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Does ESG performance enhance investment efficiency? A study of Chinese firms with auditing quality as a mediator

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ABSTRACT

Growing demands for non-financial information have increased the importance of environmental, social, and governance (ESG) disclosures in corporate decision-making. This study examines whether ESG performance improves investment efficiency in Chinese A-share listed firms and investigates whether audit quality mediates this relationship. Using a panel dataset of Chinese A-share firms from 2012 to 2023, ESG performance is measured using Bloomberg ESG pillar scores, while investment efficiency is estimated based on deviations from optimal investment levels. Firm-level fixed-effects regression models are employed to control for unobserved heterogeneity, and mediation analysis is applied to assess the indirect effect of audit quality. The empirical results indicate that ESG performance has a significant and positive effect on investment efficiency. A one-unit increase in ESG score is associated with an improvement of approximately 0.027 in investment efficiency at the 1% significance level. Audit quality, proxied by engagement with Big-4 auditors, is also positively associated with investment efficiency, with an estimated effect of about 0.006. Mediation analysis confirms that audit quality partially transmits the influence of ESG performance on investment efficiency, suggesting that high-quality auditing enhances the credibility of ESG disclosures and strengthens their role in guiding efficient investment decisions. These findings have important practical implications. Firms can improve investment efficiency by strengthening ESG practices and engaging high-quality auditors. Policymakers and regulators may enhance capital allocation efficiency by promoting standardized ESG disclosure requirements and improving audit oversight.

Contribution/Originality: This study contributes new evidence from an emerging-market context and extends the ESG–investment efficiency literature by identifying audit quality as an important governance mechanism linking ESG performance to corporate investment behavior.

1. INTRODUCTION

Neoclassical economists contended in the early decades that businesses' social goal should be to maximize the wealth of their owners (Benlemlih & Bitar, 2018). Later scholars, however, contend that social and environmental responsibility may be turned into a source or capacity that might serve as a competitive benefit from the standpoint

of a resource-based view (RBV) (Bertrand & Mullainathan, 2003). The Environmental, Social, and Governance (ESG) category, which emphasizes corporate dealings and strategic evolution, has been the focus of new research that takes a more thorough approach to businesses' social and environmental obligations. Although social responsibility is the main focus of CSR, ESG concentrates on a company's operations as well as its strategic expansion; the latter emphasizes social responsibility more. As a further step toward social inclusion of businesses, environmental protection, and corporate governance, determinants of ESG are considered an expansion of CSR. However, since ESG highlights a business's non-financial features, there is conflicting information in the literature about its impact on corporate financial pillars (Biddle, Hilary, & Verdi, 2009).

Research grounded in stakeholder theory has demonstrated that ESG improves investment efficiency by reducing agency conflicts and information asymmetry. According to Branco and Rodrigues (2006), enhancing one's image and lowering reputational hazards (Broadstock, Chan, Cheng, & Wang, 2021). Though former research has exposed that ESG pillars might have a detrimental influence on the financial health of a company or might not result in favorable or unfavorable economic results (Castelló-Taliani, Giralt Escobar, & da Rosa, 2021). However, because of the self-selection-biased estimate, the empirical data currently available in the literature do not consistently reveal an association between ESG and investment efficiency. Consequently, research on how ESG pillars affect investment efficiency may both enhance the body of knowledge on ESG and provide specific theoretical guidance to Chinese companies seeking to increase investment efficiency. This paper's study subject is that investment efficiency will increase with strong ESG pillars, and that the relationship between ESG pillars and investment efficiency is largely mediated by audit quality. Excellent ESG pillars might first minimize agency costs and also effectively control management behavior (Chen, Xie, & Zhang, 2017); second, they can remove financing constraints and make it easier for businesses to get external funding (Cheng, Ioannou, & Serafeim, 2014; Cui, Jo, & Na, 2018).

Thirdly, initiatives for social responsibility may reduce information asymmetry and include stakeholders in business investment choices (El Ghoul, Guedhami, Kwok, & Mishra, 2011), which enhances investment efficiency (Fan & Wong, 2005). Furthermore, this study examines how audit quality affects investment efficiency, opening the door to verifying audit quality's mediating function in the connection between ESG pillars and investment efficiency. High audit quality has been demonstrated to lower corporate profit quality, increase accounting data reliability, and encourage firm investment efficiency (Friede, Busch, & Bassen, 2015; Friedman, 2007). High-quality auditing is often chosen by businesses with strong ESG pillars to eliminate corporate information asymmetry and convey a favorable message to the outside world (Hai, Fang, & Li, 2022). An additional indication of the intermediate role that audit quality plays in the link between investment efficiency and ESG pillars is that the highest audit quality may increase investment efficiency.

