

Research on the Impact of ESG Performance on Enterprise Total Factor Productivity

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Abstract. The environmental, social, and governance (ESG) performance of businesses has become a crucial criterion for assessing their long-term value and comprehensive competitiveness as sustainable development becomes more widely accepted. This study aims to explore the actual impact of ESG performance on total factor productivity (TFP), the core operating efficiency of enterprises. It builds a dual-way fixed effect model for empirical testing, using the Levinsohn-Petrin (LP) semi-parametric approach to calculate corporate TFP, and chooses Chinese A-share listed businesses from 2015 to 2024 as the research sample. The results reveal that ESG performance has a notably positive impact on corporate TFP. To guarantee the reliability of the conclusions, this study performs several robustness checks, such as replacing the measurement method of core explanatory variables, eliminating low-quality financial reporting samples, and winnowing the core variables. This study not only provides empirical evidence that ESG can create economic value from the perspective of enterprise production efficiency, but also offers a clear path reference for enterprises to achieve high-quality development by practicing ESG concepts.

Keywords: total factor productivity, ESG performance, high quality development, LP method

1. Introduction

As global attention continues to rise on issues such as climate change, social responsibility and corporate governance, ESG has evolved from a marginal investment concept to a central issue in global capital markets and corporate strategies. In China, the double carbon target is put forward, and the pursuit of common prosperity also pushed the ESG practices to an unprecedented strategic height. Companies are no longer perceived merely as profitmaking machines, but are expected to become key forces driving sustainable development in society.

Against this backdrop, a central business question emerges: Are ESG practices a "burden" that increases costs and erodes profits, or an "engine" that drives innovation and efficiency? This issue has been widely discussed in academic and practical circles. However, most existing research has concentrated on the association between ESG and businesses' financial performance, such as ROA and Tobin's Q, while financial indicators are easily disturbed by short-term factors such as market sentiment and accounting policy choices. In contrast, Total Factor Productivity (TFP) serves as a more essential and holistic indicator for assessing the efficiency of resource allocation.,

technological progress and comprehensive management ability of enterprises, which directly reflects the core efficiency of enterprises to transform inputs into outputs. Therefore, investigating the relationship between enterprise TFP and ESG performance can unveil the inherent transmission mechanism through which ESG practices affect enterprises' long-term value creation. Based on this, this study uses Chinese listed businesses from 2015 to 2024 as the research sample to empirically assess how ESG performance affects corporate total factor productivity. The research provides a clear decision reference for enterprise managers, investors and policy makers.

2. Literature review and research hypotheses

In the context of developing a "double carbon" target, ESG factors on enterprise management have become a crucial area of research. Studies highlight the link between ESG and corporate performance, showing how ESG enhances financial performance, total factor productivity (TFP), and resource allocation efficiency. Based on A-share data from 2010 to 2017, Li et al. confirmed that ESG dimensions significantly promote corporate performance by improving corporate innovation, with greater effects seen in non-state-owned firms and environmentally sensitive sectors [1]. Yan et al. further found that ESG improves financial performance by easing financing constraints and increasing operational efficiency, particularly in small to medium-sized manufacturing enterprises [2]. Zhang Lin cited ESG's positive influence on enterprise value, while Huang Shizhong offered theoretical frameworks underscoring stakeholder engagement, resource dependence, and principal-agent theory [3,4].

Besides, drawing on data from 2011 to 2021, Fu Jialing pointed out that ESG boosts corporate TFP by easing financing constraints and increasing R&D investment., particularly in state-owned and larger enterprises [5]. Tian-tian Li noted that ESG promotes TFP through energy conservation and resource optimization, with heightened sensitivity during extreme weather events [6]. Wang Sanxing refined the innovation mechanism, illustrating how ESG enhances output, efficiency, and quality [7]. Centered on green TFP, Ding Shengyi stressed ESG's function in facilitating green innovation, with a notable emphasis on highly polluting sectors [8].

Further, Gao et al. found that ESG increases investment efficiency by lowering agency costs, while Qiu et al. identified a decrease in financing costs through reduced information asymmetry in an ecological framework [9,10]. However, existing literature often suffers from fragmented evaluation systems and insufficient dynamic analysis related to policy contexts. This paper argues that ESG performance should be viewed as a strategic investment rather than a mere cost. Therefore, this study proposes the following research hypothesis, which will be tested in subsequent empirical models:

H: Corporate ESG performance has a remarkable positive promoting effect on total factor productivity.

