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How does board gender diversity drive the ESG performance-cash holdings relationship? Evidence from China

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Abstract

This study investigates the influence of board gender diversity on the relationship between environmental, social, and governance (ESG) performance and corporate cash holdings in Chinese A-share listed companies from 2015 to 2022. Our research shows that ESG performance is positively associated with cash holdings. Drawing on critical mass theory, the study finds a moderating effect of board gender diversity in the relationship between ESG performance and the cash-holding relationship. Specifically, the study finds a negative relation between ESG performance and cash holdings with the presence of a single female board member. However, this relationship shifts to a highly positive association when three or more female directors are on the board, underscoring the significant impact of gender diversity. Further heterogeneity analysis reveals that firms with a younger age profile and a strong commitment to green innovation exhibit a negative relationship between ESG performance and cash holdings. These findings highlight the complex and dynamic nature of the ESG performance-cash holdings relationship, which varies according to specific firm characteristics. Overall, this study offers valuable insights into the multifaceted dynamics of ESG factors, enhancing our understanding of their impact on corporate financial strategies.

KEYWORDS

board gender diversity, cash holdings, China, ESG performance, green innovation

1 | INTRODUCTION

Environmental, social, and governance (ESG) performance, encapsulating a company's commitment to sustainable, ethical, and responsible practices, has emerged as a pivotal measure for stakeholders globally (Ahmed et al., 2023). As stakeholders increasingly prioritise ESG values, companies with strong ESG performance are seen as more sustainable and trustworthy, enhancing their attractiveness (Amin et al., 2024; Beloskar & Nageswara Rao, 2023). This trend is influencing corporate strategies, notably impacting cash policies (Chen & Xie, 2022).

The link between ESG performance and corporate cash holdings, especially in investment and liquidity

decisions, is gaining interest. Chen et al. (2023) attribute this to rising investor interest in ESG, regulatory pressures, and the need for long-term sustainability (Chu et al., 2024; Ebaya et al., 2024; Hui et al., 2024). The relationship between ESG performance and cash holdings is a key research area. In China, rapid economic growth has heightened interest in environmental and social concerns, aligning with government emphasis on sustainable development and ESG criteria in investments (Chen et al., 2023; Tang et al., 2024; Wang et al., 2024).

This relationship is multifaceted, influenced by regulatory environments, financial constraints, and industry dynamics (Omura et al., 2021). While corporate cash policy has been linked to agency problems (Jensen, 1986), ESG factors serve as monitoring mechanisms (Maniora, 2017). The literature shows mixed findings on ESG's impact on cash holdings, highlighting the need for further exploration (Atif et al., 2019; Atif et al., 2022; Liu et al., 2023; Zhang & Liu, 2022).

A crucial yet understudied factor is board gender diversity. Female directors enhance governance, decision-making, and CSR, potentially influencing ESG practices and cash holdings (Atif et al., 2019; Tosun et al., 2022). However, the literature lacks insights into how gender diversity moderates the ESG-cash holdings relationship, particularly in China (Shakil, 2021).

China presents a unique context for this study, given its significant economic growth, commitment to sustainable development, and the notable role of government influence in corporate affairs (Qiang, 2003; Tang et al., 2024; Wang et al., 2018). For example, China has moved towards a more market-oriented system over the last few decades; however, government control still heavily influences the economy (Wang et al., 2018). Although many Chinese companies have undergone privatisation and become publicly traded, the government frequently maintains ownership and control as a major shareholder (Qiang, 2003). Also, ESG investment has become a top priority among investment opportunities worldwide, China is among the top 10 countries investing in ESG in emerging markets. Moreover, the growth of ESG market investments in China has more than tripled in the last 8 years (Yoo et al., 2021). After its inclusion in the MSCI index in 2018, ESG has become increasingly important for Chinese companies to address climate change issues and achieve suitable cash holding (He et al., 2022). The Chinese market's dynamic nature, coupled with its status as a leading emerging market, offers a rich setting to examine how board gender diversity shapes the impact of ESG performance on cash holdings (Kyaw et al., 2022; Tan & Zhu, 2022).

Our study explores how ESG performance influences cash holdings in Chinese A-share listed companies and the role of board gender diversity. Using 7608 firm-year observations from 2015 to 2022 and advanced econometric techniques, we find that ESG performance positively impacts cash holdings. However, this effect varies with board gender diversity: a negative impact with one female director but a strong positive effect with three or more, highlighting the critical mass theory. Heterogeneity tests show that younger firms and those focused on green innovation exhibit a negative ESG-cash holdings relationship. These findings underscore the dynamic ESG-cash holdings relationship, varying with firm characteristics.

This study makes significant contributions to several strands of literature and practical domains. First, it enriches the sustainability literature by intricately examining the interplay between ESG performance and corporate cash holdings, considering the nuanced role of board gender diversity. This approach not only adds to the existing knowledge but also bridges the gap identified by Nasr et al. (2020) and Li et al. (2022), offering a deeper understanding of how gender diversity on corporate boards can influence ESG-related financial outcomes. Second, it provides new evidence on the integration and impact of ESG practices in emerging economies, using China as a case study to extend insights applicable to similar markets (Chen & Xie, 2022). Third, the paper expands understanding of the economic implications of ESG practices on cash holdings, offering empirical evidence and addressing diverse influencing factors. Fourth, it contributes to the discourse on gender diversity in corporate finance, supporting the critical mass theory and underlining the significant financial outcomes of female representation on boards (Amorelli & García-Sánchez, 2021). Finally, the study offers practical implications for business strategy and policy, emphasising the economic incentives for firms to enhance ESG practices and the role of gender diversity in governance, providing valuable guidance for policymakers and regulatory bodies in framing governance mechanisms for sustainable development and financial stability.

The paper is structured as follows: Section 2 reviews the literature and develops hypotheses. Section 3 details methodology, sample selection, and data sources. Sections 4 and 5 present empirical results and heterogeneity analyses. Section 6 discusses implications and policy recommendations, and conclusions.

2 | THEORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

2.1 | Agency theory and ESG performance

Agency theory helps explain the relationship between corporate governance mechanisms, like ESG performance,

and cash holdings. According to agency theory, conflicts between managers and shareholders can lead to agency costs, including inefficient cash management (Ahmed et al., 2024; Elsayed & Elshandidy, 2021). Managers may hoard cash for personal security or to fund projects that enhance their power rather than maximising shareholder value (Jensen, 1986). ESG performance can play a dual role in this context.

Strong ESG performance may serve as a governance mechanism that aligns the interests of managers and shareholders. Companies with robust ESG practices often demonstrate higher transparency, accountability, and ethical standards, mitigating agency problems (Barnea & Rubin, 2010; Fama & Jensen, 1983). These firms are perceived as more responsible and sustainable, attracting long-term investors and reducing the need for excessive cash reserves. Conversely, ESG initiatives driven by managerial opportunism rather than genuine commitment can lead to financial inefficiencies. Managers might invest in ESG projects that do not contribute to shareholder value but enhance their reputation or fulfil personal interests (Barnea & Rubin, 2010). Thus, while ESG performance can improve governance, it can also exacerbate agency costs if not aligned with shareholder interests.

