Proceedings of the 3rd International Conference on Management Research and Economic Development
DOI: 10.54254/2754-1169/180/2025.22764

# *The Impact of ESG Performance on Financial Constraints*

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***Abstract:*** The global transition toward carbon neutrality has amplified the role of green finance, with ESG (Environmental, Social, and Governance) performance becoming a critical determinant of corporate financing decisions. In China—the largest emerging market and carbon emitter—recent policy innovations, such as green finance pilot zones and carbon emission reduction instruments, have accelerated ESG adoption. However, existing studies predominantly focus on linear ESG-financing relationships, overlooking nonlinear mechanisms, regional policy synergies, and technological disruptions like blockchain. This study examines the impact of ESG performance on financing constraints using panel data from Chinese A-share listed firms (2010–2020). Employing a progressive modeling framework (POLS→OLS→FE→two-way FE), it systematically address endogeneity through financial controls, fixed effects, and robustness checks with alternative ESG metrics. Heterogeneity analyses reveal attenuated ESG effects in environmentally sensitive industries (β=-0.161 vs. -0.294) and state-owned enterprises (β=-0.106 vs. -0.323), attributable to regulatory compliance costs and soft budget constraints. The findings support the ESG signaling framework wherein enhanced disclosure reduces information asymmetry. Policy implications emphasize standardized ESG disclosure aligned with China-specific materiality and differentiated regulatory interventions across industries and ownership types.

***Keywords:*** ESG Performance, Financing Constraints, Emerging Market

## 1. Introduction

The global transition toward carbon neutrality has positioned green finance as a pivotal mechanism for sustainable development. Within this paradigm, environmental, social, and governance (ESG) performance has emerged as a critical determinant of corporate financing decisions [1]. In China — the largest emerging market and carbon emitter — recent policy innovations, such as green finance pilot zones [2] and carbon emission reduction instruments, have accelerated ESG adoption.

Recent policy innovations in China, including carbon emission reduction instruments, have accelerated ESG adoption. Existing studies predominantly focus on linear ESG-financing relationships, yet overlook heterogeneity mechanisms and institutional complexities.

Analyzing panel data from 25,108 firm-year observations of Chinese A-share listed companies (2010–2020), this study identifies significant financing constraint reduction from ESG performance ($\beta$=-0.267, $p<0.01$), with effects moderated by industrial pollution potential and state ownership. The results align with the ESG signaling theory [3], demonstrating how institutional factors reshape capital allocation in emerging markets.

DOI: 10.54254/2754-1169/180/2025.22764

# 2. Literature review

## 2.1. Theoretical foundations

### 2.1.1. Application of information asymmetry theory in ESG research

ESG disclosures mitigate financing constraints by narrowing information asymmetries between firms and capital providers. Gillan et al. [4] demonstrate that ESG disclosures convey private information regarding corporate environmental risk management capabilities, thereby mitigating adverse selection in debt contracting. For instance, the Carbon Disclosure Project (CDP) has been demonstrated to reduce green bond issuance spreads [5]. However, fragmented ESG rating standards (e.g., discrepancies between MSCI and Wind metrics) can distort signaling mechanisms and undermine theoretical explanatory power [6]. Green finance policies, such as green credit guidelines, influence corporate ESG behavior through signaling mechanisms. Lei and Yu [7] employ a quasi-natural experiment to reveal that such policies improve ESG performance via two pathways: reallocating credit resources and enhancing managerial environmental awareness, validating the role of information asymmetry theory in policy transmission.

While information asymmetry theory explains market signaling mechanisms, the actual effectiveness of ESG disclosures depends on how firms manage diverse stakeholder expectations, a perspective further developed in stakeholder theory.

### 2.1.2. Extended analysis of stakeholder theory

Superior ESG performance enables firms to obtain financing advantages through effective management of diverse stakeholder demands. Bae et al. [1] demonstrate that financial institutions systematically favor 'ethical firms' demonstrating robust social responsibility profiles in credit allocation processes, attributable to reduced default probabilities and enhanced long-term viability. However, emerging markets confront institutional challenges arising from greenwashing practices, wherein selective ESG disclosures strategically conceal unaltered environmental footprints [8]. The financing implications of ESG are structurally moderated by ownership configurations: state-owned enterprises (SOEs) display heightened sensitivity to green credit policies owing to systemic credit dependence [9], whereas non-SOEs manifest intensified ESG enhancement incentives stemming from competitive market dynamics [9].

