The Impact of Female Directors in Chinese Listed Companies on Corporate ESG Ratings: An Analysis of the Moderating Effects of the Number of Female Executives and R&D Investment

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Abstract. The concept of sustainable development for enterprises, proposed in the 1940s, has sparked extensive debate, prompting researchers to develop suitable evaluation systems that guide companies in balancing economic performance with the sustainable development of the social environment. ESG (Environmental, Social, and Governance) investment strategies, which holistically consider environmental impacts, social responsibility, and corporate governance, have gained significant attention and adoption. Concurrently, the increasing participation of female directors on corporate boards, driven by the enhancement of women's status, necessitates an examination of their impact on ESG performance due to their unique decision-making preferences, risk aversion, diligence in supervision, and stronger motivation to benefit the company compared to their male counterparts. This study utilizes ESG rating data from *Syntao Green Finance* and selects A-share listed companies in Shanghai, Shenzhen, and Beijing from 2015 to 2022 as samples. Employing panel data regression, the study systematically examines the impact of both the absolute and relative numbers of female directors on ESG performance. Furthermore, the study introduces moderating variables to analyze the changes in this relationship while considering the involvement of female executives and corporate R&D investment. Findings indicate a positive correlation between the number of female directors and the ESG performance of listed companies. Additionally, the number of female executives and corporate R&D investment exhibit different moderating effects, with the former showing a negative impact and the latter a positive impact on this relationship.

Keywords: ESG performance, Number of female directors, Number of female executives, R&D investment, Panel regression

1 Introduction

Given the heightened attention of global capital markets on environmental, social, and governance (ESG) factors, corporations are increasingly required to not only concentrate on their economic performance but also to scrutinize the impact of their business

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activities on the environment and society, alongside ensuring the transparency and equity of their internal governance structures (Ahmad, Yaqub, & Lee, 2024) [1]. Within this context, gender diversity in corporate governance—specifically the representation and influence of female directors—has emerged as a critical topic of scholarly inquiry. This study seeks to rigorously investigate the correlation between the number of female directors and the ESG performance of publicly listed companies, thereby offering valuable insights and guidelines for policymakers, investors, and corporate leaders.

The ESG standard, as a crucial metric for assessing the non-financial performance of enterprises, encompasses three dimensions: environmental, social, and governance [1]. The ESG performance of a corporation not only signifies its commitment and contributions to environmental and social responsibilities but also reflects the robustness and transparency of its internal governance structure. In recent years, an increasing body of literature has indicated that female directors play an indispensable role in corporate governance. Their unique perspectives and cognitive approaches facilitate the promotion of diversity and inclusiveness on the board, thereby enhancing the overall decision-making quality and ESG performance of the enterprise (Chang et al., 2024) [2].

Despite the growing recognition of the significance of female directors in corporate governance, research specifically examining their impact on corporate ESG performance remains relatively limited. Existing studies predominantly focus on the financial performance implications of female board members, while investigations into ESG performance are comparatively scarce. Consequently, this study aims to address this research gap by empirically analyzing the relationship between the presence of female directors and the ESG performance of publicly listed companies, hoping to offer novel insights and perspectives that contribute to the sustainable development of enterprises.

The study utilizes a Chinese sample, focusing on annual data from A-share listed companies in Shanghai, Shenzhen, and Beijing over the period from 2015 to 2022. Employing multiple regression models, it empirically examines the relationship between the number of female directors and corporate ESG performance. The research aims to verify the hypothesis that the number of female directors is positively correlated with the ESG performance of listed companies. Specifically, it posits that an increase in the number of female directors is associated with an improvement in ESG performance. Additionally, the study investigates the moderating effects of variables such as the number of female executives and R&D investment on corporate ESG performance, thereby enriching and extending the research content. A particularly noteworthy contribution of this paper is the identification of the "queen bee phenomenon" in the management of Chinese listed companies. In male-dominated enterprises, female executives may adopt characteristics of the prevailing male culture, maintaining distance from other female employees or directors to achieve personal success. This phenomenon, characterized by traits such as competitiveness and independence, may not facilitate the attainment of ESG objectives and may even negatively moderate the positive impact of the number of female directors on corporate ESG performance.

