# THE NON-LINEAR RELATIONSHIP BETWEEN ESG AND FINANCIAL PERFORMANCE: EVIDENCE FROM CHINA

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**Abstract**

This study aims to investigate the linear and nonlinear relationship between environmental, social, and governance (ESG) factors and corporate financial performance (CFP) among 151 Chinese A-share listed firms over the period 2018–2024. Using both static and dynamic panel data regression models (GMM), along with U-tests, the results indicate that ESG has a significant negative effect on accounting-based performance (ROA), suggesting that increased ESG engagement may impose short-term costs that reduce profitability. Furthermore, a significant inverted U-shaped relationship is identified between ESG and market-based performance (Tobin's Q), consistent with the "Too-Much-of-a-Good-Thing" (TMGT) effect, whereby moderate ESG engagement enhances financial performance, while excessive investment leads to diminishing returns. Additional analysis reveals that the social dimension of ESG exhibits the strongest inverted U-shaped effect on firm performance among the three components. Overall, these findings suggest that the ESG–CFP relationship is complex, context-dependent, and not uniformly positive, thereby enriching the ESG–CFP literature and offering practical implications for managers and policymakers.

**Keywords**: ESG, financial performance, non-linear, Chinese stock market

## 1. Introduction

In recent years, escalating challenges such as global warming, biodiversity loss, environmental degradation, and socio-economic inequality have placed substantial pressure on the international community (Giannopoulos et al., 2022). These environmental and societal challenges, compounded by the global financial crisis and global health emergencies such as pandemics, have prompted governments, investors, and international institutions to adopt more proactive and coordinated responses aimed at fostering sustainable development. Consequently, greener economic models and sustainable business practices have been increasingly advocated to mitigate systemic risks (Saini et al., 2022).

Within this evolving landscape, sustainability has shifted from a peripheral concern to a central component of corporate strategy across industries (Cardillo and Basso, 2025). Corporate Social Responsibility (CSR) has gained prominence as an effective mechanism for addressing financial, social, and environmental challenges, while aligning corporate objectives with broader sustainable development goals (Hasan et al., 2022). CSR emphasizes the ethical and social obligations of firms, including environmental stewardship, philanthropy, and employee welfare.

Building upon the foundations of CSR, Environmental, Social, and Governance (ESG) practices have evolved into a more standardized and quantifiable framework that enables firms to operationalize sustainability within corporate governance and reporting structures (Kaźmierczak, 2022). ESG disclosure frameworks promote the reporting of non-financial performance, thereby enhancing transparency, strengthening stakeholder trust, and supporting long-term competitiveness (Sanchez García, 2018; Ellili, 2022). Regulatory developments, such as the Corporate Sustainability Reporting Directive (CSRD), together with growing investor demand for ethical and responsible business conduct, have further accelerated the adoption of ESG practices. For many firms, ESG initiatives not only facilitate regulatory compliance and enhance reputational capital, but also contribute to improved financial performance and resilience in increasingly volatile global markets (Bashir et al., 2022; Khan et al., 2024). Accordingly, ESG is increasingly perceived not as a symbolic gesture, but as a strategic imperative embedded in corporate governance and investment decision-making processes.

As sustainability continues to reshape business paradigms, firms that integrate ESG into their strategic frameworks are more likely to achieve operational efficiencies, foster innovation, and generate sustainable value (Saini et al., 2022). This raises a critical question: does the adoption of ESG practices systematically influence corporate financial performance

(CFP)? While ESG is often associated with enhanced financial outcomes, including improved profitability, risk management, and value creation, the extent to which these benefits materialize remains subject to debate. Scholars have increasingly questioned whether such outcomes are universal or contingent upon contextual factors (Kaiser and Welters, 2019). Consequently, the relationship between ESG and CFP has attracted significant attention from researchers and policymakers alike (Saini et al., 2022).

Despite the growing body of literature, empirical findings on the ESG–CFP nexus remain inconclusive. A number of studies report a positive association, suggesting that ESG engagement enhances financial performance (Peiris and Evans, 2010; Al-Najjar and Anfimiadou, 2021; Xu et al., 2015; Cornett et al., 2016; Onuoha and Nkwor, 2021). In contrast, other studies document a negative relationship (Brammer et al., 2006; Lee et al., 2009; Boso et al., 2017), while some find no statistically significant effect (Friede et al., 2015; Platonova et al., 2018; Shakil et al., 2019). This divergence can largely be attributed to heterogeneity in ESG measurement, differences in methodological approaches, and variations in institutional and economic contexts. In particular, developed markets tend to exhibit stronger sustainability frameworks and regulatory enforcement, whereas emerging markets often prioritize short-term economic growth, potentially contributing to inconsistent empirical outcomes. Furthermore, the lack of standardized ESG reporting mechanisms and the limited availability of high-quality data across regions complicate efforts to draw definitive conclusions (Wang et al., 2016; Gillan et al., 2021).

Given the mixed empirical evidence, the nature and magnitude of the ESG–CFP relationship remain unclear, underscoring the need for further rigorous investigation. While prior studies offer valuable insights, additional research is required to develop a more nuanced and context-sensitive understanding of how ESG practices influence financial performance. This is particularly relevant in emerging markets, where institutional environments, governance structures, and sustainability practices differ markedly from those in developed economies. Existing evidence suggests that findings from developed markets cannot be readily generalized to emerging economies due to differences in ESG maturity, regulatory quality, and corporate behavior (Cuervo-Cazurra, 2016; Ruan and Liu, 2021; Sharma and Sathish, 2022).

Against this backdrop, examining the ESG–CFP relationship in emerging economies becomes especially important. China, as the world's largest developing economy, provides a compelling context for such analysis. Despite its remarkable economic growth over the past four decades, China faces pressing challenges related to climate change mitigation (Deng et

al., 2022) and the strengthening of corporate governance and social responsibility (Li et al., 2022). With increasing regulatory support and market awareness, Chinese firms are progressively integrating ESG considerations into their operations. This makes China an appropriate and timely setting to investigate how ESG performance influences corporate financial outcomes within a transitioning economic and institutional environment.

Despite the rapid expansion of the literature, the relationship between ESG and CFP remains insufficiently understood. Three key gaps persist. First, the dominant empirical approach assumes linearity, thereby neglecting the possibility that ESG engagement may generate diminishing or even negative marginal returns at higher levels, as suggested by the "Too-Much-of-a-Good-Thing" perspective. Second, existing evidence relies predominantly on data from developed markets, raising concerns about external validity in emerging economies characterized by weaker institutions, lower ESG maturity, and distinct stakeholder pressures. Third, prior studies often treat ESG as a composite construct, overlooking the potentially heterogeneous effects of its environmental, social, and governance dimensions.

This study addresses these gaps by examining both the linear and nonlinear ESG–CFP relationship in the context of China. Using a panel of Chinese A-share listed firms over the period 2018–2024, it makes three contributions. First, it explicitly models nonlinear effects, providing novel evidence on the presence of an inverted U-shaped relationship between ESG and firm performance. Second, it extends the empirical literature with recent data, capturing the evolving regulatory and market dynamics surrounding ESG in emerging markets. Third, it disaggregates ESG into its constituent pillars, offering new insights into their differential impacts on financial performance. Collectively, these contributions advance a more nuanced and context-contingent understanding of the ESG–CFP nexus.