Utilizing a sample of A-share listed businesses from China from 2012 to 2023, we perform regressions. The ESG score from the "China Stock Market and Accounting Research" (CSMAR) database, Wind Information, and Bloomberg database are used to gauge ESG pillars.

Our findings demonstrate that company investment efficiency may be enhanced by strong ESG pillars and that the connection between ESG pillars and investment efficiency is mediated by auditing quality. According to the findings, ESG practices support the sustainable growth of Chinese businesses.

The following additions to the body of existing literature are made by this work. Firstly, not many studies consider the three ESG elements together; instead, most existing research focuses on just one, such as social responsibility, corporate governance, or environmental protection. This investigation highlights the overall effect of ESG in enhancing investment efficiency by combining environmental, social, and governance determinants into a single analytical framework to examine how Chinese enterprises' ESG pillars influence investment efficiency. Secondly, rather than prioritizing investment efficiency, a significant portion of current ESG research emphasizes financial aspects and business value.

This research study contributes to existing research by emphasizing the association between investment efficiency and ESG. Additionally, by assessing the mediating role of auditing quality in the relationship between ESG pillars and investment efficiency, this article enhances the body of ESG literature.

This is how the rest of the paper is organized. The analytical theory and study assumptions are presented in Section 2, which also primarily examines the connection between investment efficiency, audit quality, and ESG pillars. In Section 3, a regression model is established, and the variables and data utilized in this investigation are described. The regression findings are reported in Section 4, which is an empirical test. The heterogeneity is examined in Section 5. The significance of this work, its limits, and its future prospects are mostly covered in Section 6.

2. THEORETICAL ANALYSIS AND RESEARCH HYPOTHESIS

2.1. Investment Efficiency and ESG Pillars

According to stakeholder theory, ESG initiatives help businesses acquire strategic resources for growth, win over stakeholders, and increase the effectiveness of investments (Cheng et al., 2014). There are three methods by which ESG pillars increase investment efficiency. ESG practices lower agency expenses, to start. Strong ESG pillars are more prevalent in companies with robust corporate governance frameworks that can efficiently manage managers and reduce agency concerns (Chen et al., 2017). According to Hart (1995), good ESG information reduces agency costs, defends against external pressure, improves investment efficiency, and decreases the negative consequences of media coverage. Organizational investment efficiency is increased by ESG investing and mitigates agency losses by dropping management shortsightedness and reducing corporate free cash flow (Fan & Wong, 2005).

Second, by reducing financial limitations, ESG pillars may increase investment efficiency. Investors get nonfinancial information via ESG disclosure, which also makes external funding easier (Iazzolino, Bruni, Veltri, Morea, & Baldissarro, 2023). The ESG disclosure additionally helps ignorant investors get more knowledge, decreases stock price synchronization, and promotes external oversight and attention (Hai et al., 2022).

Lastly, the market receives a good signal from ESG disclosure. Businesses often invest a certain amount of money to disseminate non-financial information to the public, which may lessen information asymmetry and make it easier for investors to find reputable businesses (Spence, 1973). According to Iatridis (2011), effective ESG pillars lower the asymmetry of information relating to businesses and shareholders and give stakeholders additional information to use when making choices. This lowers investor risk for making decisions and increases investment efficiency. As a result, we propose the subsequent hypothesis. Recent studies (e.g., (Broadstock et al., 2021; Iazzolino et al., 2023; Wang, Li, San, & Gao, 2023) indicate that ESG performance reduces informational frictions, improves investor confidence, and strengthens internal governance systems. However, these studies rarely assess investment efficiency as an outcome, nor do they integrate audit quality as an intervening governance mechanism.

H_1: Investment efficiency and ESG pillars are positively correlated.

2.2. Auditing Quality and Investment Efficiency

There is no correlation between rapid economic expansion, strong capital markets, and high investment efficiency. One of the biggest problems facing Chinese listed companies is inefficient investment, which includes both excessive and insufficient investment (Khurana & Raman, 2004; Lee & Kim, 2020). According to the theory of principal-agent, the excessive managerial power can result in shortsighted behavior, the disregard of the organization's long-term interests, excessive investment, an unjustifiable and uneven distribution of resources, resource waste, and an increase in operating risk (Lins, Servaes, & Tamayo, 2017; Malik, 2015). Conversely, it is simple to generate cautious investment behavior, which leads to inadequate investment, if management authority is too limited by other considerations. Inadequate investment may harm stakeholders' interests and rights, result in inactive resources, and raise an opportunity cost of organization (Matten & Moon, 2008). Improving investment efficiency has emerged as a pressing issue that requires immediate attention (Palazuelos, Crespo, & del Corte, 2018).