2 Rational and Research Hypotheses

2.1 The Relationship between the Number of Female Directors and Corporate ESG Performance

From the perspective of Gender Socialization Theory, women often exhibit softer, more inclusive, and altruistic roles in social activities (Carlson, 1972) [3]. Consequently, the inclusion of female directors may introduce diverse perspectives and alternative ways of thinking within corporate boards, thereby enhancing board diversity and inclusiveness (Ibid). This diversification can facilitate a more comprehensive consideration of stakeholders' interests in strategic and decision-making processes, encompassing environmental, social, and governance issues. Furthermore, female directors tend to exhibit a heightened focus on social responsibility and sustainable development, potentially driving corporations to engage more proactively in ESG initiatives (Peng & Chandarasupsang, 2023) [4]. Hence, from a theoretical standpoint, an increase in the number of female directors within companies may be positively correlated with enhanced ESG performance. In other words, the participation of female directors can elevate corporate ESG awareness and spur greater efforts towards ESG matters. Consequently, the following hypothesis is proposed. H1: Based on a sample of Chinese listed companies, there exists a positive correlation between the number of female directors and ESG performance. Specifically, as the number of female directors in a company increases, its ESG performance is correspondingly expected to improve.

2.2 The Impact of Increased Female Executives on ESG Performance

Upper Echelons Theory posits that the personal psychological attributes and backgrounds of corporate executives, as primary agents of strategic choices and decisions, can significantly influence the formation of strategic decisions and thereby indirectly affect various facets of a company's performance (Bekos & Chari, 2023) [5]. Extant research indicates that female executives often exhibit heightened empathy and communication skills, leading them to be more attuned to the emotional needs of employees and to prioritize robust relationships with stakeholders in their leadership and management processes. This people-centric leadership style fosters a more harmonious and inclusive work environment, thereby enhancing cooperation and trust among employees and increasing organizational cohesion and centripetal force (Zeler, Fuentes Lara & Moreno, 2022) [6]. Such a positive work environment is crucial for enhancing ESG performance, as it stimulates employees' innovative spirit and sense of responsibility, resulting in improved outcomes in environmental protection, social responsibility, and corporate governance. Moreover, Social Identity Theory suggests that an individual's status, role, sense of belonging, and values in society can influence their sense of identity (Madeson, 2024) [7]. Hence, female executives may garner greater acceptance and recognition from female employees and consumers, thereby enhancing the overall corporate image and indirectly promoting the company's ESG performance.

Drawing from these theoretical frameworks and empirical studies, this article posits Hypothesis 2: Given an equivalent number of female directors, an increase in the

number of female executives will have a more pronounced positive impact on the enhancement of corporate ESG performance.

2.3 The Role of Long-term R&D Investment in the Impact of Female Directors on ESG Performance

Research and development (R&D) investment is frequently regarded as a critical indicator of future growth. A high level of R&D investment signifies a company's commitment to innovation and long-term development, aligning with the objective of Long-termism. According to the long-term philosophy, which emphasizes sustained long-term growth and value creation over short-term profits, enterprises should prioritize enduring growth (MacAskill, 2022) [8]. Long-term oriented companies place significant emphasis on sustainability, encompassing environmental protection, social responsibility, and sound corporate governance. Empirical evidence suggests that firms with higher female representation on their boards are more inclined to engage in long-term investments, such as R&D. Female directors tend to make more sustained and long-term decisions, thereby enhancing efforts in ESG domains, which is consistent with the long-termism paradigm (Rahi, 2024) [9].

Consequently, the article posits Hypothesis 3: In companies with substantial R&D investment, the presence of female directors has a more pronounced positive impact on ESG performance.

3 Empirical Tests

3.1 Sample Selection and Data Sources

This study utilizes annual data from A-share listed companies in Shanghai, Shenzhen, and Beijing, spanning from 2015 to 2022. The primary data sources include the *Oriental Wealth Choice* financial data terminal and the *CSMAR* database. Adhering to the 2012 industry classification standards of the China Securities Regulatory Commission, the initial dataset underwent a rigorous screening process to ensure the reliability of the research outcomes. The screening criteria were as follows: (1) exclusion of samples with missing variable data; (2) exclusion of financial listed companies; and (3) exclusion of abnormal company samples designated as ST and *ST during the sample period. Following these procedures, a final dataset comprising 2412 company-year observations was obtained for analysis.

3.2 Variable Definition and Measurement

Explained Variable – Corporate ESG Performance (*ESG*). *Syntao Green Finance* possesses extensive research expertise and practical experience in the ESG domain. The organization has developed an independent carbon and climate scenario analysis platform, which has garnered prestigious international accolades such as the "ESG Data Provider of the Year, Asia", underscoring its professional competence in the field (*Sina*

Net Finance, 2023) [10]. Concurrently, its body of literature is grounded in years of cutting-edge research in ESG, delivering authoritative data and analysis while integrating closely with the specific context of China for comprehensive research (Ibid). This fusion of global knowledge and localized focus enhances the practicality and relevance of its literature. Consequently, this study employs the *Syntao Green Finance*'s rating system to evaluate the ESG performance of companies.