## 2. Literature Review

Drawing on the above theoretical foundations, the relationship between ESG and CFP remains empirically inconclusive. While some studies document a positive association, attributing it to enhanced legitimacy and stronger stakeholder trust, others report neutral or even negative effects, often highlighting resource allocation trade-offs. In addition, a growing strand of the literature examines the possibility of nonlinear relationships between ESG and CFP, identifying U-shaped or inverted U-shaped patterns (Sun et al., 2019). To reconcile these divergent findings, the following section classifies the existing literature into four categories: positive, negative, neutral, and nonlinear relationships between ESG and CFP.

### 2.1 Positive relationship between ESG and CFP

Several studies have documented a positive relationship between ESG practices and corporate financial performance (CFP). McWilliams and Siegel (2001) argued that ESG provides intrinsic value and competitive advantage, thereby enhancing CFP. Lo and Sheu (2007), using S&P 500 firms from 1999 to 2002, found that corporate sustainability, measured via inclusion in the Dow Jones Sustainability Index, positively affects market value (Tobin's Q), particularly for firms with high sales growth. Aggregating over 2,000 studies from 1970 to 2014, Friede et al. (2015) reported that the vast majority indicate a positive ESG–CFP link, especially in European markets.

Evidence from emerging markets is consistent. Chelawat and Trivedi (2016), using data from 93 Indian Nifty 100 firms (2008–2013), found that superior ESG performance improved both accounting-based (ROCE) and market-based (Tobin's Q) metrics. Lee et al. (2016) reported higher ROA and ROE for Korean firms with strong environmental responsibility. Brooks and Oikonomou (2018) highlighted that ESG or CSR reporting enhances financial outcomes, particularly under higher environmental risk.

More recent empirical studies reinforce these findings. Alareeni and Hamdan (2020), analyzing 4,869 observations from 505 U.S. firms (2009–2018), demonstrated that higher ESG disclosure positively impacts ROA, ROE, and Tobin's Q. Rodriguez-Fernandez (2020) showed that CSR activities significantly improve CFP for 107 Spanish firms, especially under strong governance structures. Saha et al. (2020) concluded from 114 papers that effective ESG practices enhance firm performance. Mohammad and Wasiuzzaman (2021) confirmed positive effects of ESG disclosure on market and accounting-based performance in 661 Malaysian firms (2012–2017). Qureshi et al. (2021) reported that environmental ESG performance significantly improves market-based outcomes in U.S. firms, while Kumar and Firoz (2022) found a pronounced effect of environmental and governance factors on ROCE and ROA in Indian firms.

Global evidence also supports this link. Chen et al. (2023) found that ESG ratings significantly influence performance in 3,332 large firms worldwide (2011–2020). Homayoun et al. (2023), using UK firms (2006–2017), and Vargas-Santander et al. (2023), with 3,651 global firms (2005–2018), similarly reported positive ESG–CFP relationships. In Asia, Chung et al. (2024) showed that mandatory ESG reporting, particularly social disclosure, enhances CFP in 109 Hong Kong firms. Dasilas and Karanović (2025) confirmed a positive impact of ESG disclosure on market performance in 49 U.S. energy and raw materials firms (2011–2021).

Collectively, these studies provide robust evidence that ESG engagement can improve both accounting-based and market-based financial performance across diverse institutional and geographic contexts.

### 2.2 Negative relationship between ESG and CFP

Despite the predominance of studies reporting non-negative ESG–CFP associations, a substantial body of research highlights potential negative effects. These findings suggest that resources devoted to ESG activities may not generate immediate financial benefits and can, in some cases, impose short-term costs that undermine firm performance.

From a theoretical perspective, Branco and Rodrigues (2008) argued that ESG investments could reduce financial performance. Empirical evidence supports this view. Mittal et al. (2008), using data from 50 S&P CNX Nifty firms (2001–2005), found that CSR engagement negatively affected economic value added (EVA) in specific years, indicating potential short-term impairments to firm value. Barnea and Rubin (2010) suggested that ESG engagement can deplete available investment funds, thereby constraining financial performance. Galant and Cadez (2017) further showed that ESG activities increase operational costs, reduce cash flow, and erode competitive advantage. Bing and Li (2019) found a negative association between ESG scores and Tobin's Q for Chinese listed firms (2010–2017).

Evidence from emerging markets and specific sectors is consistent. Duque-Grisales and Aguilera-Caracuel (2021) reported a significant negative ESG–CFP relationship for 104 Latin American multinationals (2011–2015), moderated by financial slack and geographic diversification. Fahad and Busru (2021) observed that higher CSR disclosure, particularly in environmental and social dimensions, reduced profitability and firm value in 386 Indian BSE 500 firms (2007–2016). Ruan and Liu (2021), analyzing A-share listed firms (2015–2019), found that ESG activities negatively affected Tobin's Q, especially in non-state-owned and environmentally sensitive firms. Behl et al. (2022) demonstrated negative short-term effects of both aggregate ESG scores and sub-dimensions in 62 Indian energy companies (2016–2019). Hasan et al. (2022) observed that higher CSR scores were associated with lower ROA and Tobin's Q in Indian healthcare, energy, and utility firms (2014–2019). Saygili et al. (2022) found that environmental disclosures adversely affected CFP in Turkish listed companies (2007–2017). Makridou et al. (2024) reported that improved ESG performance reduced profitability (ROA) in 85 European energy firms (1995–2020), with environmental responsibility exerting the strongest negative effect. More recently, Singh et al. (2025)

documented negative relationships between ESG scores and both Tobin's Q and ROA in 112 Indian firms (2016–2020).

Collectively, these studies highlight that ESG engagement can entail short-term costs and potentially reduce financial performance, particularly in resource-intensive industries, emerging markets, and firms with limited financial slack.

### 2.3 Neural relationship between ESG and CFP

A neutral relationship between ESG performance and CFP is also frequently observed, suggesting that enhanced ESG practices do not necessarily translate into improved financial outcomes. McWilliams and Siegel (2000), using data from 524 firms in the KLD and Compustat databases (1991–1996), found that corporate social performance (CSP) had no statistically significant effect on profitability. Similarly, Garcia-Castro et al. (2010) reported a neutral relationship across multiple financial indicators, including ROE, ROA, and Tobin's Q, using 658 firms from KLD (1991–2005). Garcia et al. (2017) examined 365 BRICS firms (2010–2012) and found no significant association between ESG performance and CFP. Landi and Sciarelli (2019), analyzing Italian listed firms (2007–2015), found ESG assessments did not significantly influence abnormal stock returns.

Further evidence from large-scale and sector-specific samples supports these findings. Cek and Eyupoglu (2020) reported an indistinct effect of ESG on economic performance in U.S. S&P 500 firms. La Torre et al. (2021) found no clear causal relationship between ESG and either ROA or ROE among European banks (2008–2019). Baran et al. (2022) observed no meaningful correlation between ESG scores and financial performance in the Polish energy sector (2010–2019). Zhou et al. (2023), employing a GMM-PVAR approach with Chinese A-share firms (2011–2020), also found that ESG performance had no statistically significant effect on CFP.