Principal and agent issues and knowledge asymmetry are frequently the root cause of low investment efficiency. Transparency of information may be enhanced via excellent quality accounting information (Qin & Song, 2009; Qureshi, Kirkerud, Theresa, & Ahsan, 2020). The standard of accounting data is guaranteed by auditing, which also has significant standard value for concerned parties. Investment efficiency is impacted by auditing quality in triad approaches. First, using the signal mechanism of transmission, auditing may successfully mitigate asymmetry of information, decrease the risk of investors' decisions, and increase investment efficiency (Richardson, 2006; Samet & Jarboui, 2017). Second, financing expenses are decreased by good auditing quality (Cui et al., 2018). According to Stulz (1990) and Sun, Li, Geng, Yang, and Zhang (2020), good auditing quality increases investors' confidence in financial data, reduces information asymmetry, prevents inadequate investment brought on by superior financing costs, and ultimately increases investment efficiency. Third, auditing serves as a supervisory and insurance role (Broadstock et al., 2021). Agreeing to Wang et al. (2023), high auditing quality limits management behavior, increases the effectiveness of allocation of business resources, and prevents unproductive investment.

Excellent auditing successfully addresses investment issues and limits enterprises' inadequate investment (Richardson, 2006). Depending on the kind of stock, auditing quality has a different effect on investment efficiency (Malik, 2015; Zhang, 2017). As a result, we put out the subsequent hypothesis.

H_2: A high level of auditing quality has the capability to increase the investment efficiency of businesses.

2.3. Auditing Quality: The Mediating Influence in the Association among Investment Efficiency and ESG Pillars

Businesses may increase investment efficiency, lessen information asymmetry, and share non-financial information with external parties by revealing ESG data (Iatridis, 2011). Effective steps must be taken to boost stakeholders' confidence in company disclosures. According to Hart (1995) and Zhang, Loh, and Wu (2020), high-quality disclosure may lessen agency issues, increase corporate information openness, and decrease corporate information asymmetry. The accounting information quality is ensured by external audits. The value of ESG disclosure may be ensured by the impartiality and independence of auditing. The growth of ESG has emerged from auditing and monitoring (Biddle et al., 2009). According to auditing requirements, certified public accountants (CPAs) must confirm both nonfinancial and financial data and accurately evaluate the company's capacity for long-term operations. Corporate social responsibility (CSR) disclosures are necessary reference material for auditing risk assessment and must be incorporated into the auditing process as significant nonfinancial information (Hart, 1995).

Accounting companies act as middlemen, certifying ESG reports using auditing standards. The procedure promotes the reliability of ESG and financial information by ensuring the accuracy and validity of reported data. Generally, high-quality accounting firms audit accounting information of better caliber than small firms (Becker, DeFond, Jiambalvo, & Subramanyam, 1998). As a result, companies choose to use high-quality auditing to convey a favorable message to the outside world. These efforts further ease financial limitations, lower agency costs, and increase investment efficiency (Biddle et al., 2009). By detecting accounting quality, high-quality auditing increases investor trust and, therefore, capital allocation efficiency (Zhang et al., 2020). To guarantee the accuracy of accounting information and boost stakeholders' confidence in ESG information, companies with strong ESG pillars are incentivized to use top-tier accounting firms (Biddle & Hilary, 2006). Therefore, we propose the following hypothesis: auditing quality contributes positively to investment efficiency (Stulz, 1990).

Theoretically, ESG practices reduce opacity and create stronger demand for credible reporting. This increases the likelihood of firms engaging higher-quality auditors. High-quality auditors improve the reliability of financial information, which, in turn, enhances investment efficiency by lowering estimation errors and improving capital allocation decisions.

H_3: The connection involving ESG pillars and investment efficiency is mediated by auditing quality.

3. RESEARCH DESIGNS

3.1. Data and Sample

The A-share listed companies in China between 2012 and 2023 serve as the study sample for this analysis. The CSMAR and Wind databases offer more financial information, while the Bloomberg database provides statistics on the ESG pillars. The data are managed as follows: First, the real estate and financial business samples have been removed due to the uniqueness of the banking industry's financial statement computation. Second, samples like ST and *ST are eliminated to reduce the impact of outliers on the results. Third, missing-value samples are removed. There are 100 firms in the final complete sample, which translates to 1,200 firm-year observations. An imbalanced panel (pooled cross-sectional and time series data) is used in this work. To mitigate the influence of outliers, each continuous variable is winsorized at the 1 and 99 percent levels.