It assigns companies one of ten ESG performance ratings, ranging from highest to lowest: A+, A, A-, B+, B, B-, C+, C, C-, and D. For the purposes of this study, an "A+" rating corresponds to a score of 10, an "A" to a score of 9, and so forth. The overall rating spectrum spans from 1 to 10.

Explanatory Variable – Absolute / Relative Number of Female Directors (FD / FDP). Data of the number of female directors of A-share listed companies was obtained from the *CSMAR* database, along with data on board members, for further calculation. The absolute number of female directors is the exact number of female directors in the board of directors of the company, and the relative number is the proportion of female directors to the total number of directors.

Moderating Variables. ① Number of female executives (FM): The absolute number of female executives in A-share listed companies in Shanghai, Shenzhen, and Beijing in the CSMAR database; ② R&D investment (RC): The ratio of enterprise R&D expenditure to operating income.

3.3 Empirical Modelling

To empirically test Hypothesis 1, the research constructed a multiple regression model to evaluate the impact of the number of female directors on the ESG performance of firms. The regression equation is specified as follows:

$$ESG_{i,t} = \alpha_0 + \alpha_1 FD(FDP)_{i,t-1} + \gamma_1 * Controls_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

Where i denotes the individual firm; t denotes the year; ESG represents the firm's ESG performance; FD and FDP denote the absolute and relative number of female directors respectively. Controls are control variables including firm size (A), managerial shareholding ($Manager$), leverage ratio (LEV), net cash flow (CF), fixed asset ratio (FA), firm growth ($Growth$), return on total assets (ROA), book-to-market ratio (BM), and firm age (AGE). Here, α represents the regression coefficients, and $\varepsilon_{i,t}$ denotes the random error term. Given the delayed effect of female directors on ESG performance, FD (FDP) was lagged in the model.

For the empirical verification of research hypothesis 2, the following regression model 2 was formulated:

$$ESG_{i,t} = \beta_0 + \beta_1 FD_{i,t-1} + \beta_2 \left(FM_{i,t-1} * FD_{i,t-1}\right) + \beta_3 FM_{i,t-1} + \gamma_2 * Controls_{i,t-1} + \varepsilon_{i,t} \quad (2)$$

In this model, FM represents the number of female executives, β denotes the regression coefficients, and other variables are defined as in Equation (1).

For the empirical verification of research hypothesis 3, the following regression model 3 was formulated:

$$ESG_{i,t} = \theta_0 + \theta_1 FD_{i,t-1} + \theta_2 (RC_{i,t-1} * FD_{i,t-1}) + \theta_3 RC_{i,t-1} + \gamma_3 * Controls_{i,t-1} + \varepsilon_{i,t} \quad (3)$$

In this model, RC represents the R&D investment, calculated by total R&D expenditure / Operating income. θ denotes the regression coefficients, and other variables are defined as in Equation (1).

4 Findings and Analyses

4.1 Descriptive Statistics

To conduct a descriptive statistical analysis of the fundamental characteristics of each variable, Table 1 presents the descriptive statistical outcomes of the primary variables. From these results, it is observed that: (1) The mean and standard deviation of ESG, an index of corporate ESG performance, are 5.487 and 1.103, respectively. This indicates that ESG performance among the sample companies predominantly falls between C+ and B, while the top-performing companies achieving an A rating; (2) The metrics for the number of female directors, FD and FDP, cluster around the mean, suggesting minimal variation in the number of female directors among Chinese enterprises, potentially due to an industry norm; (3) The distributions of other variables are within reasonable limits.

Table 1. Descriptive statistics

VarName	Obs	Mean	SD	Min	Med	Max
ESG	2412	5.487	1.103	3.000	5.000	9.000
FD	2412	1.206	1.082	0.000	1.000	8.000
FDP	2412	0.137	0.124	0.000	0.111	0.571
A	2412	23.974	1.211	21.124	23.780	28.505
LEV	2412	46.194	18.485	1.427	47.598	94.841
ROA	2412	6.651	7.005	-44.393	5.441	47.752
RC	2412	0.049	0.059	0.000	0.035	0.509
CF	2412	0.076	0.068	-0.216	0.068	0.421
FA	2412	0.198	0.157	0.001	0.154	0.899
Growth	2412	16.092	31.789	-77.648	12.036	539.397
BM	2412	0.446	0.330	0.010	0.359	2.456
Manager	2412	8.142	14.716	0.000	0.337	80.658
AGE	2412	21.213	5.577	4.000	21.000	46.000