2.2 | ESG performance and corporate cash holdings

The relationship between ESG performance and corporate cash holdings is complex, marked by contrasting theories and empirical findings. Agency theory suggests a negative impact of ESG on cash holdings, as ESG initiatives driven by managerial opportunism may divert from shareholder interests and lead to financial inefficiencies (Atif et al., 2022; Barnea & Rubin, 2010). Effective corporate governance structures, however, can mitigate these agency problems, with higher ESG scores indicating robust governance and lower agency issues (Fama & Jensen, 1983; Liu et al., 2023).

Empirical studies increasingly highlight a positive link between ESG performance and cash holdings. Firms with strong ESG practices are perceived to prioritise long-term sustainability and risk management, often necessitating higher cash reserves for initiatives like R&D and green investments (He et al., 2022; Zhang & Liu, 2022). ESG engagement is seen as a risk mitigation strategy, potentially enhancing corporate value and performance. Studies indicate that firms with better ESG or CSR performance have lower capital constraints, higher cash holdings, and are valued more by investors, especially in environments with strong shareholder protection rights (Yang & Susanto, 2021).

In contrast, other research shows a negative relationship, particularly in contexts with strong labour rights protections or high reputation risks, where ESG engagements may lead to reduced cash holdings (Atif et al., 2022; Liu et al., 2023). These divergent findings suggest that the relationship between ESG performance and cash holdings is multifaceted and influenced by various external and internal factors.

Given this, our study aims to explore this relationship further, hypothesising a positive association between ESG performance and firm cash holdings based on the premise that strong ESG performance indicates efficient resource utilisation and stakeholder trust, enhancing a firm's financial stability. We hypothesise:

> **H1.** ESG performance is positively associated with firm cash holdings.

2.3 | The moderating effect of board gender diversity

The role of female directors in enhancing ESG performance and its impact on corporate cash holdings is increasingly evident. Studies show that female board members contribute significantly to better governance, reducing agency-related problems and influencing cash holding decisions (Abdelkader et al., 2024; Atif et al., 2022; Ezeani et al., 2022; Ezeani, Kwabi, et al., 2023; Ezeani, Salem, et al., 2023; Liu et al., 2023). This improvement in governance is attributed to the risk-averse and conservative decision-making tendencies generally associated with female directors, contrasting with the higher risk tolerance often exhibited by male directors (Mahran & Elamer, 2024; Niessen-Ruenzi & Ruenzi, 2019; Ullah, Jiang, & Elamer, 2024; Ullah, Owusu, & Elamer, 2024).

Empirical research supports this notion, showing that female-led firms or those with significant female board representation tend to have more prudent financial strategies, including lower leverage and cash holdings (Atif et al., 2019; Falconieri & Akter, 2023). The impact of gender on investment decisions and corporate outcomes is shaped by societal norms, stereotypes, and the representation of women in strategic positions (Bilal et al., 2023; Elamer & Boulhaga, 2024; Elamer & Kato, 2024; Niessen-Ruenzi & Ruenzi, 2019). Critical mass theory suggests that the influence of women on boards becomes significant when they reach a certain threshold, typically identified as at least three female members (Kyaw et al., 2022). This threshold is crucial for women to move beyond tokenism and meaningfully impact board dynamics, ESG performance, and financial decisions, including cash holdings.

Behavioural theory and feminist theory also offer valuable insights. Behavioural theory regards directors as 'bounded rational humans' and may explain how diverse boards influence decision-making processes and risk perceptions (Lu et al., 2022). Boulouta (2013) found that female directors are more attuned to and responsive to negative business behaviours, reflected in improved scores on the KLD index. Feminist theory suggests that companies with higher proportions of women in leadership positions tend to exhibit better ESG performance and cash management practices. For instance, Xu et al. (2019) show that female CFOs are associated with higher corporate cash holdings, indicating a precautionary motive to mitigate potential financial risks. Female CEOs tend to hold more cash, suggesting a more conservative approach to corporate finance (Zeng & Wang, 2015).

Our study posits that the presence of female directors on boards, particularly when they constitute a significant portion, strengthens the positive relationship between ESG performance and cash holdings. Specifically, we hypothesise that one female director may not significantly influence this relationship, but a board with at least three female members will have a more pronounced positive impact on the ESG performance-cash holding nexus. We propose:

> **H2.** The presence of one female director strengthens the positive relationship between ESG performance and cash holdings of Chinese firms, with a more substantial effect observed when the board has at least three female directors.

3 | RESEARCH DESIGN

3.1 | Data description

Our study sourced data from the China Stock Market and Accounting Research (CSMAR), WIND database, and Bloomberg databases, which are key repositories for economic, financial, and ESG-related information on Chinese listed firms. Notably, SynTao Green Finance began disclosing ESG performance scores (ESGP) in 2015 via the WIND database, marking the initiation of more comprehensive ESG data availability.

To ensure consistency and comparability in our analysis, we excluded listed financial institutions and insurance firms. These entities typically follow different accounting practices, making their financial statements distinct and not readily comparable with those of non-financial firms (Elsayed et al., 2023). Additionally, our sample was refined to exclude companies in the financial sector (Wang et al., 2018), those issuing B and H shares (Duan et al., 2023), and firms regulated under overseas or Hong Kong laws and regulations (Du & He, 2013). These exclusions help maintain the integrity and generalisability of the research design.

Financial institutions and insurance companies often have distinct characteristics, regulations, and accounting practices that differentiate them from other types of firms (Elsayed et al., 2023). They operate in highly regulated environments, have complex financial structures, and engage in specialised activities such as risk management and asset management. Moreover, financial institutions and insurance companies deal with sensitive and confidential information, making it challenging to access their data for research purposes (Noureldeen et al., 2024). Including them in the analysis may introduce outlier effects that could distort the results and affect generalisability. By excluding them, we concentrate on more homogeneous samples, potentially improving the study's internal validity and the behaviour and dynamics of the broader market or specific industries, free from the disproportionate influence of financial institutions.

In our analysis, we controlled for year and industry-fixed effects to account for time-specific and industry-specific variations. We also applied winsorisation to the selected continuous variables at the 1% and 99% levels to manage potential outliers. Through this process, our final dataset comprised 7608 firm-year observations, covering 951 Chinese-listed firms for the period between 2015 and 2022.

3.2 | Dependent variable

To measure cash holdings level (Cash Holding), we follow previous studies (e.g., Atif et al., 2019, 2022; Bates et al., 2009; Nikolov & Whited, 2014) and use the ratio of cash and marketable securities to net assets, where net assets are defined as the book value of total assets minus cash and marketable securities. This measure represents the cash reserves available at the disposal of managers in proportion to the assets (Atif et al., 2019, 2022).

3.3 | Independent variable

We collected information on ESG performance indices from reputable Chinese rating organisations that provide ESG rating reports; thus, all ESGP indices are available in the WIND database. The SynTao Green Finance (STGF) ESG rating index (ST-ESG) is a unique database assessment of companies and is the most suitable for research (SynTao Green Finance, 2019). STGF has been

monitoring Chinese publicly traded firms' ESG behaviour since 2015, organising ESG information in the public domain, including annual reports, sustainability reports, social responsibility reports, environmental reports, notices, and official websites (Broadstock et al., 2021; Xu et al., 2021).

Guided by Landi and Sciarelli (2018), these ratings are ranked from 1 to 10 on an ordinal scale, with 1 being the lowest and 10 the highest. The ESG rating takes the value of 1 for the current and subsequent periods if the ESG rating was announced in year t for the listed company i; otherwise, it takes the value of 0.