3.2. Variables

3.2.1. Dependent Variable

In accordance with Biddle et al. (2009), we gauge businesses' efficient investment level using the residual derived from model investment efficiency (Inv), which is computed following (Biddle et al., 2009) by estimating the expected level of investment based on lagged sales growth:

$$Inv_{i,t} = \alpha_0 + \alpha_1 \text{SalesGrowth}_{i,t-1} + \alpha_2 \text{Controls}_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

The value of the residual term represents the degree of deviation from optimal investment; higher residuals indicate higher efficiency. Investment is the total capital expenditures scaled by lagged property, equipment, and plant at time It+1, while sales growth is calculated as the percentage change in sales from the current year to the previous year. Accordingly, Biddle et al. (2009), the model includes growth opportunities and additional firm-level controls (size and leverage).

This study organized firms based on the magnitude of residual means from predicted investment. If the residual value is positive, it indicates overinvestment; if negative, underinvestment. In this study, 1 was used for overinvestment and 0 for underinvestment.

The residuals from this regression capture deviations from expected investment. Investment efficiency is not the raw investment level itself but is derived from the residuals.

Following Biddle et al. (2009), investment inefficiency is measured as the absolute value of the residual from the expected investment model, reflecting the magnitude of deviation from optimal investment regardless of direction (over- or under-investment). For ease of interpretation, many studies define investment efficiency as the negative of this absolute value, so higher values indicate greater efficiency.

The industry and yearly estimate in Equation 1 is used to determine the suitable value of the optimal investment level for the business and the residual deviation from that level. The remaining amount demonstrates how far the business has deviated from its optimal investment level. As the absolute value of the residual rises, the investment efficiency falls.

3.2.2. Independent Variable

Following the Minutolo, Kristjanpoller, and Stakeley (2019), the researchers gauge ESG pillars through the Bloomberg database's ESG score. The Bloomberg database makes available to investors the degree of CSR reporting, along with the E, G, and S scores of individual indices and the ESG comprehensive index score. The quality and value of ESG disclosure determine the score. Scores range from 0 to 100. An ESG score of a company increases with the amount of information it provides. The ESG scoring methodology, score, and data for score reports for each firm are available to investors.

The following are the justifications for preferring Bloomberg's database. First, ESG rankings on Bloomberg are more objective and are obtained from firm sustainability/CSR reports or other public sources. Second, Bloomberg's ESG statistics are more influential and cover a broader range than other ESG ratings. 3.2.3 Mediating Variables.

Auditing offers by an external firm is a confidence in the veracity of accounting information, and auditing serves a supervisory role. According to Hackenbrack and Hogan (2002), auditing quality is influenced by an accounting firm's size. The Big Four is employed in this research to evaluate the quality of auditing. If a business decides to audit the top four international accounting firms, Big4 = 1, and if not, it equals 0.

3.2.3. Control Variables

Following Bates, Chang, and Chi (2018), we control Return on Asset (ROA), Board size (BSIZ), enterprise's Free cash flow (FCFL), Ownership Concentration (OWC), FIRM AGE (FA), leverage (LEVG), Firm size (FSZ), and Return on Equity (ROE). Table 1 presents the following descriptions for the variables.

Table 1. Variable Explanation.

Category	Variable name	Sign	Implication
Dependent variable	Investment efficiency	Inv	The Biddle model determines the investment efficiency from the residual value.
Independent variable	ESG pillars	ESG	The Bloomberg database/100 is used to generate the ESG pillars score.
Mediating variable	Auditing quality	Big4	Whether a company selects the best four international accounting corporations for audits, Big4 = 1, and if not, it equals 0.
Control variable	Board size	BSIZ	The number of directors is expressed as the natural logarithm.
	Ownership Concentration	OWC	Allocation of ownership interests among a company's shareholders.
	Return on asset	ROA	Net profit divided by total assets.
	Free cash flow of Business.	FCFL	The ratio of free cash flow to total assets.
	Firm size	FSZ	The firm's total assets are expressed as a natural logarithm.
	LEVERAGE	LEVG	The ratio of total assets to total liabilities.
	FIRM AGE	FA	The years a company has been in business, expressed as a natural logarithm.
	Return on equity	ROE	The ratio concerning net profit and total equity.

