performance. At the same time, how Het impacts corporate ESG performance differs across regional contexts. Compared to enterprises in the Midwest region, Het has a bigger influence on corporate ESG performance in Eastern region enterprises, indicating that the Eastern region has a highly developed economy, which makes the mindset of business executives in the eastern region more inclusive and open compared to their counterparts in the Midwest. Thus, a Het is more easily accepted, which is conducive to improving corporate ESG performance.

Table 6 Heterogeneity analysis.

Variables	(1) State- owned	(2) Non-State- owned	(3) Eastern	(4) Midwest
Het	1.037*** (7.62)	0.111 (0.98)	0.413*** (4.00)	0.075 (0.49)
Controls	Yes	Yes	Yes	Yes
Ind/Year	Yes	Yes	Yes	Yes
_cons	-1.386*** (-7.66)	-1.806*** (-8.96)	-1.318*** (-8.26)	-1.081*** (-4.79)
N	11136	12180	14928	8388
adj.R ²	0.156	0.162	0.159	0.142
Chow test p-value	0.000***		0.035**	

** p < 0.05; *** p < 0.01

5. Conclusion

As governments of many countries now attach great importance to the concept of ESG, enterprises have become increasingly aware of ESG performance through government policies and market signaling. However, ESG development in developing countries, including China, is relatively immature. Thus, how to further improve corporate ESG performance in emerging markets has become a common research objective in both theoretical and practical circles. This study focuses on how Het impacts corporate ESG performance. First, the findings demonstrate that Het has a significantly positive effect on corporate ESG performance. Specifically, the G-het and O-het have a significantly positive impact on corporate ESG performance, while the positive effect of the E-het on corporate ESG performance is non-significant. Second, AT plays a significantly positive moderating role in the connection between the Het and corporate ESG performance. Specifically, AT plays a significantly positive moderating role in the connection between the G-het and ESG performance. However, as a moderator in the relationships between E-het and ESG performance, and between O-het and ESG performance, it is positive, while it is non-significant. Finally, the heterogeneity of property rights and regional levels is a factor in Het's influence on corporate ESG performance. Specifically, Het in state-owned enterprises has a better encouraging influence on corporate ESG performance when compared to non-state-owned enterprises. Het in Eastern enterprises has a better encouraging influence on corporate ESG performance when compared to Midwestern enterprises.

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Appendix A

Table A1 Variable definitions

Type	Variable	Symbol	Definition
Explanatory Variable	Executive team heterogeneity	Het	The index was constructed based on the heterogeneity of education level, gender and overseas background of the executive team, and the average value was taken
Explained variable	Corporate ESG performance	ESG	Nine ratings from “C” to “AAA”
Moderating variable	Investor attention	AT	Natural logarithm of the Baidu searches plus one
	Return on assets	Roa	Net profit/total assets
	Firm age	Age	Natural logarithm of the firm’s listing age plus one
	Ownership concentration	Cent	Top 1 shareholders’ total shareholding ratio
	Duality of CEO and chairman	Dual	If the chairman and CEO are the same person, take 1, otherwise 0
	Firm size	Size	Natural logarithm of total assets
	TMT size	TMTSize	Number of TMT members
Control variables	Supervisory board size	Super	Number of supervisory board
	Proportion of explanatory directors	Indepr	Number of explanatory directors/total board members
	Solvency	CF	Net cash flows from operating activities/current liabilities
	Operation ability	Tato	Operating income/total assets
	Development ability	Growth	Growth rate of total assets
	Year	Year	Year dummy variables
	Ind	Ind	Listed manufacturing companies are 1, otherwise 0