

An Investigation into the Effects of Environmental, Social, and Corporate Governance (ESG) Performance and Financing Limitations on Total Factor Productivity

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Abstract: As the Chinese government increasingly prioritizes high-quality and sustainable economic development, Environmental, Social, and Corporate Governance (ESG) performance and Total Factor Productivity (TFP) have become central topics in academic research. This study focuses on non-state-owned enterprises in China, analyzing the impact of ESG performance on TFP and exploring the mediating role of financing constraints in this relationship. The findings indicate that alleviating financing constraints can enhance TFP, while strong ESG performance helps to ease these constraints, thereby further promoting productivity growth. Financing constraints play an intermediary role between ESG and TFP, revealing pathways for enterprises to improve TFP and elaborating on the mechanisms through which ESG performance exerts its influence.

Keywords: ESG performance; Financing Constraints; Mediating Effect; Non-State-Owned Enterprises; Total Factor Productivity

1. Introduction

The Chinese economy is presently navigating a strategic shift toward enhancing both the quality and efficiency of growth while promoting sustainable development. The guiding framework of “innovation, coordination, green development, openness, and sharing” has emerged as a cornerstone, orienting economic progress toward these goals. Total factor productivity (TFP) stands as a vital measure of high-quality development, representing the efficiency of production over time by assessing the aggregate output generated by all inputs in economic activities. TFP is often regarded as a

primary factor in explaining differences in growth and development levels across various economies.

Environmental, Social, and Corporate Governance (ESG) principles closely support the aim of high-quality development. ESG performance assesses a company’s success in areas such as environmental stewardship, social responsibility, and governance practices. In today’s sustainability-oriented environment, ESG performance has become a critical indicator of a company’s growth potential and future outlook, as well as an essential factor for investors in their decision-making processes.

To achieve the goal of transforming China’s economic development strategy, we must start from the micro entity - enterprises, based on the micro entity [1]. In contemporary China’s national economy, non-state-owned enterprises (NSOEs) are playing an increasingly important role. Compared to state-owned enterprises, NSOEs have many advantages in terms of innovation, market competitiveness, capital allocation, entrepreneurial spirit, employment opportunities, service quality, and social responsibility. Their vitality and creativity have driven sustained economic growth and structural adjustment, contributing significantly to the prosperity and development of China. NSOEs are playing an increasingly important role in economic development and reflect the current and future outlook of the country’s market economy.

This study examines non-state-owned enterprises within publicly traded companies, investigating strategies for these businesses to enhance total factor productivity (TFP), with particular attention to how ESG performance influences TFP.

2. Theoretical Framework and Hypothesis

Development

2.1 ESG Performance and Enterprise Total Factor Productivity

According to signal transmission theory, strong ESG performance enables a company to send favorable signals to the capital market. By expanding stakeholders' awareness of the company's non-financial information, this increases the green responsibility investment premium and risk premium in the capital market under the concept of green development. This demonstrates that the company actively fulfills its environmental and social responsibilities and maintains a good image of orderly corporate governance. As a result, the company can attract more social capital and strategic resources, such as talented individuals. These heterogeneous strategic resources are key to implementing the company's core technology development and value creation capabilities, thus providing critical support for optimizing the company's strategic resource allocation, enhancing resource integration, and building core competitiveness. This lays a solid foundation for improving the company's TFP.

Second, according to stakeholder theory, companies are embedded in society in various ways. By actively responding to and addressing the demands of different stakeholders, they gain society's trust, which promotes high-quality development. Good ESG performance helps companies build more robust relationships with stakeholders, maintain continuous positive interactions, and enhance market competitiveness. For example, employees, as internal stakeholders, when perceiving the positive signals of good ESG performance, may feel an increased sense of responsibility toward the organization, thereby improving production and management efficiency. These prospective returns enable companies to gather resources, generate economic and social value, and support high-quality development, which in turn enhances total factor productivity (TFP) [2]. Building on this foundation, the following hypothesis is proposed:

H1: Strong ESG performance can facilitate the improvement of corporate TFP

2.2 ESG Performance and Corporate Financing Constraints

Based on information asymmetry theory, information asymmetry is a primary factor

limiting corporate financing in imperfect capital markets. This means that the party seeking financing has more comprehensive and accurate information about its situation and risks than the investors, leading investors to demand higher risk premiums from the financing party, thereby aggravating financing constraints. In this case, actively disclosing corporate information can reduce financing constraints and put the financing party in a more favorable position. Good ESG performance will help increase ESG information transparency and reduce the degree of information asymmetry [3], thereby alleviating investors' concerns about corporate uncertainty risks and easing financing constraints.