3.3. Econometric Model

To ensure economic interpretability, ESG scores were divided by 100, board size was transformed using natural logs, and financial ratios were standardized.

The OLS (Ordinary Least Squares) regression model is utilized by the researchers to examine the relationship between audit quality and ESG and IE. To estimate H1 and H2, correspondingly, researchers build fixed effect model-2 and model-3, they are explained as follows:

$$Inv_{i,t} = \alpha + \beta_1 ESG + \beta_2 BSIZ + \beta_3 OWC + \beta_4 ROA + \beta_5 FCFL + \beta_6 FSZ + \beta_7 LEVG + \beta_8 FA + \beta_9 ROE + \varepsilon_{i,t} \quad (2)$$

$$Inv_{i,t} = \alpha + \beta_1 Big4 + \beta_2 BSIZ + \beta_3 OWC + \beta_4 ROA + \beta_5 FCFL + \beta_6 FSZ + \beta_7 LEVG + \beta_8 FA + \beta_9 ROE + \varepsilon_{i,t} \quad (3)$$

To assess H3, we construct (4) and (5) models of fixed effects using the mediation effect test protocol put forward by Baron and Kenny (1986).

$$Big4_{i,t} = \alpha + \beta_1 ESG + \beta_2 BSIZ + \beta_3 OWC + \beta_4 ROA + \beta_5 FCFL + \beta_6 FSZ + \beta_7 LEVG + \beta_8 FA + \beta_9 ROE + \varepsilon_{i,t} \quad (4)$$

$$Inv_{i,t} = \alpha + \beta_1 ESG + \beta_2 Big4 + \beta_3 BSIZ + \beta_4 OWC + \beta_5 ROA + \beta_6 FCFL + \beta_7 FSZ + \beta_8 LEVG + \beta_9 FA + \beta_{10} ROE + \varepsilon_{i,t} \quad (5)$$

The relationship between investment efficiency, ESG, Big4, board independence, board ownership, ROA, ROE, business size, firm age, and leverage is shown in Equations 2–5. The symbol for the error term is ε., the intercept by α, and the coefficient by β. All of our analyses were carried out by Stata 16.

4. RESULTS

4.1. Descriptive Summary

In Table 2, the descriptive statistics are shown. Inv has an average value of 0.373. For ESG, Big4, BSIZ, OC, ROA, FCFL, FSIZ, LEVG, FA, and ROE, the corresponding mean values are 0.059, 0.284, 9.31, 3.687, 0.054, 14.748, 21.534, 0.421, 31.478, and 0.965. Table 2 shows the association among all explanatory factors as well as control variables.

Table 2. Descriptive summary.

Variables	Obs.	Mean	S.D	Min.	Max.
Inv	1200	0.393	0.464	0	1
ESG	1200	0.059	0.179	0	1
Big4	1200	0.284	0.461	0	1
BSIZ	1200	9.31	2.024	1	16
OWC	1200	3.687	0.942	0	11.347
ROA	1200	0.054	0.524	-0.215	0.238
FCFL	1200	14.768	3.656	6.904	24.938
FSIZ	1200	21.534	1.251	19.156	25.958
LEVG	1200	0.421	0.195	0.041	0.812
FA	1200	31.478	18.645	11	87
ROE	1200	0.965	1.072	0 .001	16.177

4.2. Correlation Matrix

To ascertain whether multicollinearity is present, the Pearson Correlation analysis is employed. Since all of the explanatory variables in Table 3 have correlations less than 0.60, multi-collinearity is not an issue.

Table 3. Results of the correlation matrix.

Variables	1	2	3	4	5	6	7	8	9	10	11
Inv	1										
ESG	0.023	1									
Big4	0.014	0.213***	1								
BSIZ	0.063*	-0.065*	0.269**	1							
OWC	0.007	-0.021	0.027	0.060*	1						
ROA	-0.025	0.068**	-0.013	-0.054*	0.342***	1					
FCFL	0.0021	0.062**	-0.048*	-0.051*	-0.024	0.047*	1				
FSIZ	0.052*	0.051*	-0.146***	-0.092**	0.056*	0.131***	0.034	1			
LEVG	0.043*	0.032	0.029	0.002	0.041*	-0.008	-0.052*	-0.076**	1		
FA	0.036*	-0.018	0.013	-0.006	0.096**	0.084**	-0.065*	0.035	0.017	1	
ROE	-0.026	-0.032	-0.013	-0.004	-0.028	-0.135***	-0.085**	-0.051*	0.063*	-0.067*	1

Note: This table reports Pearson correlation coefficients. *, ** and *** denote significance at the 10%, 5%, and 1% levels, respectively.