Beyond stakeholder management, the endogenous relationship between environmental risks and capital costs provides another critical lens for understanding ESG financing effects, as elaborated in the following section.

### 2.1.3. Environmental risk management and capital cost theory

Within an endogenous risk management framework, carbon price fluctuations and climate policy uncertainties exert direct impacts on corporate capital costs. Heutel's [10] endogenous carbon pricing model establishes that carbon-intensive enterprises incur financing premiums exhibiting positive correlation with their emission profiles. China's 'Dual Carbon' strategic objectives (i.e., carbon emission peak and carbon neutrality) have institutionalized environmental risk management through Emissions Trading Systems (ETS), compelling corporate entities to mitigate risks through systematic ESG investments [11]. Through dual mechanisms of capital cost reduction (e.g., interest coverage ratio optimization) and green innovation financing, superior ESG performance effectively alleviates financing constraints, thereby constituting an integrated 'ESG-Financing Constraint-Green Innovation' transmission mechanism.

DOI: 10.54254/2754-1169/180/2025.22764

## 2.2. Global and domestic research progress

### 2.2.1. Transmission pathways of ESG performance on financing constraints

Current research identifies three distinct transmission mechanisms operating across different levels:

(1) Market Signaling Pathways (Micro-Level): Tang and Zhang [5] demonstrate that a 1-unit increase in ESG scores reduces green bond spreads by 11.5 basis points among Chinese A-share firms. This effect is most significant in industries with stringent environmental regulatory intensity, consistent with the policy framework outlined by the People's Bank of China [12].

(2) Risk Management Pathways (Meso-Level): Strong ESG performance mitigates environmental litigation risks and regulatory penalties, thereby enhancing debt repayment capacity [13]. Empirical evidence indicates that the risk mitigation effect explains approximately 38% of the ESG-related financing advantage observed in manufacturing sectors [13].

(3) Resource Reconfiguration Pathways (Macro-Level): ESG investments facilitate green technological innovations via two mechanisms: (1) securing government subsidies for sustainable projects, and (2) obtaining access to dedicated green financing instruments [14].

## 2.3. Critical perspectives

### 2.3.1. Institutional constraints in emerging markets

China's institutional architecture manifests three structural constraints:

(1) Dual-track institutional conflict: State-administered carbon quota allocation mechanisms exhibit systemic incompatibility with market-based green financial instruments, engendering systematic bias toward state-owned enterprises [15].

(2) Regulatory framework misalignment: Prevailing international ESG standards demonstrate limited incorporation ($\leqslant$40% alignment index) of China's 'Dual Control' energy policy framework [16].

(3) Spatial policy efficiency gradient: Eastern coastal provinces exhibit 35% greater policy transmission efficiency ($\beta$ =0.35***, 95%CI [0.28-0.42]) attributable to advanced financial intermediation infrastructure [17].

These institutional rigidities necessitate adaptive governance mechanisms to accommodate evolving market conditions.

### 2.3.2. Dynamic mechanisms in carbon peaking

Cutting-edge scholarship elucidates nonlinear dynamics in ESG financing effects through threshold regression analyses. Li and Zhang [18] establish statistically significant threshold effects ($\tau$=0.65, p<0.01) wherein ESG financing benefits materialize only post-attainment of minimum environmental compliance standards. Technological disruption introduces novel dynamics: blockchain-powered ESG verification systems reduce information asymmetry costs by 28-42%, thereby optimizing capital allocation efficiency [15]. Persistent research gaps remain conspicuous, particularly in SME financing dynamics. Current literature disproportionately focuses on listed entities (88% of studies) despite non-listed firms comprising 78.3% of China's corporate ecosystem.

## 3. Sample

## 3.1. Sample selection

This study examines Chinese A-share listed companies on the Shanghai and Shenzhen stock exchanges from 2010 to 2020. The data were primarily obtained from the China Stock Market and

DOI: 10.54254/2754-1169/180/2025.22764

Accounting Research (CSMAR) database and corporate annual reports, supplemented with derived indicators from WIND. The sample selection process implemented three sequential filters: (1) exclusion of financial institutions and companies under special treatment (ST/PT) status; (2) removal of observations with anomalous values or incomplete data; and (3) normalization of key financial variables by total assets to mitigate scale effects. The final dataset comprises 25,108 firm-year observations spanning 2010-2020, thus establishing a balanced panel dataset for rigorous empirical analysis.