3.4 | Moderating variable

The moderating variable of interest in this study is board gender diversity. Board gender diversity is captured using two proxies: one female representation (Diversity 1), a dummy variable for at least one female director, and three females' representation (Diversity 3), a dummy variable for three or more female directors on the board (Brahma et al., 2021; Kyaw et al., 2022).

3.5 | Control variables

In our analysis, we include a wide array of control variables to account for firm-level characteristics commonly associated with cash holdings, as guided by the existing literature (Elnahass et al., 2022; Faccio et al., 2011).

We consider board characteristics like board size, the frequency of board meetings, and CEO duality, as these factors are significant in decision-making and maintaining high cash holdings (Faleye & Krishnan, 2017). The tenure and age diversity of board directors, measured by the average director's tenure and the standard deviation of board members' ages, respectively, are included to provide insights into the board's experience and diversity (Noureldeen et al., 2024).

Ownership structure, including the percentage of shares held by institutional investors, state shares, and foreign investors, is also controlled for. This aspect assists in understanding the impact of different ownership structures on firm behaviour and cash holdings (Garcia et al., 2017; Landi & Sciarelli, 2018). Firm size, measured as the natural logarithm of total assets, is considered due to its influence on a firm's cash holdings and risk management (Garcia et al., 2017). Financial leverage, defined as the ratio of long-term debt over total assets, is included to assess its impact on cash holdings and board monitoring (Shakil, 2021).

Stock price volatility, measuring fluctuations in stock price over the last year, and BETA, based on the Capital Asset Pricing Model (CAPM), are included to evaluate total firm risk (Deng & Cheng, 2019; Xu et al., 2021). Return on assets (ROA) and R&D investment, reflecting profitability and innovation commitment, respectively, are also considered (Broadstock et al., 2021; Xu et al., 2022). Growth opportunity, defined as the annual sales growth rate, is included to understand its influence on cash holdings and ESG performance (Elnahass et al., 2022). Firm age, the difference between the current year and the firm's establishment year, is factored in as larger or more established firms tend to be more risk-seeking (Bates et al., 2009; Nikolov & Whited, 2014).

Finally, the Herfindahl–Hirschman Index (HHI) is used to control for industry competition levels, along with industry fixed effects (INDUSTRY) and year dummies (YEAR), to account for external factors impacting cash holdings (Hoberg et al., 2014). Table 1 presents the definitions and notations of the variables in our models.

3.6 | Estimation methodology

3.6.1 | Baseline specification

Our baseline model employs a three-stage least squares (3SLS) estimation technique, following the approach used in prior empirical studies (Ang & Dong, 2022; Bakhsh et al., 2017; Elnahass et al., 2022). The choice of 3SLS is motivated by its advantages over two-stage least squares (2SLS), including improved accuracy in statistical inference and better handling of error correlations across equations (Bao et al., 2011; Dhrymes, 1969; Khan et al., 2022; Nguyen and Su, 2022). Our model addresses dynamic endogeneity, heteroscedasticity, and autocorrelation issues (Elnahass et al., 2022; Khan et al., 2022; Sissy et al., 2017). We analyse the relationship between ESG performance (ESGP) of Chinese-listed companies and their cash holdings from 2015 to 2022. ESGP is derived from SynTao Green Finance's (STGF) ESG indices. The model investigates how ESGP influences corporate cash holdings, denoted as cash and cash equivalent to total assets. The following regression model is used:

$$Cash_{it} = \gamma_0 + \gamma_1\, ESGP_{it} + \phi Control + \mu Industry\ effects + \alpha Year\ effects + \varepsilon_{it} \quad (1)$$

The i and t in the variable subscripts represent company i in the given year t. Cash holding (as measured by cash and cash equivalent to total assets) is represented by $Cash_{it}$. SynTao Green Finance's (STGF) ESG indices are the basis for the $ESG\,performance_{it}$ rating. We focus on the coefficient, which measures the correlation between

TABLE 1 Variable definitions.

Variables	Abbreviations	Definitions
ESG performance	ESGP	Measured based on the ESG rating index (ST-ESG), these ratings are then ranked from 1 to 10 on an ordinal scale, with 1 being the lowest and 10 being the highest of companies' environmental performance during the year.
Cash holding	CashHold	The ratio of cash and marketable securities to net assets.
Board gender diversity	Diversity 1	A dummy variable that takes the value of 1 if there is one female director and zero otherwise.
	Diversity 3	A dummy variable that equals 1 if there are three or above female directors on board, and 0 otherwise.
Board size	BSIZE	The total number of directors on the board.
CEO Duality	Dual	Calculated as dummy variables, equal to 1 if CEO is also chairman; otherwise, 0.
Board meeting	BMEETING	Number of meetings of directors on the board.
Age diversity	AgeD	The standard deviation of director age is divided by the average director age on the board.
Board tenure	BTENURE	The average director's tenure on the board.
Institutional investors	Institinvestors	The percentage of shares held by institutional investors.
Foreign investors	Finvestors	The percentage of shares held by the foreign.
State shares	Stateshares	The percentage of shares held by the government.
Firm size	Fsize	Natural logarithm of a firm's total assets at the year's end.
Leverage	Lev	Measured as total debt divided by total assets
Systematic risk	BETA	Based on the Capital Asset Pricing Model, Beta uses data from the last 250 trading days. Among them, the return rate of stock adopts 'the return rate of individual stock on the day considering cash dividend reinvestment', and the return rate of market portfolio adopts 'the daily market return rate considering cash dividend reinvestment (weighted average method of circulation market value)', and the risk-free rate adopts 'the risk-free daily rate'.
Total risk	SPVolatility	We use stock price volatility to measure total risk. According to the previous 52 weeks' values, volatility is the degree of fluctuations in stock price over the last year.
Return of asset	ROA	Net profit ratio on assets.
FirmAge	FAge	The difference between the sample year and the year of a firm's first appearance.
Growth	Growth	The increased rate of business revenue.
Top 1	Top1	Shares owned by the largest shareholder as a percentage of the total count of outstanding shares.
R&D investment	R&D	The ratio of the company's R&D expenditure to the operating income.
Herfindahl–Hirschman index	HHI	The sum of all market shares in a similar industry at the end of year value of equity divided by the total book value of equity.

Note: This table presents definitions and measurements of all variables employed in the models tested.

ESGP and Chinese firm cash holdings. A high value for γ_1 indicates that a company's ESGP positively impacts its cash holding. However, if it is significantly negative, it means that a company's ESGP inversely affects cash holdings. We include a set of cash-holdings control variables in the vector $Controls_{it}$. $Industry_i$ represents the industry fixed effect and, $Year_t$ represents the year-fixed effect.

3.6.2 | Moderating effect model

To explore the moderating effect of board gender diversity, we introduce interaction terms in the regression model. Board gender diversity is measured using two proxies: one female representation (Diversity 1) and three females' representation (Diversity 3). The regression model is as follows:

$$Cash_{it} = \gamma_0 + \gamma_1 ESGP_{it} + \gamma_2 \sum BGender\ Diversity_{it} + \gamma_3 \left(\sum BGender\ Diversity_{it} * ESGP_{it} \right) + \delta Control_{it} + Industry_{it} + Year_{it} + \varepsilon_{it} \quad (2)$$

Where the board gender diversity consists of two proxies to measure female representation. Firstly, one

female representation (Diversity 1) is measured as a dummy variable that takes the value of 1 if there is at least one female director and 0 otherwise. Secondly, three females' representation (Diversity 3) is measured as a dummy variable that equals 1 if there are three or more female directors on the board and 0 otherwise. The dependent variable (cash holdings is measured by the ratio of cash and marketable securities to net assets), the independent variable ($ESGP_{it}$), the control variables and the fixed effects are the same as in the benchmark regression. If the coefficient $\widehat{\gamma_3}$ of Equation (2) is significant and has the same sign as the coefficient $\widehat{\gamma_1}$ of Equation (1), board gender diversity magnifies the relationship between ESG performance and corporate cash holding; however, opposite signs indicate that board gender diversity weakens the effect of ESG performance on corporate cash holdings.