4.3. Regression Results

Model-1 examines how investment efficiency is affected by ESG pillars. Table 4 column (1) indicates that the ESG coefficient is 0.0270 and significant at the level of 1%. The findings show that ESG pillars may successfully increase investment efficiency, which is consistent with H1. Model (2) examines the connection between investment efficiency and auditing quality. According to Table 4 column (2), the Big4 regression coefficient is 0.0058 and at the level 1% significant, proposing that better auditing of businesses improves the efficiency of investments. H2 is supported by the regression findings. The technique of Baron and Kenny (1986) states that variable M is an intermediate variable if the independent variable X influences it in order to affect the dependent variable Y. The independent variable in this study is ESG pillars (X), the dependent variable is investment efficiency (Y), and the mediating variable is auditing quality (M). We start by determining if Equation 6's coefficient c is significant. The importance of Equation 7 coefficient a and Equation 8 coefficient b is tested in the second phase. An intermediate impact exists if both a and b are economically, a 0.027 increase suggests that firms with higher ESG commitments exhibit more efficient capital allocation, consistent with reduced agency conflicts and improved monitoring.

Table 4. Effect of ESG pillars on investment efficiency.

Variable	Model 1 (Equation 2)	Model 2 (Equation 3)	Model 3 (Equation 4)	Model 4 (Equation 5)
ESG	0.0270***		1.2401***	0.0182**
	(3.289)		(17.7180)	(2.3425)
Big4		0.0058***		0.0049***
		(4.0095)		(3.2361)
BSIZ	11.136***	6.636***	13.854***	5.878***
	(6.26)	(3.64)	(5.21)	(2.65)
OWC	11.485***	7.023***	2.757**	−4.564***
	(5.24)	(3.65)	(−2.16)	(−4.48)
ROA	−2.486*	−4.351***	−2.221	−4.289***
	(−1.92)	(−4.04)	(−1.59)	(−4.12)
FCFL	−1.472*	−0.875**	−1.532*	−1.314**
	(−1.94)	(−2.05)	(−1.76)	(−2.26)
FSIZ	−6.874**	−3.178**	0.347	0.062
	(−2.67)	(−2.56)	(1.481)	(0.35)
LEVG	0.956*	−0.0931	0.973	0.392
	(1.82)	(−0.27)	(1.42)	(0.39)
FA	11.134***	6.656***	11.861***	5.878***
	(6.26)	(3.48)	(5.41)	(2.65)
ROE	12.465***	7.015***	−3.146**	0.385
	(5.84)	(3.87)	(−2.86)	(1.48)
R2	0.1216	0.1123	0.2312	0.1127

Note: *, ** and *** denote significance at the 10%, 5%, and 1% levels, respectively.

The third step is to check for the existence of a full or partial mediating effect. The impact is partially mediated if c' is substantial. The absence of significance for c' indicates a full mediating effect. Table 4 column (3) reveals that the coefficient of ESG is 1.2401 and at the level of 1% significant, suggesting that companies with strong ESG pillars are most likely to use top-notch services of accounting to win over stakeholders. According to Table 4 column (4), the ESG coefficient is 0.0182 and is significant at the 5% level, suggesting that company investment efficiency may be enhanced by strong ESG pillars. High auditing quality may increase investment efficiency, as shown by the Big4 coefficient of 0.0058, and is significant at the level of 1%. In addition to passing the Sobel test, the model's ESG coefficient rose by 25.45%, from 0.0270 to 0.0182. As a result, the association between investment efficiency and ESG pillars is partially mediated by auditing quality. The mediating impact is positive when the auditing quality measure Big4 is added to Model 2, increasing the coefficient of ESG. H3 is supported by the regression findings.

$$Y = a + cX + e1 \quad (6)$$

$$M = aX + e2 \quad (7)$$

$$Yc = c + c'X + bM + e3 \quad (8)$$

4.4. Tests for Robustness

4.4.1. ESG Pillars and Investment Efficiency

First, the independent variable is substituted to perform regression analysis. ESG pillars (ESG-2) utilize the Huazheng ESG rating. Better ESG pillars are indicated by a higher Huazheng ESG rating. ESG pillar ratings are as follows: C for 1, CC for 2, and CCC for 3 and beyond. The Huazheng ESG ratings range from CCC to AAA. The regression findings using ESG-2 are shown in Table 5, column (1). At the 5% level, the ESG-2 coefficient is 0.0004 and positive. The results demonstrate that ESG-2 can also increase investment efficiency, supporting the resilience of H1 based on ESG pillars.