## 3.2. Model specification

Guided by theoretical foundations and prior empirical research, we specify the following two-way fixed effects model:

$$KZ_{i,t}=\alpha_0+\alpha_1 ESG_{i,t}+\beta_j Control_{j,i,t} + \lambda_p \sum \text{Province} + \lambda_y \sum \text{Year}+\varepsilon_{i,t} \quad (1)$$

where i denotes firms, t indicates years, and $KZ_{i,t}$represents the Kaplan-Zingales index, a proxy for corporate financial constraints. $Control_{i,t}$ are control variables. Province-fixed and year-fixed effects ($\lambda_p$, $\lambda_y$) account for unobserved provincial heterogeneity and macroeconomic trends respectively.

## 3.3. Variable definitions and measurement

### 3.3.1. Dependent and independent variables

**Financial Constraints (KZ Index)**: Following corporate finance convention [19], we measure financing constraints using the KZ index, where monotonically increasing values correspond to heightened constraints. **ESG Performance (SinoSecurities ESG Index)**: Our primary ESG measure employs SinoSecurities Index Co., Ltd.'s (SSI) nine-tier rating system (AAA=9 to C=1), which synthesizes international ESG frameworks with China's distinctive regulatory regime and transitional market characteristics. Methodological robustness was verified through alternative indices including Wind ESG Rating and FTSE Russell ESG Index.

### 3.3.2. Control variables

Employing a doubly robust analytical framework, we operationalize control variables through two complementary dimensions:

1.**Financial Architecture**: Following Bennedsen et al. [20], we include profitability metrics (standardized operating profit [sOProfit], return on assets [ROA]), operational efficiency (EBIT, operating cash flow [OCF]), asset collateralization (tangibility ratio), liquidity reserves (standardized cash [sCash]), and market valuation (Tobin's Q).

2.**Endogeneity Correction**: Consistent with Gormley & Matsa's [21] endogenous selection framework, we integrate equity incentive intensity (SG1) to capture strategic compensation decisions. Provincial and temporal fixed effects address spatial-temporal heterogeneity through two-way error component modeling.

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Table1: Variable definitions and measurement

| Category | Variable | Symbol | Definition |
|---|---|---|---|
| Dependent Variable | KZ Index | KZ | Composite measure of financial constraints |
| Independent Variable | ESG performance | ESG | Nine-tier rating (1=C to 9=AAA) from Sino-Securities Index |
| Control Variables | Firm size | Size | Natural logarithm of total assets |
| | Equity incentive | SG1 | Equity incentive value / Total executive compensation×100% |
| | Standardized Operating profit | sOProfit | (Revenue – COGS – Operating Expenses)/ Total Assets |
| | EBIT-to-Asset ratio | EBIT | Earnings Before Interest and Taxes /Total Assets |
| | Return on assets | ROA | Net Income/Total Assets |
| | Cash flow ratio | OCF | Operating Cash Flow / Total Assets |
| | Tangibility Ratio | Tangibility | (Net Property, Plant & Equipment) / Total Assets |
| | Liquidity Reserve | sCash | (Cash + Short-term Investments) / Total Assets |
| | Tobin's Q Value A | TobingA | (Market Capitalization +Total Liabilities) / Total Assets |

### 3.4. Descriptive statistical analysis

Table 2: Descriptive statistics

| | N | Mean | P50 | Std | Min | Max |
|---|---|---|---|---|---|---|
| KZ | 25108 | 1.052 | 1.266 | 2.428 | -10.246 | 13.663 |
| ESG | 25108 | 4.098 | 4.000 | 1.14 | 1.000 | 8.000 |
| Size | 25108 | 22.222 | 22.042 | 1.314 | 17.641 | 28.636 |
| SG1 | 25108 | 6.300 | 0.098 | 854.758 | -2.733 | 134607.1 |
| sOProfit | 25108 | 0.039 | 0.039 | 0.088 | -2.509 | 0.782 |
| EBIT | 25108 | 0.042 | 0.043 | 0.090 | -2.823 | 0.787 |
| ROA | 25108 | 0.033 | 0.035 | 0.085 | -2.834 | 0.786 |
| OCF | 25108 | 0.619 | 0.489 | 0.589 | 0.000 | 13.455 |
| Tangibility | 25108 | 0.215 | 0.181 | 0.164 | 0.000 | 0.971 |
| sCash | 25108 | 0.184 | 0.144 | 0.914 | 0.000 | 143.638 |
| TobinqA | 25108 | 2.108 | 1.601 | 2.358 | 0.153 | 122.190 |

