

How ESG performance impacts corporate financial performance: a DuPont analysis approach

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International
Journal of Climate
Change Strategies
and Management

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Received 30 July 2024
Revised 29 September 2024
5 November 2024
Accepted 18 November 2024

Abstract

Purpose – This study aims to investigate the impact of environmental, social and governance (ESG) performance on financial capabilities and strategic decision-making within enterprises. It seeks to provide clarity on how fulfilling ESG responsibilities influences financial performance, while examining differential effects across firm types.

Design/methodology/approach – This study analyzes the relationship between ESG performance and financial metrics using data from Chinese listed companies (2013–2022) and DuPont’s analytical framework.

Findings – First, while ESG practices enhance financial stability and market appeal, they also incur additional operating costs. Second, companies tend to increase their investments in innovation and capital expenditure as a result of better ESG performance. While capital expenditure boosts financial performance significantly, innovation investment, though promising, yields uncertain outcomes and has less influence compared to capital expenditure. Furthermore, the financial performance of nonstate-owned and nonpolluting firms is more susceptible to fluctuations in ESG performance.

Research limitations/implications – The findings are context-specific and may not universally apply to all industries and regions. Further research is needed to validate the study’s propositions in diverse economic environments.

Practical implications – Policymakers should consider incentivizing ESG compliance to bolster market competitiveness. Enterprises are advised to optimize internal processes to balance ESG practices with operational efficiency and innovation for sustainable growth.

Originality/value – This paper introduces an innovative use of DuPont analysis in economics to explore how ESG affects financial and operational performance, showing it can boost corporate results and prompt ESG responsibility. It also distinguishes innovation outcomes with “Innovation Investment” and “Capital Expenditure,” offering enhanced investment guidance.

Keywords ESG performance, DuPont analysis, Financial performance, Innovation investment, Capital expenditure

Paper type Research paper

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The authors are grateful for the anonymous reviewers’ comments, which have significantly contributed to the refinement of this study.

Funding: 2023 Annual Humanities and Social Sciences Research Base Projects of Universities in Guizhou Province, China.



International Journal of Climate
Change Strategies and
Management
Vol. 17 No. 2, 2025
pp. 1-24
Emerald Publishing Limited
1756-8692
DOI 10.1108/IJCCSM-07-2024-0125

1. Introduction

Amidst the backdrop of the current economic downturn, the Chinese Government has responded by proposing a series of policy guidelines aimed at revitalizing the economy. As the cornerstone of the market economy, the economic efficiency of enterprises not only affects their own survival and growth but also plays a pivotal role in the country's overall economic prosperity. Therefore, a thorough investigation into the economic efficiency of enterprises is of paramount importance.

Nevertheless, sustainable development remains a pivotal concern in China, where the diminishing demographic dividend and the grave impacts of environmental degradation underscore the necessity for action. It is crucial to examine the positive financial impact that a robust understanding of environmental, social and governance (ESG) can have on corporations, potentially motivating them to voluntarily embrace ESG responsibilities. Such proactive steps can contribute to a more sustainable and improved environment. Assessing the efficacy of corporate incentives aimed at fostering ESG practices is, therefore, not just important, but an urgent priority. Moreover, understanding how these incentives shape corporate involvement and enthusiasm for ESG initiatives is essential for driving meaningful change.

In contemporary society, heightened global awareness of environmental conservation and the escalating demand for sustainable development have shifted public, investor and stakeholder focus toward the ESG performance of enterprises. The concept of ESG has gained prominence, evidenced by the "Report on ESG Actions of Chinese Listed Companies (2022–2023)" indicating that by June 2023, over 30% of A-share listed companies had voluntarily disclosed ESG social responsibility reports – an increase of 22.14% year-on-year ([International Institute of Green Finance, 2023](#)). This trend underscores a growing inclination among companies to publicly disclose their ESG performance alongside annual financial reports, underscoring their commitment to sustainable development and attracting more investors.

ESG is nowadays an important indicator of a company's overall competitiveness, along with financial performance. Companies are progressively moving beyond profit-centric approaches to embrace comprehensive sustainable development, aiming for a harmonious balance of economic efficiency, social responsibility and environmental stewardship. Therefore, studying the correlation between corporate ESG and financial performance is crucial for comprehending nonfinancial information disclosure, guiding corporate decision-making and advancing sustainable social development.

The innovations in this paper can be summarized in several key aspects: First, the innovation in the indicator decomposition method focuses on the ROE indicator, which is of high concern to shareholders, using the DuPont analysis model for disaggregation. This approach, as outlined in Section 3.1, represents the paper's greatest innovation, allowing for a more accurate identification and analysis of the specific factors driving the three core competencies of a company. Second, the choice of sample, as outlined in Section 3.1, is innovative, aiming to provide new evidence for the significantly positive effects of ESG responsibility fulfillment on the profitability of Chinese firms, using a large sample size and an extended timeframe, thus, enabling the observation and analysis of economic trends and patterns. Furthermore, the paper presents an innovative selection of mediating variables, introducing "Innovation Investment" and "Capital Expenditure" as discussed in Section 4.4.1, to explore how firms can achieve improved financial performance through different innovation strategies after deepening their ESG concepts. Finally, by comparing the ESG performances of state-owned (SOEs) versus nonstate-owned enterprises (NSOEs) and polluting (PE) versus nonpolluting enterprises (NPE), as analyzed in Section 4.4.2 this paper provides valuable theoretical insights for the government in formulating targeted ESG strategies tailored to different types of enterprises. These innovations not only enrich the theoretical framework related to ESG but also provide empirical support for policy formulation.

As China continues its pursuit of economic development, questions arise regarding whether ESG presents an opportunity or a burden for Chinese companies. In the field of economics, the application of DuPont analysis remains relatively underexplored. While much of the existing research has focused on how ESG impacts corporate profitability, there has been limited investigation into whether ESG influences a firm's operational efficiency and debt repayment capacity. By incorporating DuPont analysis into the study of ESG, this paper aims to provide empirical evidence that many companies, when constrained by ESG requirements, demonstrate improved performance. This finding underscores the potential benefits of ESG, encouraging firms to take on ESG responsibilities proactively.