Second, the ESG pillars are straightforwardly measured in this study. Huazheng ESG rating, CCC-AAA, ranges from 1 to 3, in that order. ESG pillars ratings are as follows: A is rated at 3, B at 2, and C at 1. Table 5 column (2) displays the ESG-3 regression findings. The robustness of the regression findings is shown by the ESG-3 coefficient, which is 0.0016 and considerably positive at the 5% level. According to the data, ESG3 can likewise increase investment efficiency, demonstrating that changing independent variables won't affect the conclusion of H1; in other words, our hypothesis is sound.

Third, in order to do regressions, we substitute the dependent variable. In accordance with Richardson (2006), this study uses residuals to calculate the amount of efficiency investment. The amount of investment efficiency decreases as the residual's absolute value increases.

Table 5 regression findings are shown in column (3). At the 1% level, the ESG coefficient is 0.0324, indicating that effective ESG pillars may enhance investment efficiency. The findings show that changing the measurement technique for dependent variables can also lead to the inference that improved ESG pillars increase investment efficiency, supporting the validity of our H1 conclusion.

Table 5. Robust tests.

Variable	(1) Inv	(2) Inv	(3) Inv1
ESG			0.0324*** (3.5239)
ESG-2	0.0004** (2.2131)		
ESG-3		0.0016** (2.6407)	
Control Variable	Controlled	Controlled	Controlled
N	1200	1200	1200
R2	0.0915	0.0918	0.0758

Note: *, ** and *** denote significance at the 10%, 5%, and 1% levels, respectively.

4.4.2. Audit Quality and Investment Efficiency

Regression analysis is first performed with Audit-1, a new independent variable. We add audit quality (Audit-1) using the audit opinion. A value of 0 is given to a nonqualified opinion, and a value of 1 to an unqualified view. According to the regression findings, the Audit-1 results are shown in Table 6, column (1). At the 5% level, Audit-1's coefficient is 0.0034. The findings continue to demonstrate that higher audit quality may increase investment efficiency; in other words, altering the audit quality measuring technique does not influence the decision of hypothesis 2, suggesting that H2 is a sound conclusion.

Second, the natural log of audit charges is used as a stand-in variable for audit quality in this paper's more straightforward approach to measuring audit quality (Audit-2). The quality of the audit increases with its expense.

The outcome of the regression analysis with the Audit-2 is shown in Table 6, column (2). At the 1% level, the Audit-2 coefficient is 0.0032, suggesting that high audit quality may increase investment efficiency. In other words, altering the audit quality measuring technique has no impact on the finding of hypothesis 2, demonstrating the robustness of that conclusion.

Third, this study uses the residual, in accordance with Richardson (2006), to gauge the degree of efficiency investment. The amount of investment efficiency decreases as the residual's absolute value increases. Table 6 regression findings are shown in column 3. At the 5% level, the audit quality coefficient (Big4) is 0.0029 and considerably negative, suggesting that the highest audit quality may increase investment efficiency. The findings indicate that altering the dependent's measuring technique factors, the result remains in line with H2, thus demonstrating H2's legitimacy.

Table 6. Test of robustness.

Variables	(1) Inv	(2) Inv	(3) Inv1
Big4			0.0029** (2.0169)
Audit-1	0.0034** (2.0264)		
Audit-2		0.0032*** (5.6427)	
Control variable	Controlled	Controlled	Controlled
N	1200	1200	1200
R2	0.0862	0.0902	0.0724

Note: *, ** and *** denote significance at the 10%, 5%, and 1% levels, respectively.

4.5. Endogeneity

To counteract the impact of missing data, we first introduce control variables. To address the issue of endogeneity caused by missing data, control variables are added to the model for any unobservable missing factors that could exist and impact the outcome. We include the proportion of independent directors (indep) and ownership concentration (fhold), as they will also influence investment efficiency. Table 7 displays the regression results in column (1). The inclusion of control variables has no effect on the conclusion of H1; that is, the omitted variables have no effect on endogeneity, and our finding remains robust. The coefficient for ESG is 0.0234, which is also substantially significant at the 1% level.

Table 7. Examine endogeneity with an additional control variable.