Second, based on agency theory, corporate agents manage the company on behalf of the principals. In this process, agents may act in their own interests, disregarding the principals' interests, resulting in agency costs. The presence of agency costs may cause investment institutions to distrust the behavior and decisions of corporate agents, leading to a loss of interest in investing. However, good ESG performance demonstrates a company's strong sense of social responsibility and high level of corporate governance [4], thereby enhancing corporate credibility, reducing external investors' concerns about agency costs, and lowering investors' risk premiums. This, in turn, alleviates financing constraints and improves corporate financing capacity. Thus, the following hypothesis is proposed:

H2: Strong corporate ESG performance can reduce financing constraints.

2.3 Financing Constraints and Corporate Total Factor Productivity

Financing constraints limit access to capital, compelling firms to seek alternative funding sources. However, these sources frequently carry greater risks and uncertainties, raising the cost of securing essential capital. These constraints reduce the availability of external loanable funds [5], thereby obstructing corporate financing. Due to the presence of information asymmetry, a company's financing structure may not reach an optimal state, which, in turn, affects productivity. Second, financing constraints reduce corporate R&D investment, leading to stagnation in labor technology, production technology, and related innovation activities, ultimately limiting the improvement of total factor productivity. When

companies face strong financing constraints, they lack the funds to invest in relevant corporate activities [6], making it impossible to enhance production efficiency.

Financing restrictions lead to higher debt costs, reduce the scale of investment, constrain project selection, and ultimately impede both economic transformation and business growth. As these financing limitations become more severe, a firm's capital structure is also affected [7], obstructing the achievement of an ideal capital structure, which consequently influences corporate productivity. Building on this analysis, we propose the following hypothesis:

H3: Reducing financing constraints can enhance a firm's total factor productivity (TFP).

2.4 The Interplay between ESG Performance, Financing Limitations, and Corporate Total Factor Productivity

Companies with robust ESG performance often garner increased attention and support from investors, improving their likelihood of issuing bonds, obtaining bank loans [8], and accessing other types of financial assistance. These resources can enable companies to pursue sustainable growth and boost productivity.

Second, companies with good ESG performance can obtain lower costs for equity financing [9], debt financing, and bank loans, among other favorable financing conditions. These preferential conditions eventually lead to an increase in TFP.

Lastly, companies with good ESG performance often receive greater societal recognition and support in the financing market. This recognition and support help companies build better brand

images, enhance reputation and credibility, and create more business opportunities, such as attracting more partners, customers, and better employee recruitment, thereby further promoting corporate development and productivity improvement. Based on the above analysis, the following hypothesis is proposed:

H4: ESG performance can enhance corporate TFP by reducing financing constraints, with financing constraints acting as a mediating factor in the process by which ESG performance promotes improvements in TFP.

3. Research Methods and Models

3.1 Sample Data

This study focuses on non-state-owned enterprises listed on A-shares in Shanghai and Shenzhen from 2016 to 2021. After excluding financial and real estate companies, as well as companies classified as ST or *ST, a final sample of 6,949 data points was obtained. The Huazheng ESG rating's comprehensive score is used to represent each company's ESG performance, with data sourced from the Wind database. The LP method is used to calculate corporate TFP, and other financial data are sourced from the GTA (Guo Tai An) database. Stata 16.0 software is employed for empirical analysis.

3.2 Definition of Variables

3.2.1 Dependent Variable: Total Factor Productivity (TFP)

This study follows Xie Haizuan's method (as outlined in [10]) to calculate TFP, based on the following enterprise production function:

$$\ln Y_{i,t} = \lambda_0 + \lambda_1 \ln PPE_{i,t} + \lambda_2 \ln NUM_{i,t} + \lambda_3 \ln M_{i,t} + \varepsilon_{i,t} \quad (1)$$

current year.

3.2.2 Independent Variable: ESG Performance (ESG)

The Huazheng ESG rating is used to measure a company's ESG performance, as it offers high update frequency and broad company coverage. This study utilizes the comprehensive score from the Huazheng ESG rating.

3.2.3 Mediating Variable: Financing Constraints (SA)

This study employs the SA index, developed by Hadlock [11], to assess financing constraints. The specific formula is as follows:

$$SA = -0.737 \times Size + 0.043 \times Size^2 - 0.040 \times Age \quad (2)$$

Where:

$Y_{i,t}$ represents the enterprise's operating revenue for the current year;

$PPE_{i,t}$ denotes the enterprise's net fixed assets, representing capital input;

$NUM_{i,t}$ is the number of employees, representing labor input;

$M_{i,t}$ refers to the sum of operating costs and the three major expenses, minus depreciation, amortization, and cash paid to employees and on behalf of employees;

$\varepsilon_{i,t}$ represents the enterprise's TFP for the

Where:

Size is the natural logarithm of the company's assets, logged in units of million yuan;

Age represents the company's age.