Table 2 summarizes the descriptive statistics of core variables, with all monetary values reported in millions of Chinese yuan (RMB). The SG1 variable demonstrates significant variability (SD = 854.76), highlighting divergent equity incentive practices across firms. Financial constraint measures exhibit substantial variability (KZ index range: -10.25 to 13.66), while ESG scores display a positively skewed distribution (mean = 4.10, max = 8), suggesting potential for enhanced sustainability practices across the sample.

As for control variables, Firm size (log-transformed total assets) exhibits considerable variation (Mean = 22.222, SD = 1.314), confirming the inclusion of firms with diverse market capitalizations; Equity incentive intensity (SG1) is characterized by pronounced right-skewness (Mean = 6.300 vs. Median = 0.098, SD = 854.76), suggesting the prevalence of concentrated high-intensity incentive

DOI: 10.54254/2754-1169/180/2025.22764

policies; Standardized operating profit (sOProfit) is tightly clustered around the mean (0.039 ± 0.088), though negative outliers (Min = -2.509) necessitate further examination of economic plausibility.

## 4. Empirical analysis

### 4.1. Main test regression results

Table 3: Main regression results (dependent variable: KZ index, unit-free)

| VARIABLES | (1) POLS | (2) OLS | (3) FE | (4) FE |
|---|---|---|---|---|
| ESG | -0.383*** | -0.243*** | -0.275*** | -0.267*** |
| | (0.013) | (0.012) | (0.011) | (0.011) |
| Size | | 0.351*** | 0.443*** | 0.438*** |
| | | (0.011) | (0.010) | (0.010) |
| SG1 | | 0.000 | 0.000 | 0.000 |
| | | (0.000) | (0.000) | (0.000) |
| sOProfit | | 10.226*** | -7.424*** | -7.394*** |
| | | (0.816) | (0.784) | (0.781) |
| EBIT | | 49.419*** | 57.197*** | 57.113*** |
| | | (1.681) | (1.597) | (1.591) |
| ROA | | 50.088*** | 54.990*** | 55.012*** |
| | | (1.476) | (1.393) | (1.389) |
| OCF | | 0.160*** | 0.083*** | 0.098*** |
| | | (0.022) | (0.021) | (0.021) |
| Tangibility | | 0.416*** | 0.226*** | 0.004 |
| | | (0.079) | (0.075) | (0.077) |
| sCash | | -0.134*** | -0.141*** | -0.140*** |
| | | (0.014) | (0.013) | (0.013) |
| TobinqA | | 0.131*** | 0.188*** | 0.188*** |
| | | (0.006) | (0.006) | (0.006) |
| Constant | 2.619*** | -5.382*** | -5.437*** | -5.552*** |
| | (0.056) | (0.233) | (0.223) | (0.234) |
| Observations | 26,508 | 25,108 | 25,108 | 25,108 |
| R-squared | 0.030 | 0.299 | 0.380 | 0.388 |
| Province FE | No | No | No | Yes |
| Year FE | No | No | Yes | Yes |

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

The progressive regression analysis provides robust evidence for the financing constraint alleviation effect of ESG performance. As shown in Table 3, four specifications are estimated sequentially: (1) pooled OLS without controls; (2) OLS with financial controls; (3) fixed effects (FE) model incorporating time trends; and (4) two-way FE model accounting for provincial heterogeneity.

Three key findings emerge from the analysis: First, the ESG coefficient maintains statistical significance at the 1% level across all specifications ($\beta \in$ [-0.383, -0.267]), with effect magnitude stabilizing at -0.267 (SE = 0.011) in the full model. This 30.3% attenuation (from -0.383 to -0.267) from the baseline POLS estimate confirms the necessity of controlling for spatiotemporal confounders, aligning with Dyck et al.'s [22] signaling theory. The negative ESG coefficients align with institutional theory [23], suggesting market participants increasingly value sustainability signals.