2. Literature review and hypothesis

2.1 *Environmental, social and governance performance*

As global environmental issues gain prominence and the concept of sustainable development becomes ingrained in public consciousness, there is an increasing demand for corporations to integrate ESG concept into their business practices, which emphasizes corporate performance in terms of environmental protection, social responsibility and governance (Rau and Yu, 2024; Tsang *et al.*, 2023). Since its formal introduction by the United Nations Environment Programme in 2004, stakeholders – including shareholders, creditors, employees, customers, suppliers, governments and communities – have shifted their focus from mere short-term profitability to evaluating companies based on ESG criteria aligned with sustainable development principles. This comprehensive assessment of non-financial performance enables stakeholders to evaluate multiple facets of a company. This holistic approach not only helps firms navigate global challenges such as climate change and resource depletion more effectively but also presents new investment opportunities for investors (Chen and Xie, 2022; Liu, 2023) and supports better decision-making for managers (Kumar, 2023).

Previous research indicates that the extent to which firms fulfil their ESG responsibilities can reveal various aspects of corporate performance. First, focusing on corporate ESG performance helps determine a firm's potential for sustainable long-term development (Efthymiou *et al.*, 2023). Several studies suggest that companies with strong ESG performance are more likely to make investments – both physical (Zhang *et al.*, 2024) and financial (Gudmundarson and Peters, 2024) – to enhance profitability. Second, ESG assessments uncover potential ESG-related risks that firms may face (Citterio and King, 2023). Environmental compliance, social responsibility fulfilment and adequacy of corporate governance structure are pivotal in assessing a firm's risk management capabilities. ESG standards gauge a firm's impact at societal levels, encompassing aspects like employee welfare (Malhotra and Pachauri, 2023), community engagement (Rau and Yu, 2024) and supply chain management (Helmold, 2023). Furthermore, studies indicate that ESG-focused firms demonstrate higher levels of innovation (Li *et al.*, 2023), cost reduction and efficiency improvements through the development of eco-friendly products, optimization of supply chains and enhancement of energy efficiency, thereby gaining competitive advantages.

2.2 *Environmental, social and governance and financial performance*

2.2.1 *Environmental, social and governance and corporate profitability.* DuPont analysis relies on financial statements, but financial data alone often misses a firm's full picture. ESG, representing nonfinancial performance, addresses this gap and complements financial data, as many scholars argue (Sinha Ray and Goel, 2023).

Several studies have explored the relationship between ESG responsibility and corporate profitability. Research indicates that ESG performance often correlates with profitability, with some studies suggesting a positive relationship (Chen and Xie, 2022; Quintiliani, 2022; Rao *et al.*, 2023). To better understand this relationship, researchers have considered various factors such as time

delays (Sinha Ray and Goel, 2023), geographical regions (Sandberg *et al.*, 2023), industries (Ben Ali and Chouaibi, 2024; Kalia and Aggarwal, 2023), individual companies (Chen *et al.*, 2023) and specific conditions (Velte, 2020). These considerations have led to nuanced findings, with some studies reporting variations in results across different industries (Agarwal *et al.*, 2023).

Given the variability in outcomes influenced by different national and regional contexts (Shin *et al.*, 2023), there remains substantial scope for further research, including perspectives from China. In China, ESG performance is regarded as an important indicator of corporate financial trends, although there are variations in ESG assessment methods (Tian, 2021). The Chinese Government has introduced policies aimed at promoting green industries, sustainable resource management, environmental protection, balanced socio-economic development and public education on sustainability (Jiang *et al.*, 2023). Companies with strong ESG performance in China may be better positioned to align with these policies and benefit from market opportunities, potentially enhancing their competitiveness and contributing to long-term economic growth. Therefore, we propose the following hypothesis:

H1. ESG performance positively affects corporate profitability [return on equity (ROE)].

2.2.2 Environmental, social and governance and other financial performance. Enterprises that demonstrate higher levels of ESG responsibility fulfilment are more inclined to adopt eco-friendly production processes and materials to meet consumer demands for environmental protection, safety and health, thereby enhancing recognition in the product market (Seo, 2023). This leads to increased market share and profitability. Moreover, companies with strong ESG performance typically reduce resource consumption and environmental pollution by adopting cost-effective, eco-friendly materials, which in turn lowers production costs (Saini *et al.*, 2023), creating a beneficial cycle. In addition, strong ESG performance often leads to favorable policies and market opportunities (Tsang *et al.*, 2023), further boosting profitability. Thus, we propose the following hypothesis:

H1a. ESG performance positively impacts commodity profitability [net profit margin (NPM)].

While enhanced ESG performance benefits firms and society, it can sometimes reduce operational agility. Meeting ESG standards often requires significant investments in environmental protection, social initiatives (Xian and Zhang, 2024; Zhang *et al.*, 2024) and governance improvements, which can divert resources from core business activities. ESG implementation may also involve operational changes, such as adjusting production lines, reconfiguring supply chains and training employees (Helmold, 2023). In addition, varying consumer and investor acceptance of eco-friendly products during initial ESG adoption stages (Suryawan *et al.*, 2023) can impact sales and reduce revenue. Hence, we propose the following hypothesis:

H1b. ESG performance has an inverse effect on corporate operating capacity [total asset turnover (TAT)].

Enhanced ESG performance typically requires firms to allocate more resources toward improving environmental standards, enhancing social responsibility and refining corporate governance structures (Zhang *et al.*, 2024). These investments may encompass capital, technology, human resources and other assets, thereby increasing the firm's total assets. Furthermore, improved ESG practices contribute to risk reduction, enhance corporate reputation and attract greater investor interest (Meng *et al.*, 2023). This often facilitates

easier access to capital through equity financing, consequently boosting total owner’s equity. Therefore, we propose the following hypothesis:

H1c. ESG performance positively affects corporate solvency [equity multiplier (EM)].