3.2.4 Control Variables

Following prior research, this study controls for

year and industry fixed effects and includes asset-liability ratio (Lev), return on total assets (ROA), and physical asset ratio (TAR) as control variables. Table 1 provides definitions for all variables used in this study.

Table 1. Definitions and Descriptions of Variables

Definitions of Variables			
Variable Nature	Variable Name	Variable Symbol	Variable Description
Dependent Variable	Corporate Total Factor Productivity	TFP_LP	Total factor productivity of enterprises calculated using the LP method
Independent Variable	ESG Performance	ESG	Comprehensive score of Huazheng ESG rating
Mediating Variable	Financing Constraints	SA	Absolute value of corporate financing constraints
Control Variable	Asset-Liability Ratio	Lev	Total liabilities/Total assets
	Return on Assets	ROA	Annual net profit/Average total assets
	Tangible Asset Ratio	TAR	(Inventory + Net fixed assets) / Total assets

3.3 Model Specification

(1) To analyze the impact of ESG performance on corporate TFP, the following Model 1 is constructed:

$$TFP = \beta_0 + \beta_1 ESG + \sum_{i=2} \beta_i contr_i + \varepsilon \quad (3)$$

(2) To examine the effect of ESG performance on financing constraints, the following Model 2 is constructed:

$$SA = \beta_0 + \beta_1 ESG + \sum_{i=2} \beta_i contr_i + \varepsilon \quad (4)$$

(3) To investigate the impact of financing constraints on corporate TFP, the following Model 3 is constructed:

$$TFP = \beta_0 + \beta_1 SA + \sum_{i=2} \beta_i contr_i + \varepsilon \quad (5)$$

(4) To examine the mediating role of financing constraints, the following Model 4 is constructed:

$$TFP = \beta_0 + \beta_1 ESG + \beta_2 SA + \sum_{i=3} \beta_i contr_i + \varepsilon \quad (6)$$

4. Empirical Analysis and Results

4.1 Descriptive Analysis and Correlation Coefficients

The descriptive statistics and correlation matrix for the study's variables are presented in Tables 2 and 3. Table 2 reveals that TFP has a range from 5.7058 to 12.1755, with a standard deviation of 0.7756, indicating a notable degree of variation in enterprise development quality. ESG has an average score of 72.6791 and a standard deviation of 5.6137, suggesting strong overall ESG performance among the sampled firms, albeit with considerable variation across entities.

Table 3 details the correlations between key variables, including dependent, independent, and mediating factors. All correlations are statistically significant at the 1% level, with coefficients under 0.5, which suggests that the variables chosen are well-suited for the analysis and do not suffer from significant multicollinearity issues.

Table 2. Descriptive Statistics

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
TFP	6949	7.7000	0.7756	5.7058	12.1755
ESG	6949	72.6791	5.6137	46.7500	88.53
SA	6949	3.8317	0.1957	2.7084	4.6964
Lev	6949	0.4016	0.4378	0.0098	31.4667
ROA	6949	0.0508	0.1493	-4.1553	8.3179
TAR	6949	0.3142	0.1595	0.0000	0.9542

Table 3. Correlation Matrix of Variables

	TFP	ESG	SA	Lev	ROA	TAR
TFP	1					
ESG	0.143***	1				

SA	-0.071***	-0.051***	1			
Lev	0.019	-0.021*	0.052***	1		
ROA	0.100***	0.113***	-0.024***	-0.001	1	
TAR	0.037***	-0.017	0.076***	0.063	0.001	1

Note: *P < 0.1, **P < 0.05, ***P < 0.01. Standard errors are shown in parentheses.

Table 4. Regression Analysis Results

	Model 1 (TFP)	Model 2 (SA)	Model 3 (TFP)	Model 4 (TFP)
ESG	0.0177*** (0.0015)	-0.0016*** (0.0004)		0.0172*** (0.0015)
SA			-0.3621*** (0.0450)	-0.3392*** (0.0446)
Lev	0.0218 (0.0190)	0.0157*** (0.0051)	0.0242 (0.0191)	0.0271 (0.0189)
ROA	0.4478*** (0.0564)	-0.0295*** (0.0152)	0.5149*** (0.0563)	0.4377*** (0.0562)
TAR	0.0444 (0.0525)	0.0911*** (0.0141)	0.0713 (0.0529)	0.0753 (0.0525)
cons	5.7442*** (0.1683)	3.8465*** (0.0453)	8.2752*** (0.2158)	7.0490*** (0.2399)
Year	YES	YES	YES	YES
Industry	YES	YES	YES	YES
N	6949	6949	6949	6949
F	25.48	11.73	24.36	26.10
R ²	0.2244	0.1175	0.2167	0.2309

Note: *P < 0.1, **P < 0.05, ***P < 0.01. Standard errors are shown in parentheses.