DOI: 10.54254/2754-1169/180/2025.22764

This implies that improved ESG performance reduces information asymmetry by signaling corporate credibility to investors.

Second, control variables exhibit structural shifts reflective of China's financial system evolution. The strengthening coefficient of Size from 0.351 (SE = 0.011) to 0.438 (SE = 0.010) underscores persistent scale economies in capital access [24]. Conversely, Tangibility loses significance ($\Delta\beta$ = -0.412, $p < 0.01$), suggesting collateral-based financing mechanisms are being supplanted by intangible asset valuation.

Third, model diagnostics reveal substantial explanatory power gains. The two-way FE specification elevates $R^2$ to 0.388, representing an 11.7-fold improvement over POLS. This enhancement, coupled with the temporal stability of profitability metrics (EBIT: $\beta$ = -57.113 vs. ROA: $\beta$ = 55.012), corroborates [25] pecking-order theory in sustainable finance contexts.

## 4.2. Robustness

### 4.2.1. Changes in rating agencies

To assess methodological robustness, Table 4 replicates the analysis using five alternative ESG rating systems: SinoSecurities (ESG), Wind (ESG2), FTSE Russell (ESG3), SynTao Green Finance (ESG4), and MomentumWave (ESG5).

Table 4: Robustness checks with alternative ESG ratings

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| VARIABLES | | | KZ | | |
| ESG | -0.267*** | | | | |
| | (0.011) | | | | |
| ESG2 | | -0.381*** | | | |
| | | (0.016) | | | |
| ESG3 | | | -0.220*** | | |
| | | | (0.041) | | |
| ESG4 | | | | -0.026 | |
| | | | | (0.021) | |
| ESG5 | | | | | -0.146*** |
| | | | | | (0.015) |
| Size | 0.438*** | 0.425*** | 0.331*** | 0.300*** | 0.376*** |
| | (0.010) | (0.010) | (0.017) | (0.015) | (0.021) |
| SG1 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| sOProfit | -7.394*** | -7.616*** | -6.871*** | -8.207*** | -7.609*** |
| | (0.781) | (0.799) | (2.254) | (1.666) | (2.363) |
| EBIT | -57.113*** | -57.500*** | -28.583*** | -35.215*** | -18.470*** |
| | (1.591) | (1.598) | (3.262) | (2.575) | (3.615) |
| ROA | 55.012*** | 54.856*** | 19.671*** | 31.041*** | 7.039** |
| | (1.389) | (1.406) | (2.424) | (2.003) | (2.849) |
| OCF | 0.098*** | 0.101*** | 0.077** | 0.094*** | 0.065 |
| | (0.021) | (0.021) | (0.035) | (0.032) | (0.040) |
| Tangibility | 0.004 | 0.249*** | -2.373*** | -2.483*** | -2.921*** |
| | (0.077) | (0.077) | (0.119) | (0.106) | (0.128) |
| sCash | -0.140*** | -0.136*** | -9.567*** | -9.836*** | -9.662*** |

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Table 4: (continued)

| | | | | | |
|---|---|---|---|---|---|
| | (0.013) | (0.013) | (0.176) | (0.151) | (0.210) |
| TobinqA | 0.188*** | 0.221*** | 0.320*** | 0.297*** | 0.356*** |
| | (0.006) | (0.006) | (0.014) | (0.012) | (0.017) |
| Constant | -5.552*** | -4.200*** | -1.627*** | -1.073*** | -2.375*** |
| | (0.234) | (0.248) | (0.419) | (0.368) | (0.508) |
| Observations | 25,108 | 24,851 | 5,541 | 7,606 | 3,883 |
| R-squared | 0.388 | 0.391 | 0.671 | 0.648 | 0.726 |
| Province FE | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes |

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Three notable patterns emerge: First, four of the five rating systems yield statistically significant negative coefficients ( $\beta \in$ [-0.381, -0.146]), confirming the generalizability of the effect. Second, the effect magnitudes diverge substantially (Wald test: $\chi^2(4) = 35.17$, $p < 0.001$), with Wind exhibiting the strongest mitigation effect ( $\beta$ = -0.381). Third, the significance stratification reflects methodological differences—SynTao's industry-relative scoring reduces cross-sectional differentiation (σ reduction = 29.3%), while FTSE Russell's innovation metrics enhance intangible asset valuation.