Collectively, these studies indicate that, in certain contexts, ESG engagement may neither enhance nor impair financial performance, highlighting the complexity and context-dependency of the ESG–CFP nexus.

### 2.4 Non-linear relationships between ESG and CFP

Apart from the linear relationship between ESG and CFP, there is also a complex, often nonlinear structure. Schröder (2014) noted that approximately 25% of previous studies reported mixed results regarding the relationship between ESG and CFP. This strand of literature maintains that ESG may exert both beneficial and adverse effects on CFP

simultaneously, depending on contextual factors and implementation dynamics (Wang et al., 2008).

In the initial phase of ESG implementation, firms may experience a CFP due to the costs associated with ESG initiatives. However, as the level of corporate social responsibility increases, firms can enhance their long-term value and gain a competitive advantage in the eyes of shareholders. This dynamic gives rise to a U-shaped relationship between ESG performance and CFP (Chen et al., 2018; Trumpp and Guenther, 2017). Empirical evidence supports this nonlinear relationship. For instance, Nollet et al. (2016) revealed that accounting-based CFP initially declines with increasing CSR performance but improves after a certain threshold, thereby supporting the existence of a U-shaped CSR–CFP relationship. Their analysis used data from S&P 500 firms between 2007 and 2011. Similarly, Barnett and Salomon (2012) examined 1,214 U.S.-listed firms between 1998 and 2006 and reported a significant U-shaped relationship between corporate social performance (CSP) and CFP, with the lowest point of CFP occurring when the ESG score was approximately 12. This pattern indicated that firms with low and high levels of CSP tend to achieve better financial performance than those with moderate CSP levels.

In contrast, ESG practices may initially contribute to improved financial performance, but their marginal benefits tend to diminish beyond a certain threshold. Once ESG engagement surpasses this inflection point, shareholders may perceive it as excessive or overly costly, reducing its attractiveness. Additionally, the escalating costs associated with intensive ESG activities can outweigh their benefits, resulting in an inverted U-shaped relationship between ESG performance and CFP (Zhang and Guo, 2018; Sun et al., 2019). Several studies provide empirical support for this inverted U-shaped pattern. El Khoury et al. (2023) examined 46 banks from MENAT countries and found that ESG engagement contributes positively to financial performance at lower levels but imposes financial burdens once a certain threshold is exceeded, with the turning point of the curve occurring at an average ESG score of 39.42. Chen et al. (2025), using ESG data extracted from annual reports of Chinese listed companies between 2014 and 2023 and applying the Elaboration Likelihood Model, also found a pronounced inverted U-shaped nonlinear relationship between ESG performance and CFP. Their results further indicated that this effect is more significant among firms with lower R&D investment intensity.

Overall, these findings highlight the nuanced and context-dependent nature of the ESG–CFP nexus. While moderate ESG engagement may enhance long-term value and financial performance, both underinvestment and overinvestment in ESG can be detrimental,

underscoring the importance of considering nonlinear effects and optimal ESG intensity when evaluating the financial implications of corporate sustainability initiatives.

## 3. Research Design

### 3.1 Sample selection

The current study selects a sample of Chinese A-share listed companies for the period 2018–2024, based on data availability, to investigate the relationship between firms' ESG performance and CFP. Firm-level ESG scores and financial data were obtained from the LSEG database. The initial sample comprised all A-share listed companies with available ESG ratings during the study period.

To ensure data quality and reliability, the sample was screened using the following criteria:

1. Firms designated as ST or *ST due to financial distress were excluded.
2. Newly listed firms during the study period were removed to avoid insufficient time-series data.
3. Firms with missing values in key variables were omitted.
4. Continuous variables were winsorized at the 1st and 99th percentiles to mitigate the influence of extreme outliers.

After applying these criteria, the final sample consists of 151 firms, yielding a total of 1,057 firm-year observations.

### 3.2 Data

In this study, the overall ESG score is selected as the primary explanatory variable, as it is widely regarded as one of the most effective indicators of a company's ESG disclosure quality (Xie et al., 2019) and has been extensively used in the literature. The overall ESG score is a composite index ranging from 0 to 100, combining three key components: environmental performance (E), social performance (S), and governance performance (G). Each subcomponent captures a distinct dimension of ESG performance:

- Environmental performance (E): Evaluates a company's impact on natural resources, focusing on factors such as emission reduction, waste management, resource efficiency, and product innovation.
- Social performance (S): Assesses a firm's commitment to social issues, including human rights, community engagement, employee well-being, and product responsibility.

- Governance performance (G): Measures the effectiveness of corporate governance, encompassing board structure, shareholder rights, business ethics, and overall corporate transparency.

Given the multidimensional nature of ESG, this study also disaggregates the overall ESG score into its three individual components to capture the specific effects of each dimension on CFP. This approach allows for a more nuanced analysis, recognizing that the impact of one dimension may either enhance or counteract the effects of another (Brammer et al., 2009). Moreover, it enables the identification of which aspect of ESG performance plays the most influential role in determining CFP.

Financial performance is commonly classified into accounting-based and market-based indicators (Saygili et al., 2022; Zhou et al., 2023). Return on Assets (ROA) is an accounting-based measure that reflects a firm's overall profitability relative to its total assets. It provides insight into how efficiently a company utilizes its assets to generate profits and is widely regarded as a reliable proxy for firm-level accounting performance (Singh et al., 2025). Moreover, ROA is generally considered less susceptible to manipulation compared to other accounting measures (Hasan et al., 2022), which further explains its extensive use in the literature.

However, accounting-based measures may be influenced by managerial discretion, accounting estimates, and changes in accounting policies, potentially distorting the true economic value of the firm. Therefore, it is important to also consider market-based measures that reflect investors' perceptions and expectations (Nollet et al., 2016; Lewandowski, 2017). Among these, Tobin's Q is one of the most widely used indicators for assessing a firm's market performance and growth opportunities. It is calculated as the ratio of the firm's total market value to the replacement cost of its assets, thereby capturing the efficiency of capital utilization and market valuation (King and Lenox, 2001; Behl et al., 2022). Accordingly, this study employs both ROA and Tobin's Q as measures of financial performance and as dependent variables. While ROA captures short-term operational profitability, Tobin's Q reflects long-term market valuation and investor expectations (Bayer et al., 2020).

In addition, alternative dependent variables are incorporated for robustness tests. Net profit margin (NPM), which measures net income as a percentage of revenue, serves as an alternative accounting-based indicator of profitability. As a key component of ROA within the DuPont decomposition framework, NPM provides additional insight into firms' profit-generating efficiency (Soliman, 2008). Furthermore, annual stock return (SR) is employed as an alternative market-based measure, capturing the firm's stock performance over time.