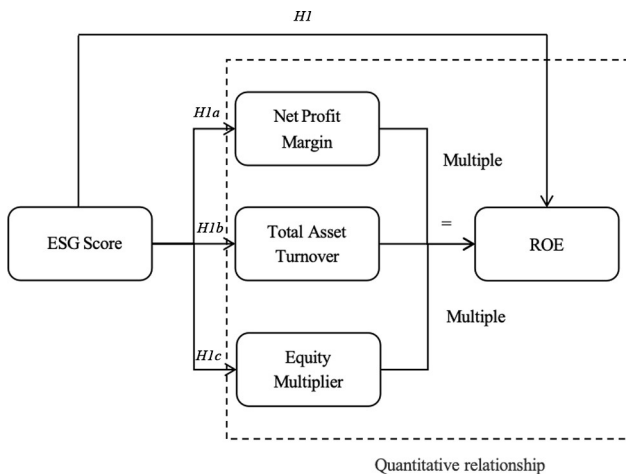
According to the DuPont analysis, *H1*, *H1a*, *H1b* and *H1c* satisfy the relationship shown in Figure 1.

2.3 Mechanism analysis

The application of mediating effects is more common in the field of ESG research. Ben Ali and Chouaibi (2024) show that ESG practices play a mediating role between executive incentive compensation and the financial performance of Islamic and conventional banks. Zhou et al. (2022) further find that ESG performance enhancement of listed firms significantly strengthens the firm’s market capitalization and the company’s financial performance with a significant mediating effect.

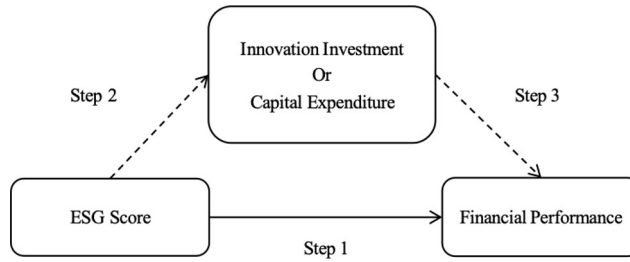
This study first constructs a model of the relationship between ESG performance and financial performance, and adopts Baron and Kenny (1986) three-step approach to test the mediating effect. On this basis, “Innovation Investment” and “Capital Expenditure” are introduced as mediating variables to distinguish the financial performance of enterprises in innovative R&D and direct investment in innovative projects. We assume that there is a discrepancy between the actual investment and the expected results. The mechanism of impact is shown in Figure 2.

2.3.1 Environmental, social and governance, financial performance and innovation investment. The ESG philosophy drives companies toward long-term value creation and sustainability, often prioritizing innovation among high-performing firms (Dai and Zhu, 2024; Gangopadhyay and Homroy, 2023; Hang et al., 2023). However, the outcomes of innovation investments are uncertain, especially for less mature firms, as these investments involve higher risks and may not yield immediate profitability gains (Hussain, 2005).



Source: Authors’ own work

Figure 1. Decomposition of ESG on ROE using DuPont analysis



Source: Authors' own work

Figure 2. The mediating mechanism

Despite this, ongoing R&D, technological advancements and talent development can enhance market competitiveness and impact product profitability (Li *et al.*, 2023). Firms with strong ESG performance, demonstrating high social responsibility and environmental awareness (Cohen and Levinthal, 1990), may invest more in innovation, potentially straining resources in the short term (Duan *et al.*, 2023). In addition, while these firms can improve their reputation and solvency through innovation investments (Zábojník, 2020), reliance on debt financing for innovation may increase solvency risks due to uncertain outcomes (Geelen *et al.*, 2022). In summary, we propose the following hypothesis:

H2. ESG performance can have an impact on financial performance through increased innovation investment.

2.3.2 *Environmental, social and governance, financial performance and capital expenditure.* Driven by ESG principles, firms may increase fixed capital expenditures on environmental protection and R&D, along with investments in intangible assets like patents and software (Xian and Zhang, 2024; Zhang *et al.*, 2024). These investments can boost operational efficiency, innovation and long-term competitiveness, thereby enhancing profitability. However, high-performing ESG firms may shift from asset-light to asset-heavy structures, which can increase operational costs and management challenges (Saif-Alyousfi *et al.*, 2023; Wang, 2024). While prioritizing socially responsible investments often requires substantial capital and may raise debt levels, these investments can improve brand image and market competitiveness over time (Zábojník, 2020). Capital expenditures generally yield more predictable outcomes than innovation investments. Thus, we propose the following hypothesis:

H3. ESG performance can have an impact on financial performance through increased capital expenditure.

3. Research design

3.1 Sample selection and data sources

In this study, Chinese A-share listed companies from the period 2013–2022 are chosen. After excluding firms under “special treatment” or “delisting warning,” and those with significant data gaps, we obtain a well-balanced panel data set comprising 1,301 listed companies. To handle the data set, we applied a 1% winsorization and used linear interpolation to impute minor missing data. Firm-specific data are sourced from the China Stock Market & Accounting Research Database (CSMAR) database, while ESG-related data are gathered from the Sino-Securities Index (SNSI).

3.2 Variable design

3.2.1 Explained variables. In this paper, the explained variables include ROE, NPM, TAT and EM. Within the DuPont analysis framework, ROE signifies enterprise profitability and is decomposed into NPM, TAT and EM (in a purely quantitative relationship) to reflect product profitability, operational efficiency and solvency. Among these, ROE, NPM and TAT serve as positive indicators, while EM is negative.