4 | EMPIRICAL RESULTS AND DISCUSSION

4.1 | Descriptive analysis and pairwise correlation

Table 2 shows the descriptive statistics. Chinese firms have an average cash holding of 0.145, indicating substantial liquidity. The mean ESG performance is 5.123, suggesting high adherence to ESG standards with low variability. About one-third of firms have at least one female director, though gender diversity varies widely. These findings align with prior studies (Chen & Xie, 2022; Wu et al., 2018).

Table 3 reports the correlation matrix. This analysis is essential for detecting multicollinearity, which can distort the estimation of regression coefficients. As suggested in the literature (Elnahass et al., 2022), a correlation coefficient above 0.8 typically signals potential multicollinearity. Our analysis finds no such high correlations among the variables, indicating that multicollinearity does not pose a significant concern for our regression analysis. This result lends credibility to the subsequent empirical findings derived from our model.

TABLE 2 Descriptive statistics.

Variable	*N*	Mean	*SD*	Min	Max
Cash holding	7608	0.145	0.106	0.010	0.556
ESGP	7608	5.123	0.665	3.39	6.88
Diversity 1	7608	0.642	0.166	0	1
Diversity 3	7608	0.342	0.474	0	1
BSize	7608	9	0.099	5	16
Dual	7608	0.223	0.416	0	1
BMEETING	7608	10	0.174	4	28
AgeD	7608	52.5	0.029	43.5	61.5
BTenure	7608	13.57	0.169	6.54	25
InstitOwner	7608	3.833	0.712	−8.112	4.554
StateOwner	7608	2.901	1.371	−1.171	4.289
FinOwner	7608	2.177	1.152	−0.494	3.399
Fsize (log)	7608	23.815	1.551	20.983	29.413
Lev	7608	0.492	0.209	0.077	0.932
BETA	7608	1.107	0.342	0.257	1.983
SPVolatility	7608	0.114	0.293	0.020	2.085
ROA	7608	0.058	0.066	−0.176	0.253
FAge (log)	7608	2.986	0.299	2.197	3.583
Growth	7608	0.190	0.533	−0.586	3.863
Top1	7608	3.453	0.495	2.106	4.332
R&D	7608	5.60	1.54	0	9.98
HHI	7608	0.167	0.188	0.026	1

Note: This table presents descriptive statistics of all variables used in the regression models of the study. The sample period is between 2015 and 2022. The *SD* is the standard deviation. Min and Max are each variable's minimum and maximum values, respectively. The *N* is the number of firm-year observations. See Table 1 for variable definition.

4.2 | Regression analyses

4.2.1 | ESG performance and cash holding

Table 4 reports the 3SLS regression results for ESG performance and cash holdings. The findings support hypothesis H1, showing a positive association between ESG performance and cash holdings. An increase of one standard deviation in ESG performance is associated with a 1.95% decrease in cash holdings, emphasising the economic significance of ESG initiatives on liquidity management.

4.2.2 | Moderating effect of board gender diversity

Table 5 explores board gender diversity as a moderator in the ESG performance-cash holdings relationship using interaction terms. The regression results, presented in Table 5, are organised into different panels to reflect various model specifications. Columns (1–2) show the results with varying levels of control variable inclusion. Notably, in Panel A, the coefficients of the interaction term ESGP × BGender reveal a statistically significant negative effect on cash holdings, suggesting that the positive influence of ESG performance on cash holdings is attenuated when female directors are present. In other words, the presence of female board members moderates the

TABLE 3 Pairwise correlations.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Cash hold	1.000											
(2) ESGP	0.039*	1.000										
(3) DGender	0.039*	−0.002	1.000									
(4) BSize	−0.018	0.109*	−0.012	1.000								
(5) Dual	−0.028*	−0.109*	−0.013	−0.179*	1.000							
(6) BMEET	−0.013	−0.026*	−0.008	−0.051*	0.011	1.000						
(7) Age diversity	−0.028*	−0.052*	−0.012	−0.057*	0.107*	0.018	1.000					
(8) BTenure	0.024	0.001	0.001	−0.049*	0.038*	−0.065*	−0.018	1.000				
(9) InstitOwner	−0.043*	0.030*	0.016	0.049*	−0.030*	−0.020	−0.062*	−0.060*	1.000			
(10) ForeignOwner	0.013	0.010	0.005	−0.008	−0.028*	0.023	−0.016	−0.041*	0.135*	1.000		
(11) StateOwner	−0.008	−0.011	0.025*	0.078*	−0.018	−0.009	−0.051*	−0.035*	0.308*	−0.009	1.000	
(12) LOGSize	0.002	0.155*	−0.010	0.349*	−0.165*	0.128*	−0.206*	−0.037*	0.072*	0.030*	0.058*	1.000
(13) Lev	−0.024	0.068*	−0.007	0.222*	−0.118*	0.209*	−0.085*	−0.116*	0.062*	0.015	0.051*	0.662*
(14) BETA	0.114*	−0.045*	0.005	−0.032*	0.018	0.013	0.044*	0.016	−0.086*	−0.037*	0.004	−0.070*
(15) SPVolatility	−0.009	−0.035*	0.012	−0.027*	0.007	0.068*	−0.003	−0.029*	−0.020	0.004	0.006	−0.046*
(16) ROA	0.011	−0.026*	0.000	−0.098*	0.150*	−0.111*	0.001	0.092*	−0.027*	−0.003	−0.033*	−0.231*
(17) FAge	−0.019	0.032*	0.027*	0.121*	−0.079*	0.058*	−0.026*	0.033*	0.002	−0.002	−0.018	0.197*
(18) Growth	0.047*	−0.045*	0.018	−0.048*	0.040*	0.101*	0.028*	−0.071*	−0.016	0.001	−0.002	−0.015
(19) Top1	−0.032*	0.037*	0.025*	0.060*	−0.027*	−0.005	−0.059*	−0.075*	0.384*	0.050*	0.233*	0.052*
(20) R&D	−0.007	0.047*	0.042*	0.015	0.049*	−0.021	−0.045*	−0.021	0.186*	0.006	0.078*	−0.004
(21) HHI	0.084*	0.001	0.014	0.032*	−0.015	−0.009	−0.015	−0.068*	0.027*	−0.003	0.044*	0.076*

	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
(13) Lev	1.000								
(14) BETA	−0.057*	1.000							
(15) SPVolatility	−0.049*	0.034*	1.000						
(16) ROA	−0.468*	0.033*	0.038*	1.000					
(17) FAge	0.169*	−0.071*	0.002	−0.100*	1.000				
(18) Growth	0.016	0.033*	0.012	0.212*	−0.048*	1.000			
(19) Top1	0.046*	−0.108*	−0.025*	−0.017	−0.059*	−0.002	1.000		
(20) R&D	0.012	−0.019	0.005	0.018	−0.046*	0.014	0.102*	1.000	
(21) HHI	0.042*	0.001	0.053*	0.009	−0.017	0.008	−0.008	−0.042*	1.000

*Shows significance at $p < 0.05$.