4.2 Correlation Analysis

To preliminarily assess the presence of a significant correlation between the variables and to mitigate the potential effects of multicollinearity in regression analysis, the study

conducted a correlation analysis. The results indicate that: (1) the correlation coefficient between the proportion of female directors and the ESG rating of enterprises is positive, suggesting that an increase in the proportion of female directors is associated with enhanced ESG performance, which aligns with our initial hypothesis; (2) The absolute values of the correlation coefficients among all variables are less than 0.7, and the Variance Inflation Factor (VIF) values for all control variables are below 10. These findings indicate an absence of substantial multicollinearity, thus all variables could be retained for further analysis.

4.3 Panel Regression Results

Based on prior research hypotheses, panel regression analyses were conducted on the entire sample, incorporating fixed effects for industry and year. Table 2 presents the multiple regression results pertaining to Hypothesis 1, while Table 3 provides the regression outcomes for Hypotheses 2 and 3.

Hypothesis 1.

Table 2. Benchmark model regression results

	Full sample 1		**Full sample 2**	
	(a)	**(b)**	**(a)**	**(b)**
FD	0.0459**	0.0740***	/	/
FDP	/	/	0.3464**	0.6771***
Manager		-0.0005		-0.0007
A		0.3922***		0.3940***
Growth		-0.0008		-0.0008
FA		0.0113		0.0078
LEV		-0.0015		-0.0014
ROA		-0.0001		-0.0003
CF		0.3025		0.3178
BM		-0.5700***		-0.5671***
AGE		-0.0044		-0.0042
year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
F	10.007	14.291	9.9781	14.313
R-squared	0.2034	0.2963	0.2030	0.2966
N	2412	2412	2412	2412

Note: The data in the table are the regression coefficients of the variables, ***, ** and * indicate that they are significant at the 1 per cent, 5 per cent and 10 per cent level of significance, respectively.

Analyzing the regression results for full sample 1, column (a) indicates that the coefficient of the absolute number of female directors (FD) is positive and statistically significant at the 5% level. Specifically, an increase in the absolute number of female directors by one unit is associated with a 0.0459-unit improvement in ESG performance. This finding suggests that increase in the number of female board members

enhances the ESG performance of enterprises, since the introduction of female directors may contribute diverse perspectives and experiences, thereby fostering enhanced focus and innovative improvements in environmental practices, social responsibility, and corporate governance. Column (b) demonstrates that after incorporating control variables, the coefficient of FD remains positive and significant at the 1% level.

Examining the results from the full sample 2, column (a) reveals that the coefficient for the relative number of female directors, defined as the proportion of female directors on the board (FDP), is positive and statistically significant at the 5% level. Each unit increase in the relative number of female directors corresponds to a 0.3464-unit improvement in ESG performance. This suggests that a higher proportion of female directors contributes to a more inclusive and balanced decision-making process, mitigating the biases associated with single-gender dominance. Furthermore, increasing the proportion of female directors can alter the culture and atmosphere of the board, promoting open and inclusive discussions, and advancing policies and practices related to sustainable development and social responsibility, thereby enhancing the company's environmental and social performance and its ESG rating. Column (b) indicates that even after incorporating control variables, FDP continues to exhibit a positive coefficient and remains significant at the 1% level. Collectively, these regression results substantiate the validity of Hypothesis 1.

Hypotheses 2 & 3. The study introduces the moderating variable FM, representing the absolute number of female executives, to test Hypothesis 2. The regression results indicate that in column (a), the coefficient of the interaction term between FM and FD is negative and significant at the 1% significance level. This suggests that the beneficial effect of increasing the number of female directors on corporate ESG performance diminishes as the number of female executives rises. The increase in female leadership might alter the power dynamics and corporate culture, particularly in companies with low gender diversity. Such abrupt diversification could precipitate power or cultural conflicts, thereby negatively influencing the company's ESG performance. Column (b) demonstrates that even after incorporating control variables, the interaction term retains a negative coefficient and remains significant at the 1% significance level, thereby rejecting Hypothesis 2.

The study also introduces the moderating variable of enterprise R&D investment (RC) to test Hypothesis 3. According to the regression results, column (a) shows that the coefficient of the interaction term between FD and RC is positive and significant at the 1% significance level. This indicates that in companies with higher R&D investment, the presence of female directors has a more pronounced positive impact on ESG performance. Companies with a higher representation of women on the board are more likely to engage in long-term investments, such as R&D, with female directors tending to make more sustained and long-term decisions, including those related to environmental protection, social responsibility, and good corporate governance. Column (b) reveals that after the inclusion of control variables, the interaction term still exhibits a positive coefficient and remains significant at the 5% significance level, thus supporting Hypothesis 3.