3.2.2 Explanatory variable. The core explanatory variable of this paper is the average annual ESG score of the firm from SNSI. Globally well-known ESG rating agencies include FTSE Russell, Morgan Stanley Capital International (MSCI), Refinitiv and Standard and Poor's (S&P) Trucost. In China, some of the more influential ESG rating agencies include China Securities Index (SNSI), the Coalition for Social Value Investing (CASVI) and SynTao Green Finance (Yin *et al.*, 2023). As a third-party organization, SNSI has developed an ESG performance framework based on international best practices and taking into account China's national conditions and capital market characteristics. The system categorizes ESG performance into nine grades ranging from "AAA" to "C," with entities rated as "C" scoring one point and those rated as "AAA" entities are given a score of 9. The higher the score, the better the performance of the assessed entity in the index.

3.2.3 Mediating variables. In this paper, there are two mechanism variables: innovation investment and capital expenditure. Innovation investment is quantified by the ratio of the firm's annual R&D expenditure to total assets, while capital expenditure is gauged by the cash outlay for acquiring and constructing fixed assets, intangible assets and other long-term assets (Wang *et al.*, 2024).

3.2.4 Control variables. Since the explanatory variables in this paper encompass extensive financial statement data, the study builds upon prior research by excluding indicators that overlap with DuPont analysis to avoid covariance issues. Ultimately, five control variables are identified:

- (1) The proportion of shares held by the largest shareholder (Top1);
- (2) Firm size (Size), represented by the logarithm of the number of employees;
- (3) Wage level (Wage), quantified by the logarithm of employee salaries;
- (4) Proportion of independent directors (SD), calculated as the ratio of independent directors to total directors; and
- (5) Market influence (AR), assessed by the logarithm of the company's accounts receivable to gauge its market clout.

3.3 Model design

DuPont analysis, a widely recognized financial analysis method, breaks down a firm's ROE into components such as NPM, TAT and EM (Soliman, 2008). This decomposition enables a deeper understanding of profitability drivers, including operational efficiency, competitiveness and capital structure (Bunea *et al.*, 2019). The method is extensively used by managers to make informed decisions across companies of different sizes and sectors (Liesz and Maranville, 2008).

Recent studies have applied DuPont analysis across various industries. Poretti and Heo (2022) showed its effectiveness in the tourism sector, particularly in assessing asset turnover and profit margins during external shocks like COVID-19. Anderson *et al.* (2024) demonstrated that DuPont components enhance future financial performance predictions. In China, Jin *et al.* (2022) found DuPont analysis useful in high-tech industries, revealing how R&D investments mitigate the pandemic's negative impact on ROE and asset turnover.

Although DuPont analysis has made significant strides in financial management, its broader application in economics is still evolving. The economic significance of DuPont's components, especially in emerging markets like China, suggests that it fills an important gap in performance evaluation while contributing to financial decision-making and economic analysis (Wen *et al.*, 2023).

First, the quantitative expression of DuPont analysis is as follows:

$$\begin{aligned} \text{ROE} &= \frac{\text{Net Profit}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Average Total Assets}} \times \frac{\text{Average Total Assets}}{\text{Average Equity}} \\ &= \text{Net Profit Margin} \times \text{Total Asset Turnover} \times \text{Equity Multiplier} \end{aligned}$$

It is evident from the formula that a company's ROE is disaggregated into product profitability (NPM), operational efficiency (TAT) and solvency (EM).

Second, we conduct a linear regression analysis on the well-balanced panel data set:

$$Y_{jit} = \alpha_1 + \alpha_2 \text{ESG}_{it} + \alpha_3 \text{Control}_{it} + \delta_{it} + \varepsilon_{it} \quad (1)$$

where i denotes firms, t denotes year and Y_j ($j = 1,2,3,4$) denote ROE, NPM, TAT and EM, respectively. α_1 is a constant factor. α_2 and α_3 are the slope parameters for the explanatory and control variables, respectively. δ_{it} represents the fixed effects for each cross-section, and ε_{it} is the random error term.

For the two models investigating the mediating mechanism (Ben Ali and Chouaibi, 2024; Zhou *et al.*, 2022), the initial step can be inferred from the above discussion. We first examine the impact of the independent variable on the dependent variable to ascertain the total effect. If this total effect is significant, we then introduce the mediating variable. The subsequent step we establish is as follows:

$$Z_{jit} = \beta_1 + \beta_2 \text{ESG}_{it} + \beta_3 \text{Control}_{it} + \theta_{it} + \mu_{it} \quad (2)$$

We set a third step like this:

$$Y_{jit} = \gamma_1 + \gamma_2 \text{ESG}_{it} + \gamma_3 Z_{jit} + \gamma_4 \text{Control}_{it} + \rho_{it} + \tau_{it} \quad (3)$$

where Z_j ($j = 1,2$) represent innovation investment and capital expenditure, respectively.

Upon incorporating the mediating variable, if the independent variable continues to significantly influence the dependent variable, this indicates the presence of a direct effect. Subsequently, methods such as the Sobel test are used to determine the significance of this effect. The outcomes of mediating analysis are typically categorized into full mediating, partial mediating and no mediating effect.

4. Result analysis

4.1 Descriptive statistics

Table 1 presents descriptive statistics. The maximum ESG performance value is 6.25, highlighting the rarity of firms with exceptionally high ESG ratings. The mean ESG rating is 4.271 with a standard deviation of 0.943, indicating a moderate and concentrated distribution. ROE and NPM average 6.9% and 8.4%, respectively, with highest values of 31.1% and 60.6%, reflecting sector-specific variations. The average TAT is 0.602, indicating low turnover in asset-heavy industries. The mean EM is 2.098, with some firms exhibiting high debt levels (up to 6.894), requiring careful financial management.