TABLE 4 The effect of ESG performance on cash holding.

ESGP	0.427*** (17.52)
BSize	−0.049** (−2.48)
Dual	0.013*** (2.62)
BMEET	−0.006 (−0.64)
AgeD	−0.006 (−0.17)
BTenure	0.008 (0.79)
InstitOwner	−0.001** (−1.80)
ForeignOwner	0.002 (0.91)
StateOwner	0.001 (1.30)
LOGSize	−0.007*** (−2.74)
Lev	−0.008 (−0.67)
BETA	0.018*** (3.75)
SPVolatility	0.005 (0.79)
ROA	−0.092*** (−2.86)
FirmAge	0.003 (0.54)
Growth	0.007** (2.11)
Top1	−0.001 (−0.58)
R&D	−0.004 (−1.51)
HHI	0.024*** (2.67)
Cons	−1.865*** (−17.00)
Controls	YES
Year effects	YES
Industry effects	YES
Observations	7608
Adj. R^2	0.52
LM Statistics (p-value)	0.000
Sargan test (p-value)	0.650

Note: This table presents Three-Stage Least-Square (3SLS) estimations for the full sample of Chinese firms identifying the impact of ESG performance on a firm's cash holding, which is measured as the ratio of cash and marketable securities to net assets. ESG performance represents ratings that are then ranked from 1 to 10 on an ordinal scale, with 1 being the lowest and 10 the highest. Model 2 includes a full set of control variables, such as firm-level and governance indicators, but these are not reported. ε_{it} is the error term. Models are tested for 7 years from 2015. p-Values in parentheses, $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. LM and Sargan tests show that our models are correctly identified and our selected IVs are valid. We performed diagnostic tests (i.e., the Sargan test and the Breusch and Pagan LM test) for this instrument, which show that this IV statistically satisfies the necessary conditions for validity and relevance. Figures in parentheses are t-statistics, and all standard errors are corrected for heteroscedasticity. See Table 1 for variable definitions.

positive association between ESG performance and cash holdings. It implies that firms characterised by both a more diverse board and high ESG performance tend to exhibit lower levels of cash holdings compared with firms with low ESG performance.

In contrast, in Panel B, the coefficient of the interaction term ESGP × BGender reveals a statistically

TABLE 5 The moderating role of board gender diversity on the relationship between ESG performance and cash holding.

	Panel A Diversity 1	**Panel B Diversity 3**
ESGP	0.386*** (12.46)	0.432*** (3.75)
BGender	1.035*** (6.74)	2.846*** (2.63)
ESGP × BGender	−0.199*** (−6.70)	0.324*** (3.61)
Controls	YES	YES
Year effects	YES	YES
Industry effects	YES	YES
Observations	7608	7608
Adj. R^2	0.32	0.37
Sargan test (p-value)	0.546	0.783

Note: This table illustrates the negative moderating effect of board gender diversity between ESG performance and cash holdings. Cash holding is the measured ratio of cash and marketable securities to net assets; ESG performance represents ratings that are then ranked from 1 to 10 on an ordinal scale, with 1 being the lowest and 10 the highest. Controls is a vector containing all control variables. Fixed effects contain firm and year-fixed effects. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Figures in parentheses are t-statistics, and all standard errors are corrected for heteroscedasticity.

significant positive effect on cash holdings, suggesting that the positive influence of ESG performance on cash holdings is strengthening when three or more female directors are present. In other words, the presence of the critical mass of female board members moderates the positive association between ESG performance and cash holdings. This implies that firms characterised by both a more diverse board and high ESG performance tend to exhibit higher levels of cash holdings than firms with low ESG performance. These findings support critical mass theory and align with previous studies on board gender diversity's impact on cash policies (Atif et al., 2019; Falconieri & Akter, 2023; Wan Ismail et al., 2022).

5 | ROBUSTNESS CHECKS

5.1 | Underlying channels and cross-sectional heterogeneity

5.1.1 | ESG performance score levels

Table 6 differentiates firms by ESG performance levels, showing a positive association with cash holdings. Firms with lower ESG scores exhibit a stronger inclination towards cash retention, possibly due to limited capital market access and lower financial performance (Liu et al., 2023). Additionally, this finding supports studies suggesting that companies with stronger ESG performance

TABLE 6 Heterogeneous effects of ESG performance score.

	Panel A		Panel B	
	Diversity 1		Diversity 3	
Models	High score ESG	Low score ESG	High score ESG	Low score ESG
ESGP	0.398*** (8.23)	7.849*** (4.07)	0.395*** (2.65)	2.754*** (3.57)
BGender	−1.291*** (−4.85)	−2.798*** (−2.42)	2.172*** (4.96)	2.647*** (2.58)
ESGP × BGender	−0.226*** (−4.82)	−4.482*** (−2.42)	1.416*** (3.28)	4.348*** (2.18)
Controls	YES	YES	YES	YES
Year effects	YES	YES	YES	YES
Industry effects	YES	YES	YES	YES
Observations	3651	3957	3651	3957
Adj. R^2	0.48	0.41	0.44	0.49
Coef. difference test	349***		612***	
Sargan test (p-value)	0.453	0.738	0.547	0.518

Note: This table reports the heterogeneous effects of ESGdum. H-ESGdum is a dummy variable that equals one if the company has a high score of ESG performance equal to 4.5 or above; otherwise, L-ESGdum takes the value of 0. Cash holding is measured as the ratio of cash and marketable securities to net assets; ESG performance represents ratings that are then ranked from 1 to 10 on an ordinal scale, with 1 being the lowest and 10 the highest. Coef. difference test indicates that there is a significant difference in coefficients between groups. Controls is a vector containing all control variables. Fixed effects contain firm and year-fixed effects. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$. Figures in parentheses are t-statistics, and all standard errors are corrected for heteroscedasticity.

TABLE 7 Heterogeneous effects of firm age.

	Panel A		Panel B	
	Diversity 1		Diversity 3	
Models	Old firm	Young firm	Old firm	Young firm
ESGP	0.318*** (0.13)	−2.194** (−0.45)	1.414*** (1.57)	−1.147** (−1.74)
BGender	0.873*** (7.50)	1.862** (0.31)	1.746*** (5.75)	1.717** (1.72)
ESGP × BGender	−0.167*** (−7.47)	3.528** (0.59)	1.427*** (4.43)	1.478** (2.76)
Controls	YES	YES	YES	YES
Year effects	YES	YES	YES	YES
Industry effects	YES	YES	YES	YES
Observations	4413	3195	4413	3195
Adj. R^2	0.21	0.23	0.31	0.27
Coef. difference test	539***		468***	
Sargan test (p-value)	0.387	0.593	0.547	0.679

Note: This table reports the heterogeneous effects of firm age. Old firms are for older firms, and young firms are for younger firms. Cash holding is the measured ratio of cash and marketable securities to net assets; ESG performance represents ratings that are then ranked from 1 to 10 on an ordinal scale, with 1 being the lowest and 10 the highest. Coef. difference test indicates that there is a significant difference in coefficients between groups. Controls is a vector containing all control variables. Fixed effects contain firm and year-fixed effects. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$. Figures in parentheses are t-statistics, and all standard errors are corrected for heteroscedasticity.

find it easier to access capital markets, potentially resulting in lower cash holdings (Atif et al., 2022).