Table 3. Regression results after adding moderating variables

	Moderating variable *FM*		Moderating variable *RC*	
	(a)	(b)	(a)	(b)
FD	0.0954***	0.1244***	0.1803***	0.1595***
FM	0.1450***	0.1277***	/	/
FDM	-0.0460***	-0.0450***	/	/
RC	/	/	-0.0145	0.0845***
FDR	/	/	0.0402***	0.0265**
Manager		-0.0007		-0.0020
A		0.3875***		0.3814***
Growth		-0.0008		-0.0004
FA		0.0451		0.6437***
LEV		-0.0015		-0.0037**
ROA		-0.0007		0.0010
CF		0.2797		0.0203
BM		-0.5703***		-0.5922***
AGE		-0.0045		-0.0031
year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
F	10.198	14.320	62.526	48.539
R-squared	0.2121	0.3029	0.0941	0.2083
N	2412	2412	2412	2412

Note: The data in the table are the regression coefficients of the variables, ***, ** and * indicate that they are significant at the 1 per cent, 5 per cent and 10 per cent level of significance, respectively.

5 Conclusion

Based on an analysis of A-share listed companies in Shanghai, Shenzhen, and Beijing from 2015 to 2022, this study explores the statistical correlation and causal relationship between the ESG rating performance of Chinese listed companies and the presence of female directors. Additionally, the study introduces the number of female executives and corporate R&D investment as moderating variables to examine their moderating roles within the research framework. The paper finally yields the following conclusions:

(1) An increase in both the number and relative proportion of female directors has a positive impact on a company's ESG rating. This phenomenon may be attributable to the tendency of women in leadership roles to prioritize the long-term interests and social responsibility of the company. Female directors are more likely to champion initiatives in environmental protection, employee welfare, and social welfare, thereby enhancing the company's performance and reputation in these domains [9]. Furthermore, the augmentation of female directors typically results in greater board diversity. A diverse board can offer varied perspectives and experiences, thereby mitigating decision-making bias and enhancing decision quality [3]. In the context of ESG-related issues, a multiplicity of perspectives can assist companies in more comprehensively identifying

risks and opportunities, thus facilitating more informed decisions in environmental protection, social responsibility, and governance structures. Additionally, contemporary societal values increasingly emphasize gender equality and diversity, and both investors and the public have heightened expectations for corporate performance in these areas (Froehlicher et al., 2021) [11]. Companies that exhibit higher levels of female directorship are better positioned to meet these expectations and consequently receive positive feedback from investors and the public, which in turn enhances their ESG ratings.

(2) There exists a notable negative interaction effect between female directors and female executives, wherein an increase in the number of female directors potentially leads to a decline in the ESG performance of the company, particularly when there is already a higher representation of female executives. This phenomenon may be attributable to the "queen bee" effect, as posited by Derks, Van Laar, and Ellemers (2016), wherein individual female executives in predominantly male-dominated organizations align themselves with male-centric cultural norms and maintain a distance from other women to further their own careers [12]. Female executives may exhibit masculine traits such as competitiveness and independence, which could be incongruent with the achievement of ESG objectives, including enhancements in environmental protection, social responsibility, and corporate governance (Ibid). Furthermore, internal competition between female directors and executives may result in suboptimal resource allocation or diminished cooperation, thereby affecting the focus and efficiency of decision-making processes, ultimately impeding the enterprise's overall ESG performance (Lv & Wang, 2017) [13].

(3) The augmentation of R&D investment within enterprises can amplify the positive impact of female directors on ESG performance. One plausible explanation for this phenomenon is that female directors inherently prioritize risk management and long-term outcomes. In the realm of research and development, this mindset may prompt companies to emphasize long-term benefits and sustainable innovation, thereby improving their ESG performance. Female directors are more inclined to advocate for and endorse decisions with enduring strategic importance, and substantial R&D investment is a crucial means for companies to achieve long-term competitive advantages. Through this mechanism, the interplay between female directors and R&D investment can markedly enhance the long-term ESG performance of the enterprise.

Based on the current national context and research findings, the government should develop pertinent regulations or policies to incentivize companies to increase the number of female board members. Meanwhile, enterprises should focus on building an inclusive culture and encourage cooperation and support among female leaders.

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