Table 1. Descriptive statistics

Variables	Code	Sample size	Mean	SD	Min.	Max.
<i>Explanatory variable</i>						
ESG rating	ESG	13,010	4.271	0.943	1.75	6.25
<i>Explained variables</i>						
Return on equity	ROE	13,010	0.069	0.096	0.386	0.311
Net profit growth rate	NPM	13,010	0.084	0.140	0.546	0.606
Total asset turnover	TAT	13,010	0.602	0.400	0.071	2.327
Equity multiplier	EM	13,010	2.098	1.058	1.069	6.894
<i>Control variables</i>						
Largest holder rate	Top1	13,010	0.343	0.152	0.003	0.900
The enterprise scale	Size	13,010	8.135	1.277	3.689	13.253
Wage	Wage	13,010	19.874	1.335	15.804	25.813
Percentage of sole director	SD	13,010	0.383	0.078	0.188	0.800
Accounts receivable	AR	13,010	17.869	1.998	8.050	26.332

Source: Authors' own work

4.2 Analysis of regression results

The robust Hausman test (Hausman, 1978) results reject the null hypothesis of no significant difference between the coefficient estimates of the fixed effects and random effects models, thus, favoring the fixed effects model. In addition, given the extensive sample size in this research, a unit root test is conducted to assess variable stationarity. The variance inflation factor (VIF) test is also applied, with VIF values falling below 10, indicating that multicollinearity among the model variables is not a significant concern.

4.2.1 Environmental, social and governance and return on equity. When examining model (1) with ROE as the explained variable, the results shown in Table 2 reveal that ESG performance significantly and positively impacts profitability, with consistent coefficients even after accounting for time and fixed effects. This finding corroborates conclusions from the existing literature, albeit over a broader time frame. This supports *H1*, suggesting that

Table 2. ESG And ROE regression results

Variables	(1) ROE	(2) ROE	(3) ROE	(4) ROE
ESG	0.0142*** (15.992)	0.0056*** (3.642)	0.0134*** (15.143)	0.0050*** (3.261)
Top1	0.0744*** (13.646)	0.1297*** (5.837)	0.0603*** (10.904)	0.0992*** (4.397)
Size	0.0073*** (4.384)	0.0143*** (2.710)	0.0019 (1.043)	0.0041 (0.730)
Wage	0.0054*** (3.142)	0.0104** (2.508)	0.0167*** (8.681)	0.0191*** (3.199)
SD	0.0108 (1.034)	0.0170 (1.270)	0.0117 (1.120)	0.0230* (1.712)
AR	0.0057*** (11.064)	0.0017 (1.357)	0.0063*** (12.237)	0.0020 (1.641)
Constant term	0.0853*** (4.214)	0.1145** (2.131)	0.2165*** (9.604)	0.3061*** (3.596)
Time effect	NO	NO	YES	YES
Fixed effect	NO	YES	NO	YES
Sample size	13,010	13,010	13,010	13,010
Adj. R ²	0.067	0.305	0.083	0.317

Notes: The values in parentheses are standard errors. *Significant at the level of 10%; **Significant at the level of 5%; ***Significant at the level of 1%

Source: Authors' own work

higher ESG ratings enhance firms' current profitability, likely due to improved reputation, better management practices, social responsibility and commitment to sustainability. These results underscore the essential role of integrating ESG factors into corporate profitability models, indicating that ESG performance is not merely a cost but a driver of financial performance. Further in-depth analysis is necessary to fully understand the specific mechanisms through which ESG fulfillment influences profitability.

4.2.2 Environmental, social and governance and financial performance. With the aid of DuPont analysis, we decompose ROE into NPM, TAT and EM, integrating them into model (1). The findings shown in Table 3 indicate that ESG responsibility fulfillment significantly impacts product profitability, corporate operating capacity and debt servicing capacity.

Specifically, ESG positively influences product profitability, validating *H1a*. Generally, enhancing ESG ratings signifies a commitment to corporate social and environmental responsibility, which enhances brand image, thereby attracting more consumers and investors. Comparative results highlight that ESG ratings exert a greater influence on product profitability compared to overall corporate profitability. Enterprises' investments in ESG can drive product innovation, foster environmentally sustainable products, establish a differentiated competitive advantage, enhance brand loyalty among consumers and thereby elevate product profitability.

Conversely, there exists an inverse relationship between ESG responsibility fulfillment and corporate operating capacity, validating *H1b*. This may stem from instances where companies, in prioritizing their ESG strategies, disproportionately allocate resources toward improving ESG performance, potentially at the expense of core business operations. For instance, substantial investments in environmental renovations, employee welfare enhancements or adjustments in corporate governance structures can escalate operational costs, divert management attention from market dynamics and hinder business expansion, thereby compromising operational capacity.

Regarding solvency, improvements in ESG responsibility fulfillment correlate with lower EM, signifying enhanced solvency and validating *H1c*. This suggests that firms implementing robust ESG strategies tend to prioritize prudent financial management practices, preferring equity financing or internal accruals over excessive reliance on debt financing. Strengthening ESG initiatives can bolster corporate reputation, enhance stakeholder relations and attract

Table 3. ESG and financial performance regression results

Variables	(1) NPM	(2) TAT	(3) EM
ESG	0.0100*** (4.687)	0.0081** (2.136)	0.0407*** (4.072)
Top1	0.1341*** (4.257)	0.0841 (1.174)	0.0173 (0.090)
Size	0.0070 (0.826)	0.0360** (2.557)	0.1114*** (2.688)
Wage	0.0055 (0.603)	0.1026*** (5.144)	0.1031** (2.188)
SD	0.0141 (0.822)	0.0072 (0.241)	0.0894 (1.023)
AR	0.0034* (1.914)	0.0146*** (4.697)	0.0621*** (6.692)
Constant term	0.0018 (0.013)	0.8162** (2.464)	1.8325** (2.516)
Time effect	YES	YES	YES
Fixed effect	YES	YES	YES
Sample size	13,010	13,010	13,010
Adj. R^2	0.420	0.821	0.803

Notes: The values in parentheses are standard errors. *Significant at the level of 10%; **Significant at the level of 5%; ***Significant at the level of 1%

Source: Authors' own work

favorable financing opportunities from the market, thereby lowering financing costs and further optimizing EM.