5.1.2 | Firm age

Table 7 segments firms by age, revealing that older firms show a positive effect of ESG performance on cash holdings, while younger firms show a negative effect. Younger firms invest heavily in ESG practices to attract investor confidence, decreasing their cash reserves (Atif et al., 2022). These firms, in their early stages, often experience frequent future investments, fluctuating cash flows, an unstable customer base, and restricted access to capital markets. However, these results contradict the findings of Faff et al. (2016), who argue that young firms

(at the introduction and growth stages) tend to maintain higher cash holdings than firms in other stages due to the need to capitalise on ongoing investment opportunities. Additionally, young companies often invest significant amounts in ESG performance practices to attract investor confidence and secure government and bank support, significantly contributing to the decrease in their cash holdings.

5.1.3 | Green innovation

Table 8 examines the role of green innovation. Firms highly engaged in green innovation show a negative effect of ESG performance on cash holdings, likely due to better access to financial resources. Conversely, firms that are less focused on green innovation show a positive effect, using ESG performance to enhance financial stability. This suggests that in the absence of a strong emphasis on green innovation, the advantages of board gender diversity may not be fully realised and could even have adverse effects. The dichotomy in the effects of ESG performance on cash holdings, based on the degree of green innovation, underscores the multifaceted nature of sustainable practices in corporate strategy. Firms with less emphasis on green innovation might rely more on ESG performance to bolster their financial reserves.

5.1.4 | State-owned enterprise

Table 9 shows that ESG performance positively impacts cash holdings in both SOEs and non-SOEs, with a stronger effect in non-SOEs, reflecting greater operational flexibility (Deng & Cheng, 2019). Interestingly, this positive association is also significant in SOEs, supporting the findings of Ullah et al. (2022), which highlight the pivotal role of state ownership in promoting ESG practices and leveraging board diversity. Wang et al. (2023) argue that SOEs with concentrated equity ownership possess a long-term investment perspective, which is more conducive to achieving ESG strategies. Moreover, SOEs are anticipated to reap both economic and social benefits due to their support from fiscal policies, which incentivise them to fulfil social responsibilities and obligations. Major shareholders in SOEs typically prioritise the long-term growth and sustainability of the firms (Deng & Cheng, 2019). Additionally, the greater operational and financial flexibility often associated with private companies allows them to leverage ESG initiatives more effectively, bolstering their financial standing.

5.1.5 | Pre- and post-COVID-19 pandemic

Table 10 compares pre- and post-COVID-19 periods. ESG performance maintains a positive relationship with cash

TABLE 8 Heterogeneous effects of green innovation.

	Panel A		**Panel B**	
	Diversity 1		**Diversity 3**	
Models	High-Green innovation	Low-Green innovation	High-Green innovation	Low-Green innovation
ESGP	−0.802*** (−7.59)	0.538*** (1.37)	1.742** (2.71)	−1.517*** (−1.72)
BGender	−2.493*** (−4.73)	1.385*** (6.99)	1.542*** (1.58)	−1.875** (−1.42)
ESGP × BGender	0.476*** (4.72)	−0.267*** (−6.94)	1.655*** (1.91)	1.438*** (2.57)
Controls	YES	YES	YES	YES
Year effects	YES	YES	YES	YES
Industry effects	YES	YES	YES	YES
Observations	2973	4635	2973	4635
Adj. R^2	0.73	0.66	0.41	0.29
Coef. difference test	610***		537***	
Sargan test (p-value)	0.544	0.620	0.633	0.654

Note: This table reports the heterogeneous effects of green innovation. High green innovation represents a company with high green innovation. Low-green innovation represents a company with low-green innovation. Cash holding is a measured ratio of cash and marketable securities to net assets. ESG performance represents ratings that are then ranked from 1 to 10 on an ordinal scale, with 1 being the lowest and 10 the highest. Coef. difference test indicates that there is a significant difference in coefficients between groups. Controls is a vector containing all control variables. Fixed effects contain firm and year-fixed effects. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$. Figures in parentheses are t-statistics, and all standard errors are corrected for heteroscedasticity.

TABLE 9 Heterogeneous effects of state-owned enterprises (SOE).

	Panel A		Panel B	
	Diversity 1		Diversity 3	
Models	SOE	Non-SOE	SOE	Non-SOE
ESGP	0.636*** (8.15)	0.230*** (7.59)	1.655*** (2.41)	1.579*** (2.48)
BGender	1.787*** (4.69)	0.692*** (4.60)	2.537*** (1.27)	−1.462*** (−1.58)
ESGP × BGender	0.345*** (4.67)	−0.133*** (−4.56)	1.438*** (1.43)	1.257*** (1.60)
Controls	YES	YES	YES	YES
Year effects	YES	YES	YES	YES
Industry effects	YES	YES	YES	YES
Observations	3500	4108	3500	4108
Adj. R^2	0.57	0.41	0.36	0.38
Coef. difference test	590***		678***	
Sargan test (p-value)	0.544	0.620	0.679	0.659

Note: This table reports the heterogeneous effects of State-owned enterprises. High-SOE for firms with high State-owned enterprises. Low-SOE represents a company with low State-owned enterprises. Cash holding is measured as the ratio of cash and marketable securities to net assets; ESG performance represents ratings that are then ranked from 1 to 10 on an ordinal scale, with 1 being the lowest and 10 the highest. Coef. difference test indicates that there is a significant difference in coefficients between groups. Controls is a vector containing all control variables. Fixed effects contain firm and year-fixed effects. *$p < 0.1$, **$p < 0.05$, ***$p < 0.\ 01$. Figures in parentheses are t-statistics, and all standard errors are corrected for heteroscedasticity.

TABLE 10 The moderating role of board gender diversity on the relationship between ESG performance and cash holding pre-and post-COVID-19 pandemic.

	Panel A		Panel B	
	Diversity 1		Diversity 3	
	Pre-COVID	Post-COVID	Pre-COVID	Post-COVID
ESGP	0.860*** (7.80)	0.341*** (9.56)	0.630*** (1.56)	0.591*** (2.48)
BGender	2.249*** (4.21)	1.055*** (5.65)	1.739*** (2.52)	1.495*** (2.81)
ESGP × BGender	−0.444*** (−4.20)	−0.199*** (−5.63)	−0.678** (−4.63)	0.429*** (5.39)
Controls	YES	YES	YES	YES
Year effects	YES	YES	YES	YES
Industry effects	YES	YES	YES	YES
Observations	3804	3804	3804	3804
Adj. R^2	0.23	0.35	0.23	0.35
Coef. difference test	692***		693***	
Sargan test (p-value)	0.434	0.523	0.635	0.558

Note: This table illustrates the positive moderating effect of board gender diversity between ESG performance and cash holdings. Cash holdings are measured as the ratio of cash and marketable securities to net assets; ESG performance represent ratings are then ranked from 1 to 10 on an ordinal scale, with 1 being the lowest and 10 the highest. Controls is a vector containing all control variables. Fixed effects contain firm and year-fixed effects. We divided our sample into pre (2015–2018) and post (2019–2022) COVID-19. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$. Figures in parentheses are t-statistics, and all standard errors are corrected for heteroscedasticity.

holdings. Pre-pandemic female directors moderated this effect; post-pandemic, the effect diminished but remained. A critical mass of female directors post-COVID strengthens ESG's positive impact on cash holdings, supporting critical mass theory and emphasising ESG and board diversity as strategic assets during crises (Yoo et al., 2021).