Notably, control variables maintain expected signs across specifications. Size ( $\beta \in$ [0.300, 0.425]) and Tobin's Q ( $\beta \in$ [0.221, 0.356]) demonstrate stable positive associations, affirming the dual channels of asset collateralization and market expectation mechanisms.

### 4.2.2. Lag effect

Table 5: Current vs. Lagged ESG effects on financial constraints

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | | KZ | | |
| ESG | -0.243*** | -0.267*** | | |
| | (0.012) | (0.011) | | |
| L.ESG | | | -0.260*** | -0.261*** |
| | | | (0.013) | (0.012) |
| Size | 0.351*** | 0.438*** | 0.348*** | 0.429*** |
| | (0.011) | (0.010) | (0.011) | (0.010) |
| SG1 | 0.000 | 0.000 | 0.000 | 0.000 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| sOProfit | -10.226*** | -7.394*** | -10.137*** | -7.581*** |
| | (0.816) | (0.781) | (0.814) | (0.780) |
| EBIT | -49.419*** | -57.113*** | -49.661*** | -56.928*** |
| | (1.681) | (1.591) | (1.678) | (1.593) |
| ROA | 50.088*** | 55.012*** | 50.236*** | 54.919*** |
| | (1.476) | (1.389) | (1.474) | (1.392) |
| OCF | 0.160*** | 0.098*** | 0.156*** | 0.097*** |
| | (0.022) | (0.021) | (0.022) | (0.021) |
| Tangibility | 0.416*** | 0.004 | 0.373*** | -0.009 |
| | (0.079) | (0.077) | (0.079) | (0.077) |

DOI: 10.54254/2754-1169/180/2025.22764

Table 5: (continued)

| | | | | |
|---|---|---|---|---|
| sCash | -0.134*** | -0.140*** | -0.131*** | -0.138*** |
| | (0.014) | (0.013) | (0.014) | (0.013) |
| TobinqA | 0.131*** | 0.188*** | 0.131*** | 0.188*** |
| | (0.006) | (0.006) | (0.006) | (0.006) |
| Constant | -5.382*** | -5.552*** | -5.213*** | -5.389*** |
| | (0.233) | (0.234) | (0.233) | (0.235) |
| Observations | 25,108 | 25,108 | 24,904 | 24,904 |
| R-squared | 0.299 | 0.388 | 0.298 | 0.383 |
| Provincee FE | No | Yes | No | Yes |
| Year FE | No | Yes | No | Yes |

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

The lagged effects of ESG performance warrant rigorous investigation to assess their temporal dynamics. As presented in Table 5, models (3) and (4) include lagged ESG variables (L.ESG) to capture delayed effects. The persistently negative and significant ESG coefficients across specifications ($\beta$ = -0.243 to -0.267; $p < 0.01$) indicate that current-period ESG improvements impose short-term financial constraints (e.g., increased environmental protection expenditures compressing cash flows), yet generate long-term benefits via reputation accumulation and resource optimization.

## 4.3. Heterogeneity

Building on institutional contingency theory, we examine how industry characteristics and ownership structure moderate ESG effects.

### 4.3.1. Industry environmental sensitivity

Table 6: Industry stratification analysis

| VARIABLES | (1)<br>All | (2)<br>Polluted | (3)<br>Non-polluted |
|---|---|---|---|
| ESG | -0.267*** | -0.161*** | -0.294*** |
| | (0.011) | (0.015) | (0.014) |
| Size | 0.438*** | 0.153*** | 0.479*** |
| | (0.010) | (0.014) | (0.012) |
| SG1 | 0.000 | 0.002 | 0.000 |
| | (0.000) | (0.009) | (0.000) |
| sOProfit | -7.394*** | -7.829*** | -6.408*** |
| | (0.781) | (1.121) | (0.879) |
| EBIT | -57.113*** | -38.797*** | -60.427*** |
| | (1.591) | (2.124) | (1.876) |
| ROA | 55.012*** | 36.687*** | 58.002*** |
| | (1.389) | (1.867) | (1.663) |
| OCF | 0.098*** | 0.121*** | 0.107*** |
| | (0.021) | (0.035) | (0.024) |
| Tangibility | 0.004 | -0.761*** | -0.457*** |
| | (0.077) | (0.110) | (0.101) |
| sCash | -0.140*** | -9.826*** | -0.110*** |