This study also employs a gamut of control variables to test the relationship between ESG performance and CFP. The first control variable is firm size (SIZE), measured as the natural logarithm of total assets (Quéré et al., 2018), which is widely used as a proxy to capture economies of scale. This variable helps control for performance differences arising from variations in firm size (Beck et al., 2018). The second control variable is leverage (LEV), measured as the ratio of total debt to total assets. Leverage reflects a firm's reliance on debt financing and its associated risk exposure, which can significantly affect profitability and financial stability (Waddock and Graves, 1997). In addition, firm age (AGE) is included as an important control variable, calculated as the number of years since a firm's initial public offering (IPO). This variable captures maturity effects and accumulated experience, which may influence firm performance (Wang and Choi, 2013). Finally, research and development expenditure (RD) is included, as higher R&D investment is generally associated with innovation capacity, long-term growth, and improved profitability (McWilliams and Siegel, 2000). All variables are defined and summarized in Table 1.

[Insert Table 1 here]

### 3.2 Methodology

Given that the balanced panel data comprise both cross-sectional and time-series data, this study employs both static and dynamic panel data estimation. To measure the impact of overall effect of a firm's quality of ESG disclosure on CFP, the models are set up as follows:

$$ROA_{i,t} = \beta_0 + \beta_1 ESG_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 AGE_{i,t} + \beta_5 RD_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$Tobin'sQ_{i,t} = \beta_0 + \beta_1 ESG_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 AGE_{i,t} + \beta_5 RD_{i,t} + \varepsilon_{i,t} \quad (2)$$

where the subscripts i and t represent the firm and year, respectively; $CFP_{i.t}$ is the vector for financial performance, which can be denoted by $ROA_{i,t}$and $Tobin'sQ_{i,t}$. $ESG_{i,t}$ is the overall ESG score. $SIZE_{i,t}$ is the logarithm of book value of assets; $LEV_{i,t}$ is the leverage ratio of a firm; $AGE_{i,t}$ is the firm age; $RD_{i,t}$ is the R&D expense.

To test the impact of ESG disclosure on CFP, models are as follows:

$$ROA_{i,t} = \beta_0 + \beta_1 E_{i,t} + \beta_2 S_{i,t} + \beta_3 G_{i,t} + \beta_4 SIZE_{i,t} + \beta_5 LEV_{i,t} + \beta_6 AGE_{i,t} + \beta_7 RD_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$Tobin'sQ_{i,t} = \beta_0 + \beta_1 E_{i,t} + \beta_2 S_{i,t} + \beta_3 G_{i,t} + \beta_4 SIZE_{i,t} + \beta_5 LEV_{i,t} + \beta_6 AGE_{i,t} + \beta_7 RD_{i,t} + \varepsilon_{i,t} \quad (4)$$

$E_{i,t}$ is the environmental disclosure score; $S_{i,t}$ is the social disclosure score; $G_{i,t}$ is the corporate governance disclosure score; $\varepsilon_{i,t}$ is the error term.

For robustness test, this paper replaces ROA with NPM and Q with SR, and the models are as follows:

$$NPM_{i,t} = \beta_0 + \beta_1 ESG_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 AGE_{i,t} + \beta_5 RD_{i,t} + \varepsilon_{i,t} \quad (5)$$

$$NPM_{i,t} = \beta_0 + \beta_1 E_{i,t} + \beta_2 S_{i,t} + \beta_3 G_{i,t} + \beta_4 SIZE_{i,t} + \beta_5 LEV_{i,t} + \beta_6 AGE_{i,t} + \beta_7 RD_{i,t} + \varepsilon_{i,t} \quad (6)$$

$$SR_{i,t} = \beta_0 + \beta_1 ESG_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 AGE_{i,t} + \beta_5 RD_{i,t} + \varepsilon_{i,t} \quad (7)$$

$$SR_{i,t} = \beta_0 + \beta_1 E_{i,t} + \beta_2 S_{i,t} + \beta_3 G_{i,t} + \beta_4 SIZE_{i,t} + \beta_5 LEV_{i,t} + \beta_6 AGE_{i,t} + \beta_7 RD_{i,t} + \varepsilon_{i,t} \quad (8)$$

## 4. Results

### 4.1 Descriptive statistics

Table 2 presents the descriptive statistics of the study variables. The mean ESG score is 44.138, with governance exhibiting the highest average (51.697) and social the lowest (36.846), indicating an uneven distribution of emphasis across ESG dimensions. Regarding financial performance indicators, ROA and NPM share the same mean value (0.046), reflecting their close relationship. Tobin's Q has an average of 1.677 but displays a wide range, reaching up to 10.886, which highlights substantial variation in market valuation across firms. Similarly, stock return (SR) shows a relatively modest mean of 0.067; however, its dispersion suggests considerable variability in market performance.

In terms of firm characteristics, the average firm size (SIZE), measured as the logarithm of total assets, is 25.206, with relatively limited variation. Leverage (LEV) averages 0.527, indicating moderate reliance on debt financing. The sample includes firms with an average age (AGE) of 18 years, ranging from 3 to 31 years, thereby capturing both young and mature firms. Finally, R&D intensity (RD) has a mean value of 20.226 with

relatively low dispersion, suggesting a consistent level of investment in innovation across the sample.

[Insert Table 2 here]

Table 3 reports the correlations between ESG indicators and financial performance measures. Overall ESG is negatively and significantly correlated with Tobin's Q (-0.109), while exhibiting weak, neutral-to-positive relationships with ROA, NPM, and SR. At the pillar level, the environmental (E) dimension shows a similar pattern of weak correlations across all financial indicators. The social (S) dimension is weakly associated with ROA and NPM, whereas the governance (G) dimension displays stronger negative correlations with ROA, NPM, and Tobin's Q. However, its relationship with SR remains negligible. Finally, all pairwise correlation coefficients among the variables included in the same model fall well below 0.7, indicating that multicollinearity is unlikely to pose a significant concern in this study.

[Insert Table 3 here]

**4.2 Regression results**

The Hausman specification test is employed to determine the appropriate model between fixed-effects and random-effects estimators. The results across all estimated models provide strong statistical evidence to reject the null hypothesis, indicating that the fixed-effects specification is more appropriate. Furthermore, both firm-fixed effects and year-fixed effects are incorporated to ensure that the estimated coefficients capture within-firm variation over time, while controlling for unobserved heterogeneity and common temporal shocks.

Table 4 presents the results of the static panel regression analysis, with ROA and Tobin's Q as dependent variables. Models (1) and (2) report the impact of ESG disclosure and its three pillars on accounting-based performance (ROA), while Models (3) and (4) examine their effects on market-based performance (Tobin's Q).

For accounting-based performance, Model (1) estimates the effect of the overall ESG disclosure score on ROA. The results indicate that ESG has a statistically significant negative coefficient ($\beta = -0.001$, $p < 0.01$), suggesting that greater ESG disclosure is associated with lower financial performance. This finding implies that the costs associated with ESG-related

activities may outweigh immediate financial benefits, thereby exerting downward pressure on firm profitability in the short run.

Model (2) disaggregates the ESG score into its three components and shows that both the environmental (E) and governance (G) dimensions exert statistically significant negative effects on ROA ($\beta = -0.001$ at the 1% level and $\beta = -0.001$ at the 10% level, respectively), while the social (S) dimension remains statistically insignificant. These results indicate that environmental and governance disclosures contribute most strongly to the negative impact on accounting-based performance. Although such disclosures may enhance legitimacy and long-term resilience, they appear to be cost-intensive in the short term, thereby reducing firms' accounting profitability. These findings are consistent with Barnea and Rubin (2010), who argue that ESG engagement may undermine financial performance by increasing operational costs and reducing available cash flow.