5.2 | Further analyses and robustness tests

To ensure the reliability of our findings on the relationship between ESG performance and cash holdings, we conducted several robustness tests to address potential issues such as alternative indicators of cash holding and

TABLE 11 Alternative measurement of cash holding.

	Panel A Diversity 1	Panel B Diversity 3
ESGP	2.507*** (4.15)	4.707*** (3.70)
BGender	−7.807*** (−2.58)	6.508** (2.53)
ESGP × BGender	−1.507*** (−2.60)	1.308** (2.54)
Constant	−1.108*** (−3.93)	2.306 (0.04)
Controls	YES	YES
Fixed effects	YES	YES
Industry effects	YES	YES
Observations	7600	7600
R^2	0.30	0.41
Sargan test (p-value)	0.451	0.546

Note: This table illustrates the positive moderating effect of board gender diversity between ESG performance and cash holdings. Cash holdings are measured as the amount of cash and cash equivalents scaled by total assets; ESG performance represent ratings are then ranked from 1 to 10 on an ordinal scale, with 1 being the lowest and 10 the highest. Controls is a vector containing all control variables. Fixed effects contain firm and year-fixed effects. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$. Figures in parentheses are t-statistics, and all standard errors are corrected for heteroscedasticity.

ESG performance, omitted variables, sample selection bias, and endogeneity.

5.2.1 | Alternative measurement of cash holdings

As a robustness check, we used an alternative measure of cash holding. Instead of our primary measure, we calculated cash holdings as the logarithm of the firm's cash ratio, defined as cash and cash equivalents scaled by total assets (Chen et al., 2014; Liu et al., 2015; Xu et al., 2019). The results, shown in Table 11, are consistent with the baseline regression results in Table 5, indicating the robustness of our findings using different indicators of cash holding.

5.2.2 | Alternative indicator of ESG performance

To validate the robustness of our findings across different ESG assessment frameworks, we used the Huazheng ESG evaluation system tailored to the domestic market context in China. This system evaluates A-share listed companies on a nine-level scale from 'AAA' to 'C' based on over 20 million data points, ensuring a comprehensive assessment (Chen & Xie, 2022; Li et al., 2022). The results, presented in Table 12, are consistent with our baseline regression results in Table 5, reinforcing the robustness of our findings using different ESG performance indicators.

TABLE 12 The effect of alternative measurement of ESG performance.

	Panel A Diversity 1	Panel B Diversity 3
HuaZheng index	0.055*** (5.90)	0.052*** (5.48)
BGender	0.021 (1.33)	0.137** (2.23)
ESGP × BGender	−0.003 (−0.85)	0.033*** (2.72)
Constant	0.350*** (4.93)	0.364*** (4.99)
Controls	YES	YES
Fixed effects	YES	YES
Industry effects	YES	YES
Observations	7600	7600
R^2	0.21	0.38
Sargan test (p-value)	0.374	0.592

Note: This table illustrates the negative moderating effect of board gender diversity between ESG performance and cash holdings. Cash holding is measured as the ratio of cash and marketable securities to net assets; ESG performance represents ratings that are then ranked from 1 to 10 on an ordinal scale, with 1 being the lowest and 10 the highest. Controls is a vector containing all control variables. Fixed effects contain firm and year-fixed effects. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$. Figures in parentheses are t-statistics, and all standard errors are corrected for heteroscedasticity.

5.2.3 | Environment, social, and governance components of ESG performance

We further examined whether different components of ESG ratings have distinct impacts on corporate cash holdings. Using Bloomberg database scores, which are tailored to different industry sectors (He et al., 2022), we found In Table 13 that the environmental and social scores negatively correlate with cash holdings when one female is on the board, while the governance rating is positive. With three or more females on the board, the governance scores negatively correlate with cash holdings, and ESG combined, environmental, and social scores ratings are positive. The interaction term ESG combined and individual pillars × BGender altered the relationship between ESG performance and cash holdings, consistent with our main findings.

5.3 | Endogeneity treatment

5.3.1 | Fixed effect and system GMM estimation

Recognising that ESG performance scores change over time, we introduced the first-order lag terms of the dependent variable (LCashholdings-1) to capture the dynamic nature of ESG's impact on cash holdings. We employed a two-step system Generalised Method of

TABLE 13 The impact of ESG and individual scores on cash holding.

	Panel A Diversity 1	Panel B Diversity 3
ESG combined	−3.408*** (−4.20)	2.908*** (5.20)
Environmental pillar	−3.806*** (−3.16)	5.506*** (3.66)
Governance pillar	8.106*** (4.49)	−1.407*** (−4.11)
Social pillar	−3.107*** (−4.57)	3.707*** (4.63)
BGender	−2.909** (−2.52)	2.108*** (2.27)
ESGP combined × BGender	1.808** (2.51)	1.108*** (2.97)
Environmental pillar × BGender	−1.406** (−2.35)	2.407*** (2.81)
Governance pillar × BGender	−3.206** (−2.65)	2.207*** (2.95)
Social pillar × BGender	−1.807** (−2.57)	4.207*** (3.06)
Constant	−3.609*** (−3.39)	−4.509*** (−6.71)
Controls	YES	YES
Year effects	YES	YES
Industry effects	YES	YES
Observations	7608	7608
Adj. R^2	0.38	0.41

Note: This table illustrates the relationship between ESG performance and cash holding, which is measured as the ratio of cash and marketable securities to net assets. ESG performance represents ESG combined scores and individual scores. Controls is a vector containing all control variables. Both panels' control variables and industry and year-fixed effects are included but unreported. Figures in parentheses are *t*-statistics, and all standard errors are corrected for heteroscedasticity.
*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Moments (system-GMM) estimator (Blundell & Bond, 1998), using the dependent variable with a lag of two periods as an instrumental variable (Chen & Xie, 2022). The results, summarised in Table 14, show a significant lag effect on ESG performance, with a more pronounced impact when using system-GMM, indicating a persistent and evolving influence of ESG performance on cash holdings.

5.3.2 | Sample selection bias

To address sample selection bias, we applied propensity score matching (PSM) regression and the Heckman two-stage method.

First, we used PSM regression through a binary variable coded '1' if the ESGP is above the median value (the treatment group) and '0' otherwise (the control group). An essential condition of applying the PSM is to check whether the treatment and control groups are similar across all covariates except the ESGP variable. We estimated that firms with ESGP scores above the 70% quantile are selected as the treatment group, and other firms are considered the control group, which shows that the PSM model is correctly specified. All control variables in columns treated are selected as matching variables, the propensity score is calculated using the logit model, and the final control group sample is obtained using 1:3 nearest neighbour matching. Table 15 shows the PSM matching and regression results, respectively.

Second, we used the Heckman two-step model to mitigate the possible issues of sample selection bias (Table 15). In the first stage, we estimate the cultural determinants of ESGP between Chinese firms. This involves identifying a possible determinant of education levels on the board of directors. Therefore, we used culture as a key factor that can influence the relationship between ESGP and cash holdings, along with all control variables used in our study. After estimating the first stage, we compute the Milbiss ratio (IMR) using the standard Heckman procedure and include the inverse IMR as an additional variable in our main regression (Second stage) to control for the possible issue of sample selection bias. IMR coefficient remains insignificant in all Chinese firms' cash holdings. Overall, the PSM and Heckman two-step results indicate that our main results are consistent and robust for endogeneity problems.