4.3 Robust checks

The explained variable is replaced by the equivalent indicators: ROA, which reflects the profitability of the enterprise; the operating margin (OM), which denotes the profitability of the commodity; the current asset turnover (CAT), which represents the operating ability of the enterprise; and the cash ratio (CR), which indicates the solvency of the enterprise. The results maintain a significant correlation, as shown in Columns (1)–(4) of [Table 4](#). Higher CRs represent stronger solvency, which has the same economic meaning as the results above. The explanatory variable is replaced with the firm’s ESG median (ESG_{medium}) for the same year, and the results remain significantly correlated, as shown in Columns (5)–(8) of [Table 4](#). Considering the possibility of mutual causality in the model that may bias the results, the core explanatory and control variables are treated with a lag of one period and the results are still significant, as shown in Columns (1)–(4) of [Table 5](#). A 5% shrinkage treatment is performed, and the results are still significant [see Columns (5)–(8) of [Table 5](#)]. In this paper, we use the market value of firms’ shareholdings in ESG funds as an instrumental variable for ESG performance ([Li and Chen, 2023](#); [Mao and Wang, 2023](#)) and continue to test it with the help of the two-stage least squares (2SLS) method. “Pan-ESG” fund shareholding not only symbolizes a financial investment but also introduces ESG concepts into the company through the mechanism of “voting with one’s feet” and plays an important role in corporate governance, which positively affects a company’s ESG performance. ESG performance has a positive impact, and there is a correlation with the explanatory variables, which is consistent with the result that the regression coefficient is significantly positive in the first stage. The establishment size, portfolio and changes of “Pan-ESG” funds mainly depend on the decisions of fund companies and fund managers and seldom directly interfere with the investment decisions of listed companies, so there is an exogenous correlation with the explanatory variables, which is in line with the requirements of instrumental variables. The first-stage regression coefficient is significantly positive, the second-stage regression coefficient is consistent with the previous section and there is no weak instrumental variable problem. The results are shown in [Table 6](#).

4.4 A Further study

4.4.1 Mechanism analysis

4.4.1.1 Environmental, social and governance, financial performance and innovation investment. The regression results are shown in [Table 7](#), where *H2* is verified. The ESG rating has a positive effect on firms’ innovation investment at the 1% significance level. Moreover, there is no significant correlation between innovation input and ROE when innovation input is used as a mediating mechanism variable. This is most likely due to the uncertainty surrounding the feasibility of the innovation, its market acceptance and its ultimate success ([Hussain, 2005](#); [Tan, 2023](#)). At this moment, innovation investment is not why ESG positively contributes to firms’ profitability. In unison, the increase in innovation investment leads to a significant decrease in NPM, and the regression coefficient of ESG on net sales margin increases, with a suppression effect ([Cheung and Lau, 2008](#)). At this point, we consider that the pro-social nature of ESG is conducive to gaining market recognition, and innovation input, as part of ESG practices, further enhances the market competitiveness of firms through the introduction of new technologies, products or services, thus, increasing the level of ESG’s impact on commodity profitability. However, in contrast to the number of patent applications ([Hang et al., 2023](#)) – often used in studies that focus solely on the outcomes of R&D – there exists an inherent uncertainty surrounding the innovation

Table 4. Robustness check (1)

Variables	(1) ROA	(2) OM	(3) CAT	(4) CR	(5) NPM	(6) EM	(7) ROE	(8) NPM
ESG	0.0029*** (3.699)	0.0146*** (4.151)	0.0461*** (2.740)	0.0895*** (4.109)	0.0041*** (2.980)	0.0082*** (4.259)	0.0060* (1.823)	0.0331*** (3.866)
ESGmedium	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES
Time effect	YES	YES	YES	YES	YES	YES	YES	YES
Fixed effect	YES	YES	YES	YES	YES	YES	YES	YES
Sample size	13,010	13,010	13,010	13,010	13,010	13,010	13,010	13,010
Adj. R ²	0.417	0.390	0.730	0.286	0.317	0.419	0.821	0.802

Notes: The values in parentheses are standard errors. *Significant at the level of 10%, **Significant at the level of 5%, ***Significant at the level of 1%
Source: Authors' own work

Table 5. Robustness check (2)

Variables	(1) ROE	(2) NPM	(3) TAT	(4) EM	(5) ROE	(6) NPM	(7) TAT	(8) EM
L,ESG	0.0039** (2.380)	0.0052** (2.256)	0.0074* (1.869)	0.0231** (2.251)	0.0038*** (3.506)	0.0071*** (5.302)	0.0070** (2.175)	0.0304*** (3.665)
Controls	YES	YES	YES	YES	YES	YES	YES	YES
Time effect	YES	YES	YES	YES	YES	YES	YES	YES
Fixed effect	YES	YES	YES	YES	YES	YES	YES	YES
Sample size	11,709	11,709	11,709	11,709	13,010	13,010	13,010	13,010
Adj. R ²	0.328	0.430	0.832	0.812	0.414	0.543	0.819	0.815

Notes: The values in parentheses are standard errors. *Significant at the level of 10%, **Significant at the level of 5%, ***Significant at the level of 1%
Source: Authors' own work

Table 6. 2SLS regression results

Variables	(1) ESG	(2) ROE	(3) NPM	(4) TAT	(5) EM
ESG	0.0032**** (3.49)	0.1895*** (13.623)	0.2347*** (13.440)	0.0811*** (2.838)	0.8942*** (10.453)
ESGfund	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES
Time effect	YES	YES	YES	YES	YES
Fixed effect	YES	YES	YES	YES	YES
Sample size	13,010	13,010	13,010	13,010	13,010
Underidentification test	16.957				
	[0.0000]				
Weak identification test	17.010				
	{16.38}				