3. Research design

3.1. Variable selection

The variables involved in the research include explained variable, explanatory variable and control variable. The explained variable in this study is total factor productivity (Y). As a crucial metric for measuring a firm's resource allocation efficiency and the level of technological progress, TFP can fully reflect the change of enterprise operating efficiency. To estimate TFP, this research uses the semi-parametric Levinsohn-Petrin (LP) technique [11]. This method employs intermediate inputs as

proxy variables for productivity, which can effectively address the issue of sample loss with zero investment and improve the estimation accuracy. ESG performance serves as this paper's primary explanatory variable. The average of all China Securities' ESG rating results for the current year is used to calculate the ESG performance. In addition, in the robustness analysis, the median value derived from all ESG ratings of the enterprise in the current year serves as an alternative metric for assessing its ESG performance., which is denoted as "ESG performance 2".

This study also includes a set of control variables during the empirical analysis to guarantee the validity and reliability of the empirical findings. Table 1 provides information on the development and selection of these control variables.

Table 1. Introduction of control variables

Variables	Way to build
Fixed assets ratio	Net fixed assets divided by total assets at the end of the year
Ratio of assets receivable	Net assets receivable divided by total assets at the end of the current year
Proportion of highly educated employees	Proportion of employees with bachelor degree or above at the end of the year
Enterprise growth	Tobin's Q value at the end of the current year is from the CSMAR database
Employee size	Log the number of employees at the end of the year plus one
Asset-liability ratio	Total liabilities divided by total assets at the end of the year
Size of assets	Total assets of the enterprise at the end of the year (unit: 10 billion yuan)

3.2. Model construction — benchmark regression model

To test the research Hypothesis 1, ESG performance significantly promotes the total factor productivity of enterprises, a linear model including enterprise individual and year fixed effects is constructed.

$$Y_{it} = \alpha + \beta X_{it} + \chi \text{Cont}_{it} + \mu + \eta + \varepsilon_{it} \quad (1)$$

Where Y is the explained variable, representing the total factor productivity of the enterprise; X is the explanatory variable, indicating the ESG performance of the enterprise; Subscripts i and t denote enterprise individual and year respectively; Con denotes various control variables; μ represents the firm individual effect; η is the year effect; And ε represents the random error term. Equation (1) and Hypothesis 1 have the following relationship: if the explanatory variable (X) coefficient estimate is significantly positive, it suggests that ESG performance has a considerable promoting effect on enterprise TFP, and Hypothesis 1 is established.

3.3. Data sources and descriptive statistics of variables

The research samples comprises companies in China during the period 2015–2024. A total of 34,450 observation samples of pertinent financial data are obtained from the CSMAR database. The China City Statistical Yearbook provides city-level data, while the Registration data of Industrial and Commercial Enterprises in China provides information on urban entrepreneurial vitality. Table 2 displays descriptive statistics for the major variables employed in the empirical investigation.

Table 2. Descriptive statistics of variables

Variables	Sample size	Mean value	Standard deviation	Minimum	Maximum
Total factor productivity	34,450	8.997	1.120	5.265	14.35
ESG performance	34,450	4.088	1.046	1	8.500
Fixed asset ratio	34,450	0.201	0.151	0.000	0.929
Ratio of assets receivable	34,450	0.148	0.116	0	0.813
Proportion of highly educated employees	34,450	32.78	22.18	0.190	100
Enterprise growth	34,450	2.114	2.000	0.609	122.2
Employee size	34,450	7.628	1.279	2.485	13.78
Asset-liability ratio	34,450	0.427	0.275	0.00836	31.47
Size of assets	34,450	1.945	9.619	0.00459	318.9

4. Empirical analysis

4.1. Analysis of benchmark regression results

Firstly, the fixed effect test is performed to identify whether mixed regression or FE regression is more appropriate. Then, a Hausman test is performed to decide whether FE regression or RE regression is better. Table 1 displays the outcomes of both tests. FE regression is favored over mixed regression in the fixed effect test because the p-value of the F test is less than 0.01, indicating the presence of a significant fixed effect in Equation (1) at the significance level of 1%; in the Hausman test, the p-value level is less than 0.01, indicating that FE regression is superior to RE regression for Equation (1) at the significance level of 1%. Therefore, based on the empirical results in Table 3, the FE regression method is used for empirical analysis in this paper.

Table 3. Relevant test results of regression method selection

Variables	F-test p-values	Hausman test p values
Fixed effects test	0.000	—
Hausman test	—	0.000

The effect of ESG performance on TFP is examined by regressing equation (1) using the FE approach; the results are shown in Table 4. Without control variables, the ESG performance coefficient in column (1) is 0.062, which is significant at the 1% level. Even after adding more control variables, the ESG performance coefficient in Column (2) is still positive (0.022) and significant at the 1% level. Therefore, whether control variables are introduced or not, ESG performance can significantly improve TFP.