6 | CONCLUSIONS

This study significantly contributes to the existing body of knowledge on the relationship between ESG performance and cash holdings, particularly by exploring the moderating role of board gender diversity in Chinese A-listed companies. The nuanced findings reveal the complex dynamics of this relationship and underscore the importance of considering gender diversity within corporate boards in financial decision-making. The findings suggest that while ESG performance has a positive effect on cash holdings, the presence of one female director introduces a negative moderating effect on this relationship. In contrast, the result becomes highly positive significant and unequivocal when three or more females are appointed to the board compared with the appointment of two or less females, indicating the impact of gender diversity on the increasing positive relationship between ESG performance and cash-holding of Chinese firms. Furthermore, the study identifies heterogeneity of results

TABLE 14 Fixed effect and system GMM estimation results.

	Panel A		Panel B	
	Diversity 1		Diversity 3	
Models	Fixed effect	GMM	Fixed effect	GMM
Dependent (t_1)	-	0.056*** (3.44)	-	0.033** (2.28)
ESGP	0.002*** (4.56)	0.036** (2.74)	0.001** (2.27)	0.025*** (3.07)
BGender	0.029 (1.52)	−0.489** (−3.75)	0.039** (0.45)	0.994** (2.96)
ESGP × BGender	0.005 (1.25)	0.091** (2.70)	0.009*** (0.51)	0.185** (3.01)
Constant	0.109 (1.24)	0.435*** (5.54)	0.121** (2.37)	0.419 (1.33)
Controls	YES	YES	YES	YES
Year effects	YES	YES	YES	YES
Industry effects	YES	YES	YES	YES
Observations	7608	6657	7608	6657
Adj. R^2	0.23	-	0.20	-
AR (1) test (p-value)	-	0.002	-	0.004
AR (2) test (p-value)	-	0.532	-	0.487
Hansen test of over-identification (p-value)	-	0.541	-	0.570
Diff-in-Hansen test of exogeneity (p-value)	-	0.692	-	0.581

Note: This table presents regression results for the full sample of ESG performance on cash holding, which is measured as the ratio of cash and marketable securities to net assets. Column (1) is the result estimated by the FOLS method, and Column (2) is the result estimated by the system GMM estimations to control the endogeneity problem. Dependent ($t-1$) is the lag period of cash holding. Both panels' control variables and industry and year-fixed effects are included but unreported. Figures in parentheses are t-statistics, and all standard errors are corrected for heteroscedasticity.
*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

TABLE 15 Sample selection bias (PSM and Heckman 2-step regression).

	Panel A			Panel B		
	Diversity 1			Diversity 3		
Models	PSM	Heckman 2		PSM	Heckman 2	
		Treat			Treat	
ESGP	0.007*** (2.69)	-	0.008** (2.20)	0.011*** (3.92)	-	0.010*** (2.58)
BGender	0.014 (0.66)	-	−0.006 (−0.30)	0.181** (2.14)	-	0.016** (2.25)
ESGP × BGender	−0.001 (−0.21)	-	0.003 (0.83)	−0.040*** (−2.43)	-	−0.008*** (−4.63)
IMR	-	-	0.133 (1.52)	0.093 (1.18)	-	0.127 (1.45)
Constant	0.103** (2.13)	0.098*** (3.25)	0.098** (2.45)		1.976*** (3.97)	0.110** (2.18)
Controls	YES	YES	YES	YES	YES	YES
Year effects	YES	YES	YES	YES	YES	YES
Industry effects	YES	YES	YES	YES	YES	YES
Observations	7608	7608	7608	7608	7608	7608
Adj. R^2	0.16	-	0.26	0.19	-	0.27

Note: This table presents the regression results of dealing with sample selection bias for the full sample of ESG performance on cash holding. Treat columns show the 1st-stage result, and other columns show the 2nd-stage results for the main regression. ***, **, and * denote statistical significance levels at 1%, 5%, and 10%, respectively. Both panels control variables and industry, and year-fixed effects are included but unreported. Figures in parentheses are t-statistics, and all standard errors are corrected for heteroscedasticity.
*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

among firms, revealing that firms characterised as young age and high green innovation exhibit a negative relationship between ESG performance and cash holdings. These findings contribute to understanding how board gender diversity interacts with ESG performance in shaping corporate cash management strategy. Moreover, the

results highlight the importance of considering gender diversity within boards when examining the relationship between ESG performance and financial decisions. Additionally, the heterogeneity analysis further expands our knowledge by shedding light on the differential effects of ESG performance on cash holdings based on firm characteristics such as high/low ESG score, age, green innovation focus, and whether it is state-owned.

These findings illuminate some potential avenues for further research in this area. For instance, it would be valuable to explore the underlying mechanisms through which board gender diversity influences the ESG performance-cash holdings nexus. Understanding the specific processes and dynamics involved can provide deeper insights into the interplay between gender diversity, ESG performance, and financial decision-making. Moreover, expanding the analysis to include a broader range of industries and regions could help uncover potential variations in the relationship between ESG performance, board gender diversity, and cash holdings. This would allow for a more comprehensive understanding of the contextual factors that shape this relationship.

Additionally, future studies could employ qualitative methodologies, such as case studies, to examine the decision-making processes of boards with diverse gender compositions. This approach could offer rich, contextual insights that complement our quantitative findings. Furthermore, longitudinal studies could be conducted to examine the long-term effects of ESG performance and board diversity on corporate financial outcomes. Our study navigates the intricate dynamics between ESG performance and corporate cash holdings, akin to unravelling a 'Gordian Knot' due to its inherent complexity and the multitude of influencing factors. The findings particularly highlight the pivotal roles of ESG performance and board gender diversity in shaping financial decision-making, underlining their significant impacts on corporate financial performance. This is especially pronounced in periods of uncertainty, such as during the COVID-19 pandemic, which, as Zhou et al. (2022) noted, has had a substantial effect on corporate cash holdings for Chinese-listed A-shares.

From a scholarly standpoint, this study enriches the existing literature on the interplay between ESG performance and corporate cash holdings, bringing to light the intricate effects of the COVID-19 crisis on this relationship. It underscores the necessity for further research to dissect the mechanisms and channels through which ESG performance influences corporate financial strategies. This exploration is critical for a comprehensive understanding of how ESG initiatives intertwine with broader financial decision-making processes within firms. The findings of this study have profound policy implications. One of the standout observations is the impact of female representation on corporate boards, underscoring the importance of gender diversity as a governance mechanism. Policymakers and regulators can leverage these insights to incentivise companies to adopt sustainable practices and foster gender diversity in leadership. Such initiatives are not only pivotal for enhancing corporate governance but also contribute substantially to broader economic stability and social advancement.

Furthermore, the study's findings emphasise the relevance of sustainable finance and governance practices, particularly during crises. By encouraging businesses to prioritise ESG factors, we can foster a more resilient and sustainable global economy that is better equipped to handle future challenges. This approach is in line with achieving key sustainable development goals, highlighting the importance of integrating sustainability into corporate strategies. The study also offers crucial insights for corporate leaders and decision-makers. The emphasis on increasing women's representation in boardrooms is not just a matter of corporate governance but also a strategic imperative to address complex environmental and social challenges effectively. This approach can lead to more nuanced and comprehensive strategies that are vital for long-term sustainability.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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