

Research On the Impact of ESG Performance on Operating Capacity in Environmental Protection Industry

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Abstract. With the rise of ESG concepts as a hot topic, the topic of corporate Environment. Social. Government(ESG)governance has attracted the attention of scholars. However, there is a lack of research on the relationship between corporate ESG governance and operational capabilities. This article explores the impact and mechanism of ESG performance of listed companies in the environmental protection field on their operational capabilities. Based on quarterly data from 2010 to 2023, this article uses the Topsis model and linear regression analysis to do empirical analysis. Research shows that the comprehensive ESG performance of environmental protection enterprises is significantly positively correlated with their operational capabilities. Enterprises with excellent ESG can improve operational efficiency by effectively reducing sales costs. The study emphasizes the role of ESG in corporate strategy, information transparency, and financing simplification, and suggests that companies strengthen the integration of ESG strategies into their business, transparent disclosure, and internal and external supervision. This article enriches the research on the operational efficiency of ESG in environmental protection enterprises and has practical guidance value for ESG application, policy formulation, and corporate strategy.

Keywords: ESG performance; Environmental protection industry; Operational capability; Cost of goods sold.

1. Introduction

Since the 18th National Congress of the Communist Party of China, China has entered a new stage of development, which put forward new tasks and requirements for strengthening the construction of corporate ecological civilization. The ESG concept advocating environmental, social, and governance information disclosure is highly in line with the era's task of strengthening ecological civilization construction. The ESG concept, as a hot topic in society, has received widespread attention from scholars and businesses in recent years. According to Wind statistics, there are currently 1738 listed companies in China that actively disclose information, with a disclosure rate of 73.5% for central enterprises, and the scale is still expanding. Meanwhile, operational capability is an important performance indicator for enterprises, and research on the factors influencing operational capability has always been an important topic in the academic community.

In China, many scholars have confirmed a positive correlation between ESG performance and corporate financial performance [1], profitability [2], and financing costs [3], and numerous ESG rating agencies emerge. However, there is a lack of research on the impact of corporate ESG performance on operational capabilities. Therefore, this article combines the Topsis model and linear regression model to attempt to answer the relationship between the ESG performance of environmental protection companies and their operational capabilities, as well as the mechanism of improving their operational capabilities.

In the empirical testing section, this article selects multiple financial indicators as factor pools, assigning weights using the entropy weighting method, and using the Topsis model to score the operating capacity. The operating capacity score of the enterprise is used as the dependent variable, and the ESG performance indicator of the enterprise is used as the explanatory variable for linear regression. At the same time, this article also conducted multiple linear regression with the cost of goods sold as the dependent variable and the ESG performance indicator as the independent variable. It was ultimately confirmed that the ESG performance of the environmental protection industry has a positive impact on the operational capacity of enterprises, and the ESG performance of the

environmental protection industry promotes the operational capacity of enterprises by reducing sales costs.

The marginal contribution of this article is mainly reflected in the following two aspects. Firstly, unlike traditional research focusing on a single financial indicator and ESG performance, this article uses the Topsis model to explore the relationship between multiple financial indicators and ESG performance. Secondly, this article examines the mechanism by which ESG performance in the environmental protection industry affects operational capacity by reducing the cost of goods sold by enterprises. This article enriches the relevant research on the impact of ESG performance on the cost of goods sold and sales capacity in the environmental protection industry. In summary, based on the ESG perspective, this article considers the impact of ESG practices on the operational capabilities of environmental protection enterprises, explores their mechanisms, and fills the gap in the existing ESG research field, which has certain practical significance.

2. Literature review

2.1. Research on the Impact of ESG Performance of Environmental Protection Enterprises on Their Operational Capacity

In recent years, with the increasing attention of investors, entrepreneurs and other groups to ESG as a social hot topic, many scholars have conducted research on the impact of ESG performance on overseas investment returns of enterprises [4], internal control and audit efficiency of enterprises [5], and enterprise valuation [6]. In terms of overseas investment returns for enterprises, under the same conditions of other factors, excellent ESG performance of enterprises can enhance their investment returns overseas by promoting green innovation and enhancing business reputation. In terms of internal control and audit efficiency, better ESG performance of enterprises can improve their audit efficiency through the mediating variable of connotation control, and this promoting effect is more significant in central and eastern enterprises. From the perspective of corporate valuation, compared to companies with average ESG performance, excellent ESG performance can improve corporate valuation by reducing corporate risk. Based on this, this paper proposed the following assumptions:

H1: The ESG performance of environmental protection enterprises can promote their operational capabilities.