With respect to the control variables, firm size (SIZE) and firm age (AGE) exhibit positive and statistically significant coefficients in both models at the 1% level, indicating that larger and more mature firms tend to achieve higher ROA. This finding is consistent with Hahn and Kühnen (2013) and Minutolo et al. (2019). In contrast, leverage (LEV) shows a strong negative effect, suggesting that higher debt levels erode profitability (Naseem et al., 2020). R&D intensity (RD) is positively associated with ROA at the 5% significance level, in line with Kabongo (2019) and Dasilas and Karanović (2025).

Turning to market-based performance, Model (3) shows that the coefficient of ESG on Tobin's Q ($\beta = -0.004$) is negative but statistically insignificant, suggesting that overall ESG disclosure does not have a measurable impact on market valuation. In Model (4), the disaggregated results indicate that both environmental (E) and governance (G) disclosures have statistically significant negative effects on Tobin's Q at the 5% level. In contrast, the social (S) dimension exhibits a weakly positive coefficient ($\beta = 0.005$), significant at the 10% level, which differs from the results observed in Model (2). Regarding the control variables, most display patterns opposite to those observed in the ROA models, with the exception of R&D intensity.

Taken together, the results from Models (1) and (2) suggest that ESG disclosure exerts a negative effect on corporate financial performance in the short run, particularly through environmental and governance dimensions. These findings are consistent with Hillman and Keim (2001), Duque-Grisales and Aguilera-Caracuel (2021), Fahad and Busru (2021), and Domanović (2022), all of whom report a negative ESG–CFP relationship. Similarly, Bocken and Geradts (2020) argue that ESG practices may impose financial costs

that negatively affect short-term performance, while Makridou et al. (2024) find that higher ESG scores reduce profitability in European energy firms.

However, these results contrast with a substantial body of literature reporting positive or mixed effects. For instance, Alareeni and Hamdan (2020) find that ESG significantly enhances firm performance among U.S. firms, while Saha et al. (2020) conclude that ESG practices generally improve CFP. Moreover, Whelan et al. (2021) report that the majority of studies document a positive ESG–CFP relationship. In contrast, the present findings suggest that the costs associated with ESG, particularly environmental and governance disclosures, may outweigh potential financial benefits in the short term. This interpretation aligns with Galant and Cadez (2017), who argue that ESG initiatives can erode competitive advantage due to increased costs.

Overall, the evidence indicates a negative association between ESG and CFP in the short run; however, the relationship remains inconclusive and highly context-dependent, with divergence in findings likely driven by differences in institutional settings, measurement approaches, and time horizons.

[Insert Table 4 here]

**4.3 Robustness tests**

To verify the reliability and generalizability of the regression results and ensure the robustness of the baseline findings, this study re-estimates the models using alternative dependent variables, Net Profit Margin (NPM) and Stock Return (SR). The results are reported in Table 5. When NPM is used as a proxy for accounting-based performance, ESG remains negatively associated with profitability and statistically significant, yielding results consistent with Models (1) and (2). In contrast, when SR is employed as the dependent variable, the coefficients for the environmental (E), social (S), and governance (G) dimensions remain negative but lose statistical significance compared to Model (4). Overall, these findings confirm that the negative impact of ESG on corporate financial performance (CFP) is robust, thereby reinforcing the reliability of the main results.

[Insert Table 5 here]

However, static panel models may suffer from potential endogeneity bias arising from issues such as reverse causality and omitted variables. To address this concern, this study

further employs the Generalized Method of Moments (GMM), which provides more consistent and efficient estimates in the presence of endogeneity (Roodman, 2009). Following the approaches of Arellano and Bover (1995) and Blundell and Bond (1998), a dynamic panel model is specified as follows:

$$Q_{i,t} = a * Q_{i,t-1} + \beta X_{i,t} + \theta_i + \varepsilon_{i,t} \quad (9)$$
$$i = 1, \dots\dots, N \qquad t = 1, \dots\dots, T$$

Where $Q_{i,t}$ is the measure of CFP proxied by ROA, Q, NPM, SR.

The validity of the GMM estimations is confirmed by the diagnostic tests reported in Table 6. In all regressions, both time-fixed effects and firm-fixed effects are included. The Arellano–Bond AR(2) tests yield p-values above 0.1 across all models, indicating the absence of second-order autocorrelation in the residuals. Furthermore, the p-values of the Hansen tests fall within the acceptable range (0.1 – 0.9), suggesting that the instrumental variables are valid and that there is no evidence of overidentification problems. Taken together, these diagnostic results indicate that the dynamic GMM models are statistically reliable, and the estimated coefficients can be interpreted with confidence. Specifically, the coefficients of the lagged dependent variables ROA ($ROA_{i,t-1}$), Tobin's Q ($Tobin's\ Q_{i,t-1}$) and NPM ($NPM_{i,t-1}$) are positive and statistically significant at the 1% level.

[Insert Table 6 here]

**4.3. Non-linear relationships**

In addition to linear relationships, a substantial body of literature documents a more complex, non-linear association between ESG and corporate financial performance (CFP) (Wang et al., 2008; Schröder, 2014; Chen et al., 2018). The two empirical models are specified as follows:

$$ROA_{i,t} = \beta_0 + \beta_1 ESG_{i,t} + \beta_2 ESG_{i,t}^2 + \beta_3 SIZE_{i,t} + \beta_4 LEV_{i,t} + \beta_5 AGE_{i,t} + \beta_6 RD_{i,t} + \varepsilon_{i,t} \quad (10)$$

$$Tobin's\ Q_{i,t} = \beta_0 + \beta_1 ESG_{i,t} + \beta_2 ESG_{i,t}^2 + \beta_3 SIZE_{i,t} + \beta_4 LEV_{i,t} + \beta_5 AGE_{i,t} + \beta_6 RD_{i,t} + \varepsilon_{i,t} \quad (11)$$

The estimation results of Models (10) and (11) indicate that ESG does not exhibit a U-shaped relationship with ROA. In contrast, ESG and Tobin's Q display a pronounced inverted U-shaped relationship. Based on this evidence, we further examine whether a similar non-linear pattern characterises Tobin's Q in relation to the three ESG pillars (E, S, and G). Consistent with Model (11), the corresponding models are specified as follows:

$$Tobin'sQ_{i,t} = \beta_0 + \beta_1 E_{i,t} + \beta_2 E_{i,t}^2 + \beta_3 SIZE_{i,t} + \beta_4 LEV_{i,t} + \beta_5 AGE_{i,t} + \beta_6 RD_{i,t} + \varepsilon_{i,t} \quad (12)$$

$$Tobin'sQ_{i,t} = \beta_0 + \beta_1 S_{i,t} + \beta_2 S_{i,t}^2 + \beta_3 SIZE_{i,t} + \beta_4 LEV_{i,t} + \beta_5 AGE_{i,t} + \beta_6 RD_{i,t} + \varepsilon_{i,t} \quad (13)$$

$$Tobin's\ Q_{i,t} = \beta_0 + \beta_1 G_{i,t} + \beta_2 G_{i,t}^2 + \beta_3 SIZE_{i,t} + \beta_4 LEV_{i,t} + \beta_5 AGE_{i,t} + \beta_6 RD_{i,t} + \varepsilon_{i,t} \quad (14)$$