4.2 Regression Analysis Results

The first column in Table 4 shows the regression outcomes for the dependent, explanatory, and control variables. The ESG-TFP coefficient is 0.0177, implying that, controlling for other factors, each 1-unit increase in ESG is associated with an average 0.0177-unit rise in TFP. This result is statistically significant at the 1% level, thus supporting Hypothesis H1.

The second column presents the regression of ESG on SA, yielding a coefficient of -0.0016. This means that, with other variables held constant, a 1-unit increase in ESG corresponds to an average 0.0016-unit decrease in SA, which is also significant at the 1% level. This result indicates that high ESG performance may help reduce a company's financing limitations, supporting Hypothesis H2.

In the third column, the regression between SA and TFP yields a coefficient of -0.3621, suggesting that a 1-unit decrease in SA leads to an average increase of 0.3621 units in TFP. This finding, significant at the 1% level, implies that

easing financing restrictions can enhance a company's TFP, supporting Hypothesis H3.

The fourth column of Table 4 shows that, when the mediator variable SA is included, ESG continues to have a positive effect on TFP at the 1% significance level, while SA retains its significant negative effect on TFP at the same level. From the combined results of Models 1, 2, and 4, it can be inferred that financing constraints mediate the relationship between ESG and TFP, thereby validating Hypothesis H4.

4.3 Bootstrap Analysis

A Bootstrap test, summarized in Table 5, was conducted to confirm the mediating role of financing constraints. The confidence interval for ESG's indirect effect on TFP ranges from (0.0002, 0.0008), and the direct effect has a confidence interval of (0.0129, 0.0215), with neither interval including 0. These findings highlight significant indirect and direct effects, indicating that the Bootstrap results align with the regression analysis.

Table 5. Bootstrap Test Results

VAR	effect	Observed Coef.	P	Normal based [95% Cn of Interval]	
RiskT	indirect	0.0005	0.001	0.0002	0.0008
	direct	0.0172	0.000	0.0129	0.0215

4.4 Robustness Test

The ESG score from Sino-Sustainability was used as an alternative to Huazheng ESG ratings,

with the new score denoted as ESG1. Perform regression analysis again, the results are consistent with the conclusions of the original regression analysis, as detailed in Table 6.

Table 6. Robustness Regression Analysis Results

	Model 1 (TFP)	Model 2 (SA)	Model 3 (TFP)	Model 4 (TFP)
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ESG1	0.0150*** (0.0009)	-0.0008*** (0.0002)		0.0147*** (0.0009)
SA			-0.3621*** (0.0450)	-0.3305*** (0.0441)
Lev	0.0177 (0.0187)	0.0160*** (0.0051)	0.0242 (0.0191)	0.0229 (0.0187)
ROA	0.1400** (0.0597)	-0.0154 (0.0163)	0.5149*** (0.0563)	0.1349** (0.0595)
TAR	0.0380 (0.0519)	0.0917*** (0.0141)	0.0713 (0.0529)	0.0683 (0.0518)
cons	6.5894*** (0.1340)	3.7615*** (0.0365)	8.2752*** (0.2158)	7.8327*** (0.2129)
Year	YES	YES	YES	YES
Industry	YES	YES	YES	YES
N	6949	6949	6949	6949
F	28.19	11.70	24.36	28.77
R ²	0.2425	0.1173	0.2167	0.2486
Note: *P < 0.1, **P < 0.05, ***P < 0.01. Standard errors are shown in parentheses.				

5. Conclusion

This study focuses on non-state-owned enterprises listed on the Shanghai and Shenzhen A-share markets with Huazheng ESG ratings from 2016 to 2021, analyzing the influence of ESG performance on corporate total factor productivity (TFP). The results demonstrate that enhanced ESG performance can alleviate financing constraints for companies, which in turn positively affects TFP. Additionally, strong ESG performance has a direct positive impact on TFP, with financing constraints serving as a mediating factor in this relationship.

To motivate companies to actively adopt ESG practices and promote higher-quality development alongside TFP growth, the following recommendations are made:

Corporate Level: Companies are encouraged to embrace ESG management practices, increase transparency in ESG disclosures, and develop forward-looking ESG investment strategies.

Government Level: The government should enhance financial support for non-state-owned enterprises, improve the institutional environment, establish comprehensive ESG disclosure frameworks for publicly traded companies, and create specialized agencies to manage ESG-related issues.

Acknowledgments

This work was supported by the "Study on the Construction of Regional Innovation Evaluation System for Langfang City's Adaptation to New Productivity Development" (2024029026)

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