2.2. Research on the Impact Mechanism of ESG Performance on Enterprise Operating Capacity

Operational capability is an important performance indicator for environmental protection enterprises. Research on the factors influencing the operational capability of environmental protection enterprises has always been an important topic in the academic community, mainly focusing on two aspects: internal factors and external environmental factors. Based on internal influencing factors of enterprises [7]. Enterprises with excellent ESG performance can reduce their operational and operational risks through green finance reform, information disclosure, and other paths, thereby reducing their financing costs. Therefore, from a macro perspective, in the short term, due to increased investment in ESG green reform by enterprises, there will be certain losses in financial performance. However, in the long run, the revenue increase brought about by excellent ESG performance will compensate for the financial losses incurred in the short term and exhibit a positive impact. From the perspective of external environmental factors, companies with excellent ESG performance will publicly disclose information, allowing investors to obtain more specific information about the company, thereby increasing investment information and simplifying corporate financing.

2.3. Assumption Proposal

Based on existing theories, excellent ESG performance of enterprises has a high probability of promoting the improvement of operational efficiency. The theory of information asymmetry suggests that companies with excellent ESG performance will publicly disclose their relevant information. On

the one hand, it enhances investors' interest in investing in the company, facilitates financing, and enhances its operational capabilities. On the other hand, adopting public information disclosure can reduce the degree of information asymmetry between investors and the company, and reduce the occurrence of events such as adverse selection and moral hazard. The high or low cost of goods sold is an important indicator that affects and reflects a company's operational capacity, which can be generally transmitted through the following paths [8]. Firstly, the cost of goods sold, as the direct cost of providing products and services, will directly affect the gross profit of the enterprise. Secondly, the high cost of goods sold can affect a company's pricing strategy. If the cost of goods sold is high, the company often adopts high pricing to offset the high cost, and the high or low pricing will directly affect the company's market competitiveness. Furthermore, high sales costs will mean that companies need to invest more funds to maintain inventory. Based on this, a hypothesis is proposed:

H2: Excellent ESG performance of environmental protection enterprises will improve their operational capabilities by reducing sales costs

3. Research Design

3.1. Indicators Selection

Operational capacity is reflected by operational capacity indicators, which can evaluate the operation and management of an enterprise. At present, the research on financial performance evaluation systems has become more mature. Based on scholars' research and Standard Value of Enterprise Performance Evaluation (2022 edition), this paper finally selects 6 indicators that reflect enterprise operation capability. Six indicators are as follows: inventory turnover rate, accounts receivable turnover rate, accounts payable turnover rate, current assets turnover rate, fixed assets turnover rate, and total assets turnover rate.

3.2. Topsis Model

At present, there are various research methods for enterprise performance evaluation, mainly including Factor Analysis, Grey Relational Analysis, Topsis, Fuzzy Comprehensive Evaluation, and Catastrophe Progression Method, etc. After reviewing the relevant literature and considering the actual situation of the research, the paper finally chose Topsis as the scoring method of our operation score. Topsis is flexible, abnormal values will not affect results. It considers the interdependence of each turnover indicator, so it is appropriate as an evaluation approach for enterprise operational capacity. Here are the brief steps for Topsis:

Positive Orientation Adjustment: As the 6 indicators selected are Maximizing Metrics, this step can be skipped.

Data Standardization: where Z_{ij} is a standardized element.

$$Z_{ij} = \frac{X_{ij}}{\sqrt{\sum_{i=1}^n X_{ij}^2}} \quad (1)$$

Take each indicator, that is, the largest value in each column, forming an ideal optimal solution vector:

$$z^+ = [z_1^+, z_2^+, \dots, z_m^+] = [\max\{z_{11}, z_{21}, \dots, z_{n1}\}, \max\{z_{12}, z_{22}, \dots, z_{n2}\}, \dots, \max\{z_{1m}, z_{2m}, \dots, z_{nm}\}]$$

Likewise, select the minimum value from each column to compute the optimal worst-case solution vector.