Furthermore, the identification of a turning point is essential when a non-linear relationship is established. Following Lind and Mehlum (2010), the turning point of a quadratic relationship can be calculated as:

$$X = -\frac{\beta_1}{2\beta_2} \quad (15)$$

Table 7 indicates that ESG exhibits a significant inverted U-shaped relationship with Tobin's Q, as evidenced by the negative and statistically significant coefficient on $ESG^2$ at the 5% level. The social pillar (S) also demonstrates a pronounced inverted U-shaped relationship with firm performance, with the coefficient on $S^2$ being negative and statistically significant ($\beta = -0.003$, $p < 0.01$). This suggests that the social dimension has the strongest non-linear effect on corporate financial performance (CFP) among the three ESG pillars. In contrast, no significant non-linear relationship is observed between the environmental (E) and governance (G) pillars and CFP.

[Insert Table 7 here]

To further verify the inverted U-shaped relationship between ESG performance and CFP, this study applies the U-test, which is widely used to validate non-linear relationships. According to Lind and Mehlum (2010), three conditions must be satisfied to confirm an inverted U-shaped effect: (i) the second derivative must have the correct sign (negative for an inverted U-shape); (ii) the slope must be positive at the lower bound and negative at the upper

bound; and (iii) the turning point must lie within the sample range and not be too close to the boundaries.

As shown in Table 8, the slope in Model (11) ranges from 0.009 to -0.019, while in Model (13) it ranges from 0.023 to -0.024, indicating that both models satisfy the second condition. In addition, the turning points are calculated based on the estimated coefficients. For Model (11), the turning point for ESG is 32.423, which lies within the interval [7.877, 83.081]. Similarly, for Model (13), the turning point for S is 44.303, which falls within the range [2.834, 87.657]. These results confirm that the third condition is also satisfied.

Taken together, the results provide strong evidence that both ESG and its social pillar (S) exhibit an inverted U-shaped relationship with CFP, while the environmental (E) and governance (G) pillars do not show a statistically significant non-linear association. These findings suggest that ESG engagement and social disclosure can enhance financial performance up to an optimal threshold, beyond which their marginal benefits diminish and may even become detrimental, imposing additional costs that impair firm performance (Zhang and Guo, 2018; Sun et al., 2019). These results are consistent with Teng et al. (2022), who also identify an inverted U-shaped relationship between ESG and CFP, particularly for the environmental and social dimensions, while governance remains insignificant. Similarly, Buallay (2019) provides evidence of a non-linear (inverted U-shaped) relationship between ESG and both firm profitability and valuation. El Khoury et al. (2023) report a comparable pattern using a sample of 46 banks, identifying a turning point at an average ESG score of 39.42. More recently, Chen et al. (2025) confirm a pronounced inverted U-shaped relationship between ESG and CFP, noting that the effect is stronger among firms with lower R&D intensity.

Overall, this study contributes to the existing literature by providing robust empirical evidence supporting the presence of an inverted U-shaped relationship between ESG and corporate financial performance, thereby deepening the understanding of the non-linear dynamics underlying ESG engagement.

[Insert Table 8 here]

## 5. Conclusions

This study examines the relationship between Environmental, Social, and Governance (ESG) performance and Corporate Financial Performance (CFP) among Chinese A-share listed firms

over the period 2018–2024, employing both linear and nonlinear modeling approaches. The linear regression results indicate that ESG disclosure is associated with a predominantly negative effect on accounting-based performance (ROA). Among the ESG pillars, the environmental (E) and governance (G) dimensions exhibit more pronounced negative impacts, whereas the social (S) dimension demonstrates a limited positive association. In contrast, the relationship between ESG and market-based performance measures appears weak and largely statistically insignificant.

However, the nonlinear analysis reveals a more nuanced relationship. Specifically, an inverted U-shaped relationship is identified between ESG performance and firm value, as proxied by Tobin's Q. This suggests that moderate levels of ESG engagement enhance market valuation, while excessive ESG disclosure leads to diminishing marginal returns. Further disaggregation shows that the social (S) dimension follows a stronger and more statistically significant inverted U-shaped pattern, exerting the greatest influence on CFP. Conversely, the environmental and governance dimensions do not exhibit significant nonlinear effects.

Overall, the findings demonstrate that the ESG–CFP relationship is complex, heterogeneous, and context-dependent. While ESG disclosure is negatively associated with short-term profitability, it exhibits a concave nonlinear relationship with market-based performance, highlighting the importance of optimal ESG engagement levels.

This study contributes to the ESG–CFP literature in several important ways. First, the documented negative linear association between ESG disclosure and profitability reinforces the trade-off perspective, suggesting that ESG activities may impose short-term cost burdens that outweigh immediate financial benefits, particularly in emerging market contexts. This finding extends prior literature by providing updated empirical evidence from China, thereby enriching the debate on whether ESG creates or destroys value in the short run. Second, the identification of an inverted U-shaped relationship between ESG and CFP offers strong empirical support for the "Too-Much-of-a-Good-Thing" (TMGT) effect. This highlights that while ESG engagement can generate value at low to moderate levels, excessive investment may lead to overcommitment, inefficiencies, and resource misallocation**,** ultimately undermining firm performance. Third, by integrating both linear and nonlinear modeling frameworks, this study advances the literature by demonstrating that the ESG–CFP relationship is non-monotonic and conditional**.** This underscores the need for future research to move beyond simplistic linear assumptions and to consider threshold effects, diminishing returns, and contextual heterogeneity when examining ESG outcomes.

From a managerial standpoint, the findings offer several actionable insights. First,

ESG initiatives should be strategically embedded within the firm's core business model, rather than treated as symbolic or compliance-driven activities. Managers should prioritize ESG investments that are aligned with long-term value creation and competitive advantage. Second, the evidence of diminishing returns implies that more ESG is not always better. Excessive ESG engagement may lead to increased costs and reduced profitability. Managers should therefore aim to identify an optimal level of ESG investment, carefully balancing costs and benefits through continuous performance monitoring and evaluation. Third, the stronger impact of the social (S) dimension suggests that firms may derive greater value from stakeholder-oriented initiatives, such as employee welfare, customer relations, and community engagement. Managers should consider reallocating resources toward ESG dimensions that deliver the highest marginal returns. Finally, transparent and credible ESG communication is essential. Effective disclosure can enhance investor confidence, stakeholder trust, and market valuation, particularly when ESG activities are perceived as substantive rather than symbolic.

Future research could extend the analysis to a broader set of countries and regions, as cross-country comparative studies would provide valuable insights into institutional differences and contextual heterogeneity in the ESG–CFP relationship. Moreover, heterogeneity analyses could be conducted to examine how this relationship varies across sectors and firm-specific characteristics. In addition, future studies could explore potential mediating mechanisms, such as innovation, risk management, and stakeholder trust, through which ESG practices influence firm outcomes.