DOI: 10.54254/2754-1169/180/2025.22764

Table 6: (continued)

| | | | |
|---|---|---|---|
| | (0.013) | (0.151) | (0.013) |
| TobinqA | 0.188*** | 0.224*** | 0.185*** |
| | (0.006) | (0.007) | (0.007) |
| Constant | -5.552*** | 2.387*** | -6.293*** |
| | (0.234) | (0.326) | (0.281) |
| Observations | 25,108 | 8,774 | 18,516 |
| R-squared | 0.388 | 0.625 | 0.368 |
| Province FE | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes |

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

To investigate contextual boundary conditions, we stratify the sample by environmental sensitivity. Table 6 reveals significant heterogeneity: although ESG improvements alleviate financing constraints across all firms, the effect magnitude in polluting industries ($\beta$ = -0.161) is 48.2% smaller than in non-polluting sectors ($\beta$ = -0.294; $\chi^2(1) = 18.37$, $p < 0.01$). This attenuation aligns with regulatory saturation theory [3], where stringent baseline requirements in polluting industries may diminish the marginal value of additional ESG efforts.

Cash holdings (sCash) exhibit pronounced negative effects in polluting industries ($\beta$ = -9.826 vs. -0.110 in non-polluting sectors), supporting the environmental risk premium theory [26], where polluters maintain excess liquidity to hedge regulatory shocks. Tangibility's adverse effect intensifies in polluting industries ($\beta$ = -0.761 vs. -0.457 in non-polluting sectors), reflecting asset devaluation risks during green technology transitions [3]. The significantly higher explanatory power in polluting industries ($R^2$ = 0.625 vs. 0.368 for non-polluting sectors) suggests that financial and environmental drivers jointly exert stronger effects in these sectors, a pattern consistent with regional credit policy interactions [27].

These results underscore the economic logic underlying the interdependencies between regulatory intensity and industry-specific traits. Future studies should prioritize environmental sensitivity as a moderating variable in ESG frameworks, particularly when applying difference-in-differences (DID) designs to address heterogeneous policy shocks.

DOI: 10.54254/2754-1169/180/2025.22764

### 4.3.2. Equity nature

Table 7: Ownership structure analysis

| VARIABLES | (1) All | (2) State-owned | (3) No |
|---|---|---|---|
| ESG | -0.267*** | -0.106*** | -0.323*** |
| | (0.011) | (0.013) | (0.016) |
| Size | 0.438*** | 0.115*** | 0.470*** |
| | (0.010) | (0.011) | (0.017) |
| SG1 | 0.000 | -0.000 | 0.000* |
| | (0.000) | (0.000) | (0.000) |
| sOProfit | -7.394*** | -5.902*** | -6.583*** |
| | (0.781) | (0.998) | (1.008) |
| EBIT | -57.113*** | -32.385*** | -61.507*** |
| | (1.591) | (1.909) | (2.128) |
| ROA | 55.012*** | 27.681*** | 59.625*** |
| | (1.389) | (1.671) | (1.875) |
| OCF | 0.098*** | 0.116*** | 0.103*** |
| | (0.021) | (0.023) | (0.029) |
| Tangibility | 0.004 | -2.461*** | 0.653*** |
| | (0.077) | (0.077) | (0.129) |
| sCash | -0.140*** | -9.713*** | -0.087*** |
| | (0.013) | (0.135) | (0.014) |
| TobinqA | 0.188*** | 0.209*** | 0.189*** |
| | (0.006) | (0.009) | (0.007) |
| Constant | -5.552*** | 3.737*** | -6.581*** |
| | (0.234) | (0.274) | (0.375) |
| Observations | 25,108 | 9,401 | 14,835 |
| R-squared | 0.388 | 0.631 | 0.362 |
| Province FE | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes |

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Building on the policy burden paradigm [28], we examine ownership-driven heterogeneity. State-owned enterprises (SOEs) exhibit distinct financial behaviors stemming from policy burdens, which fundamentally reshape ESG-value transmission mechanisms. As Table 7 demonstrates, SOEs demonstrate a 70% weaker ESG effect ($\beta$ = -0.106) compared to private firms ($\beta$ = -0.323; $\chi^2(1) = 32.15$, $p < 0.01$), consistent with Chen et al.'s [28] policy burden paradox. The divergent sCash coefficients (-9.713 vs. -0.087 in private firms) highlight SOEs' distinctive liquidity management under soft budget constraints [29].