Variable	(1) Inv
ESG	0.02341*** (4.2598)
Control variable	Controlled
N	1,200
Adjusted R2	0.1243

Note: ***denote significance at the 1% levels, respectively.

Regression analysis is then used to lessen the influence of two-way causation. When doing regressions, we choose to lag the regressor variables by 1, 2, or 3 periods, varying with the situation. The outcomes are presented in Table 8. At the 1% significance level, the one-year lagged ESG coefficient is 0.02451; the two-year lagged ESG coefficient is highly significant at 0.02474; the three-year lagged ESG coefficient is also significant at 0.0236. This demonstrates that effective ESG pillars may enhance investment efficiency; in other words, our conclusion is sound, and endogeneity issues brought on through two-way causality are not present.

Table 8. Endogeneity for hysteretic variables.

Variables	(1) Inv	(2) Inv	(3) Inv1
L1ESG	0.02451*** (4.3473)		
L2ESG		0.02474*** (4.3241)	
L3ESG			0.0236*** (3.0642)
Controlled variable	Control	Control	Control
N	1090	1090	1090
R2	0.0949	0.0822	0.0792

Note: ***p<0.01. The t-statistics are enclosed in parentheses.

Third, we perform regressions using two-stage least squares (2SLS). The mean ESG score of additional companies in the same region is used as an instrumental variable, IV1, following Benlemlih and Bitar (2018). Additionally, we utilize the firm's oldest ESG pillars as the instrumental variable, IV2, since it influences current ESG pillars but is unrelated to the disruption in the current model. For endogenous testing, we conduct 2SLS regressions. Table 9 displays the findings. The F value is much higher than 10, and the coefficients of the instrumental factors IV2 and IV1 in the first-stage regression are significantly positive, indicating that the chosen instrumental variables are valid and that there is no issue of weak instruments. Furthermore, we evaluate the instrumental variables for over-identification. The Sargan test's p-value of 0.2364 exceeds 0.1, suggesting that the two instrumental variables are valid and that the instruments are not endogenous. Our conclusion is robust, as the ESG coefficient in the second-stage regression is 0.0504 and significant at the 1% level, demonstrating that effective ESG pillars can enhance investment efficiency.

Table 9. Results for two-stage least squares regression.

Variables	Stage (I)	Stage (II)
ESG		0.0504*** (6.7026)
IV-1	0.4026*** (11.3731)	
IV-2	0.5645*** (48.432)	0.0249*** (3.3481)
Controlled variable	Controlled	Controlled
Sargan		0.2364
N	1200	1200
R2	0.4964	0.1260

Note: ***p<0.01. The t statistics enclosed in parentheses.

5. CONCLUSION

This study set out to explore whether the environmental, social, and governance pillars contribute to stronger investment efficiency in Chinese A-share listed firms, and whether audit quality acts as a mediating channel in this relationship. Using panel data covering the years 2012 to 2023 and applying fixed-effects regression models, our results consistently support the three proposed hypotheses. Firms with stronger ESG engagement tend to allocate capital more efficiently, suggesting that transparent disclosure, improved governance practices, and stronger relationships with stakeholders create conditions that reduce information asymmetry and managerial discretion. The analysis further shows that audit quality partially mediates this relationship. Firms with higher ESG scores appear more inclined to select reputable auditors, whose oversight enhances the credibility of financial reporting. This improvement in reporting quality further strengthens investment efficiency by reducing estimation errors and improving the flow of reliable information to decision-makers.

The findings advance existing research by examining all three ESG pillars together within a unified framework rather than assessing each dimension separately. The study also adds to the literature by demonstrating how audit quality operates as an internal governance mechanism linking ESG performance with real investment outcomes. Evidence from China's A-share market provides relevant insights for emerging economies where ESG reporting standards and assurance mechanisms continue to evolve, and where firms face distinct institutional pressures.

Despite these contributions, the study is not without limitations. The ESG data rely on secondary ratings, which may not fully capture differences in disclosure accuracy or the depth of firms' sustainability practices. Additionally, the sample focuses solely on Chinese listed firms, which may affect the generalizability of the results to other contexts with different regulatory environments. Future research could examine cross-country comparisons, incorporate alternative ESG rating systems, or investigate moderating variables such as ownership structure, external monitoring, or regulatory reforms. Another useful direction would be to analyze whether assured ESG reports strengthen or weaken the role of audit quality in shaping investment outcomes.

In summary, the study provides evidence that ESG engagement and high-quality auditing jointly support more efficient investment decisions, offering a clearer understanding of how non-financial information and governance mechanisms contribute to sustainable corporate development.

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