Notes: ***Underidentification test uses Kleibergen-Paap rk LM statistic. The datum in [] is the P value. The weak identification test uses the Kleibergen-Paap rk Wald F statistic, and the datum in {} reflects critical values at the 10% significance level in the Stock-Yogo weak ID test critical values. The values in parentheses are standard errors. *Significant at the level of 10%; **Significant at the level of 5%; ***Significant at the level of 1%

Source: Authors' own work

Table 7. ESG, financial performance and innovation investment

Variables	(1) Innovation investment	(2) ROE	(3) ROE	(4) NPM	(5) NPM	(6) TAT	(7) TAT	(8) EM	(9) EM
ESG	0.0004*** (2.670)	0.0050*** (3.261)	0.0049*** (3.187)	0.0100*** (4.687)	0.0102*** (4.755)	0.0081** (2.136)	0.0097*** (2.582)	0.0407*** (4.072)	0.0387*** (3.883)
Innovation investment			0.1977 (1.082)		0.5169** (2.066)		3.5873*** (5.778)		4.6814*** (4.768)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
Fixed effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
Sample size	13,010	13,010	13,010	13,010	13,010	13,010	13,010	13,010	13,010
Adj. R ²	0.875	0.317	0.318	0.420	0.420	0.821	0.826	0.803	0.804
Sobel test		0.000** (1.865)	0.000*** (2.804)			0.002*** (3.730)	0.002*** (3.478)		

Notes: The values in parentheses are standard errors. *Significant at the level of 10%; **Significant at the level of 5%; ***Significant at the level of 1%
Source: Authors' own work

investments examined in this paper. This uncertainty may potentially diminish the profitability of products to a certain degree, thereby prompting firms to engage in more strategic contemplation regarding their investment decisions.

While this may not directly affect the profitability of enterprises, it can improve the level of ESG's influence on commodity profitability to some extent. However, there is a certain amount of risk in innovation investment, making it not the best choice for noninnovation mature enterprises. When innovation input is a mediating variable, the regression coefficient of ESG rating on TAT decreases, indicating a partial mediating effect. While successful innovation can boost productivity and operating capacity, unsuccessful innovation may negatively impact operations due to high resource demands, which is aligned with the findings from [Duan et al. \(2023\)](#). In addition, the influence of ESG performance on firms' solvency lessens with innovation input as a mediator. Although ESG pressures drive innovation investments, the uncertainty of outcomes can worsen market disillusionment, potentially leading to reduced solvency. This is also a support for findings from [Geelen et al. \(2022\)](#).

4.4.1.2 Environmental, social and governance, financial performance and capital expenditure. The results in [Table 8](#) validate *H3*. ESG ratings positively promote capital expenditure at the 1% significance level, which is consistent with the research by [Xian and Zhang \(2024\)](#) and [Zhang et al. \(2024\)](#). This possibly because firms accelerate their investment in ESG-related areas, such as environmental technology, employee welfare and social good, to maintain a positive external image of their fulfillment of ESG responsibilities and to send positive signals to their stakeholders that they are doing well.

After including capital expenditure as a mediating variable, we find that ESG performance still maintains a significant effect on ROE, NPM, TAT and EM, and the signs of these effects remain the same when capital expenditure is not included. In addition, capital expenditure itself also has a significant impact on these financial metrics.

Profitability may be due to the fact that ESG contributes to the formation of a firm's core competencies, which, in turn, improves the return on industrial capital expenditure, thus, positively affecting the firm's industrial capital expenditure ([Wang et al., 2024](#)). For operating capacity, this indicates that firms are motivated to invest in ESG-related areas to enhance their reputation and brand image ([Zhang et al., 2024](#)), which lays the foundation for sustainable development of the firms but, to a certain extent, increases the total amount of assets of the firms, resulting in a decrease in the operating capacity of the firms. Regarding solvency, capital expenditure, as an investment with the certainty of outcome, such as the direct purchase of clean fixed assets or green patents, can bring a direct reputation to the enterprise, attract more bond investment and alleviate financing constraints.

4.4.2 Heterogeneity analysis

4.4.2.1 Shareholding heterogeneity. The varying nature of shareholding can lead to differences in firms' ESG practices ([Zhou et al., 2022](#)), influencing their decision-making mechanisms and incentives. To provide a comprehensive understanding of how equity nature affects ESG performance, we examine equity heterogeneity. The regression results, presented in [Table 9](#), exclude firms with ambiguous equity structures.

SOEs in China benefit from operational stability due to their close government ties and unique market position, making them less vulnerable to fluctuations. This stability is essential as the government grapples with challenges like income disparities and limited energy access for millions. Although climate policies are tightening, findings from [Clark et al. \(2023\)](#) indicate that some enterprises continue to construct new coal-fired power plants, reflecting the complexity of balancing economic growth, social progress and CO₂ emission reductions. Consequently, market-based policies alone are insufficient for these multifaceted goals ([Lv](#)

Table 8. ESG, financial performance and capital expenditure

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Capital expenditure	ROE	ROE	NPM	NPM	TAT	TAT	EM	EM
ESG	0.0822*** (5.797)	0.0050*** (3.261)	0.0042*** (2.713)	0.0100*** (4.687)	0.0086*** (4.028)	0.0081** (2.136)	0.0063* (1.665)	0.0407*** (-4.072)	0.0390*** (-3.970)
Capital expenditure			0.0104*** (7.205)		0.0170*** (7.563)		0.0225*** (5.954)		0.0205* (1.663)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
Fixed effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
Sample size	13,010	13,010	13,010	13,010	13,010	13,010	13,010	13,010	13,010
Adj. R ²	0.830	0.317	0.324	0.420	0.428	0.921	0.923	0.803	0.803
Sobel test		0.001*** (6.126)	0.001*** (6.473)	0.002*** (6.152)	0.002*** (3.206)				