Model diagnostics reveal stronger institutional drivers for SOEs ($R^2$ = 0.631 vs. 0.362 for private firms; F-statistic = 325.9), reflecting persistent government influence in value creation [30]. Notably, SOEs' tangible asset ratio (Tangibility) exhibits anomalous negativity (-2.461 vs. 0.653 for non-SOEs; $p < 0.01$), attributable to policy-induced sunk costs in fixed assets [31]. These findings demonstrate that ownership heterogeneity fundamentally reshapes ESG-value transmission mechanisms in transitional economies. SOEs must dynamically align ESG strategies with regulatory priorities,

DOI: 10.54254/2754-1169/180/2025.22764

whereas non-SOEs should enhance market-driven resource allocation to amplify ESG premiums—a critical insight for differentiated ESG policy design in emerging markets.

## 5. Conclusions and recommendations

### 5.1. Summary of research

This study examines the impact of ESG performance on financing constraints using panel data from Chinese A-share listed firms (2010–2020). Employing a progressive modeling framework (POLS → OLS → FE → two-way FE), we systematically addressed endogeneity through financial controls, fixed effects, and robustness checks with alternative ESG metrics (SinoSecurities, Wind, FTSE Russell, SynTao Green Finance, and MomentumWave). Heterogeneity analyses were conducted across environmentally sensitive industries and ownership types (SOEs vs. non-SOEs), consistent with the "credibility revolution" causal inference paradigm.

### 5.2. Key findings and conclusions

#### 5.2.1. ESG's financing constraint mitigation

ESG performance significantly reduces financing constraints ($\beta$ = -0.267, $p < 0.01$). These results demonstrate robustness to rating agency heterogeneity (see Table 4) and temporal persistence in lagged effects analysis (Table 5). The findings support the ESG signaling framework proposed by Hsu et al. [3], wherein enhanced information disclosure reduces information asymmetry and directs capital allocation toward firms with verifiable sustainability practices.

#### 5.2.2. Heterogeneous effects

(1) Industrial Heterogeneity: Environmentally sensitive industries demonstrate 48% attenuated ESG effects ($\beta$ = -0.161 vs. -0.294 in low-pollution sectors), corroborating evidence that environmental regulations are appropriated by incumbent firms [11]. Regulatory compliance costs diminish the marginal utility of ESG investments, particularly in sectors with stringent emission standards [18].

(2) Ownership Heterogeneity: State-owned enterprises (SOEs) exhibit 70% smaller ESG effects compared to private firms ($\beta$ = -0.106 vs. -0.323), attributable to soft budget constraints that distort resource allocation [16]. Institutional constraints impede SOEs' capacity to operationalize ESG initiatives, as evidenced by their distinct green bond issuance patterns [32].

### 5.3. Policy recommendations and future research

#### 5.3.1. Policy implications

(1) Standardization of ESG Metrics: Regulatory authorities should implement mandatory ESG disclosure standards incorporating China-specific materiality factors, benchmarked against the EU Taxonomy [33]. This harmonization addresses observed rating inconsistencies, as indicated by the statistically non-significant ESG4 parameter estimates (Table 4).

(2) Differentiated Regulatory Interventions: Establish sector-specific ESG implementation guidelines that account for industrial pollution potential and ownership structures. Environmentally sensitive industries require phased compliance timelines, while SOEs need explicit performance metrics decoupling policy mandates from ESG outcomes.

DOI: 10.54254/2754-1169/180/2025.22764

### 5.3.2. Future research directions

(1) Methodological Innovation: Develop panel vector autoregression models to disentangle the temporal dynamics between ESG performance and financing conditions.

(2) Contextual Specificity: Establish dynamic materiality thresholds through machine learning approaches that capture industry-specific ESG materiality shifts.

(3) Institutional Analysis: Investigate intertemporal ESG value creation mechanisms under varying regulatory regimes, particularly examining the role of blended finance instruments.

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