Table 4. Empirical results of the impact of ESG performance on total factor productivity

Variables	(1)	(2)
	Total factor productivity	Total factor productivity
ESG performance	0.062*** (12.490)	0.022*** (5.574)
Fixed assets ratio		-1.325*** (-17.317)
Ratio of assets receivable		0.931*** (10.164)
Proportion of highly educated employees		0.010*** (9.442)
Corporate growth		-0.008** (-2.002)
Size of staff		0.530*** (29.737)
Asset-liability ratio		0.003 (1.600)
Size of assets		0.004 (0.236)
Constant term	8.334*** (350.799)	4.427*** (31.870)
Sample size	34,450	34,450
R-squared	0.156	0.413
Firm effect	Control	Control
Time effect	control	Control
F-statistic	195.8	221.5

Note: T-values are in parentheses, and "*", "**" and "***" indicate significance at the 10%, 5% and 1% levels, respectively. (Same as in Table 5)

4.2. Robustness test

The empirical findings reported in Table 4 verify hypothesis 1 of this paper, but whether this conclusion is robust and reliable needs to be supported by more robustness analysis. Table 5 reports the robustness checks of the benchmark regression outcomes. From three perspectives: first, the ESG performance coefficient continues to be significantly positive after samples with low-quality financial reporting are eliminated, indicating that the financial reporting quality does not change the conclusion; Second, the median of ESG performance is used as a proxy indicator, and the regression results are also significantly positive, confirming that the conclusion is not contingent on the specific measurement methods; Third, after winnowing the core variables, the coefficient of ESG performance is still stable and significant, suggesting that the conclusion is not disturbed by extreme values. In conclusion, ESG performance's positive impact on TFP proves stable under various

specification standards, different samples and different data processing methods, which further strengthens the credibility of Hypothesis 1.

Table 5. Empirical results of the robustness test

Variable	(1) Exclude low-quality financial report samples Total factor productivity	(2) 0.019*** (4.938)	(3) Replace explanatory variables Total factor productivity 0.054*** (12.591)	(4) 0.019*** (5.538)	(5) Core variables are winsorized Total factor productivity _ wind-down 0.061*** (12.342)	(6) 0.022*** (5.530)
ESG performance	0.047*** (10.075)					
ESG performance 2						
ESG performance _ windup						
Fixed assets ratio		-1.345*** (-18.547)		-1.326*** (-17.331)		-1.312*** (-17.463)
Assets receivable ratio		0.839*** (10.083)		0.929*** (10.146)		0.891*** (9.920)
Proportion of highly educated employees		0.009*** (8.761)		0.010*** (9.446)		0.009*** (9.447)
Business growth		-0.007** (-1.974)		-0.008** (-2.007)		-0.004 (-1.384)
Size of staff		0.504*** (26.561)		0.530*** (29.761)		0.523*** (30.320)
Asset-liability ratio		0.003 (1.576)		0.003 (1.611)		0.002 (1.247)
Size of assets		0.295*** (5.884)		0.004 (0.216)		0.006 (0.308)
Constant term	8.413*** (372.533)	4.573*** (31.770)	8.366*** (387.468)	4.437*** (31.918)	8.347*** (353.394)	4.495*** (33.605)
Sample size	32,946	32,946	34,450	34,450	34,450	34,450
R-squared	0.182	0.425	0.155	0.413	0.154	0.411
Firm effect	Control	Control	Control	Control	Control	Control
Time effect	Control	Control	Control	Control	Control	Control
F-statistic	193.9	223.8	194.4	221.8	192.9	223.1

5. Conclusion

The impact of ESG performance on TFP is methodically examined in this study. The following are the main findings from the empirical investigation of 34,450 Chinese listed firms between 2015 and 2024: Corporate TFP is strongly and favorably impacted by ESG performance. The benchmark

regression results demonstrate that each unit improvement in ESG rating will result in a statistically significant rise in a firm's TFP after adjusting for a number of firm-level variables as well as year and industry fixed effects. The reliability of the research conclusion is demonstrated by the consistency of this finding across several robustness tests, such as substituting the measurement method of explanatory variables, removing aberrant samples, and handling extreme values. This shows that ESG practices are neither an empty slogan nor a mere cost center, but rather a strategic investment that can actually be translated into core competitiveness and operational efficiency of enterprises, and those enterprises that regard ESG as an extra cost or public relations burden are foregoing a critical opportunity for long-term development. True long-term value creation comes from responsible and sustainable business practices.

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