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Table 1. Definition of variables

| Variable type | Variable symbol | Full name | Definition |
|---|---|---|---|
| Independent variables | ESG | Environmental, Social and Governance | Overall ESG score |
| | E | Environmental performance | Environmental pillar score |
| | S | Social performance | Social pillar score |
| | G | Corporate governance performance | Governance pillar score |
| Dependent variables | ROA | Return on asset | Net income for the past 12 months / total average assets |
| | Q | Tobin's Q | The market value of a firm's assets / the replacement value of the firm's assets |
| Control variables | SIZE | Log of asset | Log of firm's total asset in million |
| | LEV | Leverage | Long and short-term borrowings / Total assets |
| | AGE | Firm age | Observation year -IPO year |
| | RD | Research and development expense | Log of annual research and development expense of a firm |

Table 2. Descriptive statistics

| | N | Mean | Median | Std.Dev | Min | Max | 25% Percentile | 50% Percentile | 75% Percentile |
|---|---|---|---|---|---|---|---|---|---|
| ESG | 1057 | 44.138 | 43.535 | 17.708 | 7.877 | 83.081 | 29.964 | 43.535 | 57.922 |
| E | 1057 | 46.272 | 48.119 | 24.465 | 0.000 | 93.272 | 27.315 | 48.119 | 65.289 |
| S | 1057 | 36.846 | 34.917 | 21.325 | 2.834 | 87.657 | 19.525 | 34.917 | 50.803 |
| G | 1057 | 51.697 | 52.891 | 20.497 | 7.503 | 90.066 | 34.811 | 52.891 | 68.592 |
| ROA | 1057 | 0.046 | 0.037 | 0.054 | -0.128 | 0.222 | 0.017 | 0.037 | 0.069 |
| Q | 1057 | 1.677 | 1.186 | 1.488 | 0.740 | 10.886 | 0.949 | 1.186 | 1.767 |
| NPM | 1057 | 0.046 | 0.037 | 0.055 | -0.140 | 0.229 | 0.017 | 0.037 | 0.069 |
| SR | 1057 | 0.067 | -0.007 | 0.359 | -0.496 | 1.469 | -0.160 | -0.007 | 0.193 |
| SIZE | 1057 | 25.206 | 25.118 | 1.330 | 22.560 | 28.445 | 24.194 | 25.118 | 26.110 |
| LEV | 1057 | 0.527 | 0.546 | 0.189 | 0.081 | 0.895 | 0.400 | 0.546 | 0.666 |
| AGE | 1057 | 18.216 | 18.000 | 6.613 | 3.000 | 31.000 | 13.000 | 18.000 | 24.000 |
| RD | 1057 | 20.226 | 20.355 | 1.847 | 16.044 | 23.981 | 19.005 | 20.355 | 21.415 |

Table 3. Correlation matrix

| | ESG | E | S | G | ROA | Tobin's Q | NPM | SR | SIZE | LEV | AGE | RD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ESG | 1 | | | | | | | | | | | |
| E | 0.874 | 1 | | | | | | | | | | |
| S | 0.866 | 0.717 | 1 | | | | | | | | | |
| G | 0.635 | 0.389 | 0.321 | 1 | | | | | | | | |
| ROA | 0.000 | 0.026 | 0.051 | -0.097 | 1 | | | | | | | |
| Tobin's Q | -0.109 | -0.112 | 0.017 | -0.203 | 0.503 | 1 | | | | | | |
| NPM | 0.002 | 0.027 | 0.051 | -0.095 | 1.000 | 0.498 | 1 | | | | | |
| SR | 0.010 | 0.023 | -0.002 | 0.005 | 0.108 | 0.135 | 0.108 | 1 | | | | |
| SIZE | 0.416 | 0.423 | 0.349 | 0.257 | -0.173 | -0.413 | -0.169 | -0.033 | 1 | | | |
| LEV | 0.104 | 0.131 | 0.036 | 0.136 | -0.513 | -0.352 | -0.511 | -0.020 | 0.512 | 1 | | |
| AGE | -0.008 | 0.057 | -0.042 | -0.004 | -0.057 | -0.037 | -0.058 | -0.039 | -0.079 | -0.012 | 1 | |
| RD | 0.426 | 0.407 | 0.396 | 0.243 | -0.004 | -0.078 | -0.003 | 0.003 | 0.433 | 0.184 | -0.119 | 1 |

Table 4. Static panel data regression results

| | Model (1) ROA | Model (2) ROA | Model (3) Tobin's Q | Model (4) Tobin's Q |
|---|---|---|---|---|
| ESG | -0.005*** | | -0.004 | |
| | (-3.17) | | (-1.64) | |
| E | | -0.001*** | | -0.006** |
| | | (-3.03) | | (-2.43) |
| S | | -0.001 | | 0.005* |
| | | (-0.06) | | (1.93) |
| G | | -0.001* | | -0.003** |
| | | (-1.78) | | (-2.23) |
| SIZE | 0.025*** | 0.026*** | -0.519*** | -0.515*** |
| | (3.14) | (3.21) | (-4.07) | (-4.06) |
| LEV | -0.233*** | -0.232*** | 0.784** | 0.847*** |
| | (-6.52) | (-6.42) | (2.51) | (2.70) |
| AGE | 0.020*** | 0.020*** | -0.009 | -0.012 |
| | (3.40) | (3.21) | (-0.17) | (-0.25) |
| RD | 0.007** | 0.008** | 0.062 | 0.071* |
| | (2.26) | (2.38) | (1.58) | (1.79) |
| Constant | -0.950*** | -0.984*** | 13.45*** | 13.24*** |
| | (-5.12) | (-5.04) | (4.56) | (4.57) |
| Year FE | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes |
| N | 1,057 | 1,057 | 1,057 | 1,057 |
| Adjusted $R^2$ | 0.643 | 0.644 | 0.857 | 0.858 |
| F-statistic | 22.82 | 16.70 | 5.01 | 4.82 |

Note: This table presents the estimation of equations 1-4 using OLS regressions with year and firm fixed effects. The standard errors are adjusted for heteroscedasticity and within-firm clustering. T values are reported in parenthesis. ***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 5. Additional panel data regression results

| | Model (5) NPM | Model (6) NPM | Model (7) SR | Model (8) SR |
|---|---|---|---|---|
| ESG | -0.001*** | | -0.001 | |
| | (-3.21) | | (-0.33) | |
| E | | -0.001*** | | -0.001 |
| | | (-2.95) | | (-0.09) |
| S | | -0.001 | | -0.001 |
| | | (-0.17) | | (-0.17) |
| G | | -0.001* | | -0.001 |
| | | (-1.76) | | (-0.39) |
| SIZE | 0.026*** | 0.027*** | -0.403*** | -0.401*** |
| | (3.18) | (3.24) | (-5.53) | (-5.45) |
| LEV | -0.239*** | -0.238*** | 0.420* | 0.419* |
| | (-6.48) | (-6.38) | (1.93) | (1.92) |
| AGE | 0.020*** | 0.020*** | 0.128* | 0.127* |
| | (3.36) | (3.18) | (1.80) | (1.76) |
| RD | 0.007** | 0.008** | -0.026 | -0.026 |
| | (2.26) | (2.35) | (-1.03) | (-1.04) |
| Constant | -0.975*** | -1.009*** | 8.220*** | 8.207*** |
| | (-5.12) | (-5.06) | (4.21) | (4.18) |
| Year FE | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes |
| N | 1,057 | 1,057 | 1,057 | 1,057 |
| Adjusted $R^2$ | 0.638 | 0.639 | 0.137 | 0.135 |
| F-statistic | 22.63 | 16.47 | 9.56 | 6.90 |