Notes: The values in parentheses are standard errors. *Significant at the level of 10%; **Significant at the level of 5%; ***Significant at the level of 1%
Source: Authors' own work

Table 9. Results of shareholding heterogeneity

Variables	State-owned enterprises (SOEs)			Nonstate-owned enterprises (NSOEs)			
	ROE	NPM	TAT	ROE	NPM	TAT	EM
ESG	0.0011 (0.499)	0.0011 (0.401)	0.0024 (0.404)	0.0360** (2.040)	0.0136*** (4.371)	0.0119** (2.339)	0.0304** (2.560)
Controls	YES	YES	YES	YES	YES	YES	YES
Time effects	YES	YES	YES	YES	YES	YES	YES
Fixed effects	YES	YES	YES	YES	YES	YES	YES
Sample size	5,803	5,803	5,803	6,709	6,709	6,709	6,709
Adj. R ²	0.369	0.591	0.848	0.331	0.331	0.799	0.764

Notes: The values in parentheses are standard errors. *Significant at the level of 10%; **Significant at the level of 5%; ***Significant at the level of 1%
Source: Authors' own work

et al., 2024). To address this, integrating ESG standards into SOE operations can enhance their appeal to investors while encouraging investments in green projects. While the immediate profitability of ESG practices may be limited, their alignment with national objectives supports debt reduction and improves solvency by demonstrating stable, sustainable growth. Thus, SOEs are crucial in fostering both economic and social advancements.

4.4.2.2 Industry heterogeneity. According to the industry to which the sample enterprises belong, the sample is classified into PEs and NPEs based on the “Listed Company Environmental Verification Industry Classification and Management Directory” [1]. From the results shown in Table 10, it can be seen that NPE is more susceptible to ESG performance, which is the same as the results obtained by Shangguan *et al.* (2024). Based on the theory of resource conservation, once a company reaches a certain resource threshold, it tends to avoid activities that deplete resources (Grant, 1991). This is particularly relevant in the context of ESG compliance, where costs and benefits vary by industry. NPEs can use resources more efficiently because they do not incur additional pollution management costs, making the initial impact of ESG compliance more pronounced for them. In the eyes of the public and investors, NPEs do not use direct environmental pollution issues as excuses; fulfilling ESG responsibilities enhances their long-term value creation. Conversely, poor ESG performance can lead to public and investor criticism, negatively affecting reputation and market position. By focusing on ESG, NPEs can establish effective internal management and risk control systems, enabling them to identify and address potential risks promptly, thus, ensuring long-term, stable development.

5. Research conclusions and policy recommendations

In today’s volatile economy, ESG responsibility significantly influences enterprise management decisions and financial evaluations. Our study reveals that companies actively fulfilling ESG responsibilities see improvements in profitability, solvency and commodity profitability, though their operational capacity may decline. This finding supports the theory that while ESG practices enhance financial stability and market appeal, they also incur additional operating costs. Governments should, thus, promote active ESG engagement through policies that balance ESG responsibilities with operational efficiency, focusing on optimizing internal management to foster sustainable development.

The stakeholder theory emphasizes that companies should consider not only shareholder interests but also the needs of various stakeholders when making decisions, particularly regarding R&D investments aimed at innovation. While Cabaleiro-Cerviño and Mendi (2024) points out that ESG-driven firms are hypothesized to outperform their non-ESG counterparts in future innovation outcomes, labor productivity, export capacity and survival rates, the uncertainty surrounding innovation, which may change decisions of managers (Hussain, 2005), can lead to fluctuating investment levels. Enhanced ESG performance encourages investment in innovation, yet its impact on operational capacity, solvency and product profitability is limited, with no significant effect on overall profitability. In contrast, acquiring mature technologies or green assets can boost profitability. To mitigate innovation risks, government policies should include risk-sharing mechanisms, low-interest loans and tax incentives, while strengthening intellectual property protection and offering enterprise training to improve innovation outcomes and asset management, ensuring a balanced approach to stakeholder expectations and sustainable innovation.

In addition, NSOEs and NPEs are more sensitive to ESG performance compared to SOEs and PEs, which are influenced more by institutional factors. This observation supports the theory that institutional and ownership structures affect the integration of ESG performance into business strategies. The 2018 “Guidelines on Environmental, Social, and Governance Information Disclosure for Listed Companies” encourage, but do not mandate, ESG disclosures, while the

Table 10. Result of industry heterogeneity

Variables	Polluting enterprises (PEs)			Nonpolluting enterprises (NPEs)		
	ROE	NPM	TAI	ROE	NPM	TAI
ESG	0.0002 (0.065)	0.0053* (1.685)	0.0073 (1.041)	0.0083*** (4.332)	0.0132*** (4.818)	0.0080* (1.812)
Controls	YES	YES	YES	YES	YES	YES
Time effects	YES	YES	YES	YES	YES	YES
Fixed effects	YES	YES	YES	YES	YES	YES
Sample size	4,020	4,020	4,020	8,990	8,990	8,990
Adj. R ²	0.305	0.448	0.790	0.345	0.429	0.843

Notes: The values in parentheses are standard errors. *Significant at the level of 10%; **Significant at the level of 5%; ***Significant at the level of 1%
Source: Authors' own work

“Green Finance Guidelines” advocate for incorporating environmental and social risks into investment decisions but lack stringent enforcement. Given the vast size of China’s market and the number of nonlisted companies, these voluntary guidelines have limited impact. The government should adopt a more rigorous approach to ESG reporting, ensuring accuracy and completeness for all companies, especially SOEs. Effective policy guidance and oversight are essential to ensure that SOEs and other major players fully integrate ESG factors into their operations, setting a strong example for the broader business community.

Note

1. Based on the “Listed Company Environmental Verification Industry Classification and Management Directory,” B06-B09, C17, C19, C22, C25-C28, C30-C33, and D44 are classified as polluting industries.

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Further reading

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