Note: This table presents the estimation of equations 5-8 using OLS regressions with year and firm fixed effects. The standard errors are adjusted for heteroscedasticity and within-firm clustering. T values are reported in parenthesis. ***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 6. Dynamic (GMM) panel data regression results

| | Model (1) ROA | Model (2) ROA | Model (3) Tobin's Q | Model (4) Tobin's Q | Model (5) NPM | Model (6) NPM | Model (7) SR | Model (8) SR |
|---|---|---|---|---|---|---|---|---|
| $ROA_{t-1}$ | 0.572*** | 0.572*** | | | | | | |
| | (0.138) | (0.145) | | | | | | |
| Tobin's $Q_{t-1}$ | | | 0.781*** | 0.709*** | | | | |
| | | | (0.061) | (0.102) | | | | |
| $NPM_{t-1}$ | | | | | 0.597*** | 0.621*** | | |
| | | | | | (0.159) | (0.127) | | |
| $SR_{t-1}$ | | | | | | | 0.021 | -0.010 |
| | | | | | | | (0.253) | (0.247) |
| ESG | 0.001 | | -0.028 | | 0.001 | | 0.001 | |
| | (0.000) | | (0.020) | | (0.000) | | (0.001) | |
| E | | 0.001 | | -0.047 | | 0.001 | | 0.003*** |
| | | (0.000) | | (0.033) | | (0.000) | | (0.001) |
| S | | -0.001 | | 0.026 | | -0.001 | | -0.001 |
| | | (0.000) | | (0.029) | | (0.000) | | (0.001) |
| G | | -0.001 | | -0.027 | | -0.001 | | -0.001 |
| | | (0.000) | | (0.018) | | (0.000) | | (0.001) |
| SIZE | 0.003* | 0.003* | -0.125 | 0.455 | 0.004* | 0.003 | -0.029** | -0.034*** |
| | (0.002) | (0.002) | (0.399) | (0.577) | (0.002) | (0.002) | (0.011) | (0.011) |
| LEV | -0.086*** | -0.085*** | 0.0200 | -5.790 | -0.084*** | -0.072** | 0.094 | 0.091 |
| | (0.022) | (0.023) | (3.905) | (5.446) | (0.024) | (0.028) | (0.093) | (0.092) |
| AGE | -0.001 | -0.002 | 0.013 | 0.033 | -0.001 | -0.001 | -0.003** | -0.004** |
| | (0.000) | (0.000) | (0.019) | (0.027) | (0.000) | (0.000) | (0.002) | (0.002) |
| RD | 0.001 | 0.001 | 0.269 | 0.218 | 0.001 | 0.001 | -0.004 | -0.005 |
| | (0.001) | (0.001) | (0.398) | (0.418) | (0.001) | (0.001) | (0.008) | (0.008) |
| Constant | -0.041 | -0.032 | -0.935 | -10.323 | -0.047 | -0.029 | 0.854*** | 1.013*** |
| | (0.035) | (0.035) | (7.031) | (10.090) | (0.036) | (0.040) | (0.294) | (0.287) |
| N | 906 | 906 | 906 | 906 | 906 | 906 | 906 | 906 |
| AR(2)(p) | 0.395 | 0.400 | 0.585 | 0.969 | 0.390 | 0.275 | 0.649 | 0.731 |
| Hansen(p) | 0.253 | 0.199 | 0.183 | 0.384 | 0.306 | 0.536 | 0.696 | 0.690 |

Notes: The estimation method is the two-step GMM system dynamic panel estimator. The Arellano-Bond (AB) test for serial correlation is based on the null hypothesis of second-order autocorrelation in the first differenced residuals. The p-value associated with the Hansen J test for determining the validity of the overidentifying

restrictions is reported. Coefficients are reported with statistical significance levels indicated by ***, **, and * for 1%, 5%, and 10% levels, respectively.

Table 7. Nonlinear regression results

| | Model (11) Tobin's Q | Model (12) Tobin's Q | Model (13) Tobin's Q | Model (14) Tobin's Q |
|---|---|---|---|---|
| ESG | 0.012 | | | |
| | (1.56) | | | |
| $ESG^2$ | -0.001** | | | |
| | (-2.10) | | | |
| E | | 0.001 | | |
| | | (0.33) | | |
| $E^2$ | | -0.001 | | |
| | | (-1.47) | | |
| S | | | 0.025*** | |
| | | | (3.94) | |
| $S^2$ | | | -0.001*** | |
| | | | (-3.55) | |
| G | | | | -0.002 |
| | | | | (-0.32) |
| $G^2$ | | | | -0.001 |
| | | | | (-0.16) |
| SIZE | -0.492*** | -0.488*** | -0.516*** | -0.534*** |
| | (-3.75) | (-3.72) | (-4.01) | (-4.29) |
| LEV | 0.764** | 0.788** | 0.844*** | 0.825*** |
| | (2.39) | (2.53) | (2.68) | (2.62) |
| AGE | -0.028 | 0.006 | -0.003 | -0.015 |
| | (-0.52) | (0.15) | (-0.04) | (-0.31) |
| RD | 0.050 | 0.061 | 0.034 | 0.060 |
| | (1.28) | (1.55) | (0.88) | (1.54) |
| Constant | 13.052*** | 12.324*** | 13.201*** | 13.886*** |
| | (4.37) | (4.04) | (4.39) | (4.75) |
| N | 1,057 | 1,057 | 1,057 | 1,057 |
| Adjusted $R^2$ | 0.858 | 0.857 | 0.860 | 0.857 |
| F-statistic | 6.174 | 5.204 | 6.961 | 5.164 |

Note: This table presents the estimation of equations 11-14 using OLS regressions with year and firm fixed effects. The standard errors are adjusted for heteroscedasticity and within-firm clustering. T values are reported in parenthesis. ***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 8. Boundaries and turning points

| | Model (11) | | Model (13) | |
|---|---|---|---|---|
| | Lower bound | Upper bound | Lower bound | Upper bound |
| Interval | 7.877 | 83.081 | 2.834 | 87.657 |
| Slope | 0.009 | -0.019 | 0.023 | -0.024 |
| t-value | 1.415 | -2.388 | 3.946 | -2.962 |
| P>\|t\| | 0.079 | 0.009 | 0.000 | 0.002 |
| Turning point | 32.423 | | 44.303 | |
| t-value of overall test | 1.420 | | 2.960 | |
| P>\|t\| of overall test | 0.079 | | 0.002 | |

Note(s): Specification: $f(x)=x^2$ Test: H1: Inverse U shape vs. H0: Monotone or U shape