$$z^- = [z_1^-, z_2^-, \dots, z_m^-] = [\min\{z_{11}, z_{21}, \dots, z_{n1}\}, \min\{z_{12}, z_{22}, \dots, z_{n2}\}, \dots, \min\{z_{1m}, z_{2m}, \dots, z_{nm}\}]$$

For the i th scheme Z_i , this paper calculates its distance from the optimal solution.

$$d_i^+ = \sqrt{\sum_{j=1}^m (z_j^+ - z_{ij})^2} \quad (2)$$

Distance from the worst solution:

$$d_i^- = \sqrt{\sum_{j=1}^m (z_j^- - z_{ij})^2} \quad (3)$$

Define the score of the i scheme as S_i :

$$S_i = \frac{d_i^-}{d_i^+ + d_i^-} \quad (4)$$

Topsis needs to determine the weight of each factor, and the methods to confirm the weight of indicators are mainly divided into subjective weighting and objective weighting. Because the subjective weighting requires the participation of experienced experts, it can be influenced by personal subjective biases. Thus, the entropy method, which pertains to the objective assignment approach, is adopted here. By calculating the information entropy to reflect the information provided by the index, the entropy method determines the importance of the index in the comprehensive evaluation. The following are the brief steps of the entropy method:

Positive Orientation Adjustment: As the 6 indicators selected are Maximizing Metrics, this step can be skipped.

Calculate the proportion P_{ij} of item i of the j -TH indicators

$$P_{ij} = \frac{x_{ij}^1}{\sum_{i=1}^m x_{ij}^1} (i = 1, 2, \dots, m; j = 1, 2, \dots, n) \quad (5)$$

Calculate k :

$$k = \frac{1}{\ln(m)} \quad (6)$$

The entropy of the j -TH index e_j :

$$e_j = -k * \sum_{i=1}^m P_{ij} * \ln(P_{ij}) \quad (7)$$

The variation index d_j of j -TH indicators:

$$d_j = 1 - e_j (j = 1, 2, \dots, n) \quad (8)$$

The weight w_j of j -TH indicators:

$$w_j = \frac{d_j}{\sum_{j=1}^n d_j} \quad (9)$$

3.3. Data Source and Processing

Turnover rates denote the velocity at which an entity deploys its assets for sales or service provision over a given timeframe. Analysis of diverse turnover metrics elucidates corporate management efficacy and asset utilization efficiency, offering insights into operational health. Therefore, this paper selected six major turnover rates as the underlying factors of operating capacity scores

The main data in this paper comes from quantitative platforms, annual reports, official websites, etc. The quarterly data of all factors of all listed companies in the "ecological protection and environmental governance industry" in the new industry classification of China Securities Regulatory Commission from 2010 to 2023 are selected and sorted out with the ESG score of Shanghai Huazheng Index Information Services Co., Ltd..this paper assign entropy weights to the industry-wide data, the results of weight analysis are shown in table 1.

Table 1. Weight of each factor of environmental protection enterprises

Entropy weight method			
factors	Comentropy e	Information Value d	Weight (%)
operating_stat_inventory_turnover_ratio	0.866	0.134	18.417
operating_stat_turnover_ratio_of_receivable	0.805	0.195	26.875
operating_stat_turnover_ratio_of_account_payable	0.889	0.111	15.294
operating_stat_turnover_of_current_assets	0.914	0.086	11.816
operating_stat_turnover_of_overall_assets	0.897	0.103	14.131
operating_stat_turnover_of_fixed_assets	0.902	0.098	13.467

After determining the weights, this paper processes Raw Data through Missing Value Imputation and Non-dimensionalization. Eliminate the influence of dimension and outliers. According to the formula above, the processed raw data were scored by Topsis.

To adjust and correct the main analysis indicators and eliminate the interference of other factors, to more accurately evaluate the operation efficiency of the enterprise, paper selects a series of control variables, and table 2 shows the main variables in the regression analysis.

Table 2. Setting of main variables

Type of variable	Variable name	Variable symbol
Explained variable	Operational capability score	Topsis_score
Explained variable	ESG rating	ESG_score
	E rating	E_score
	S rating	S_score
	G rating	G_score
Control variable	Cost-to-Revenue Ratio	cost_to_revenue
	Current ratio	current_ratio
	Share of top 10 shareholders	top 10 shareholders
	Total capital	Total capital
	Return on Equity	ROE

4. Result Analysis

Due to the multicollinearity among ESG scores, the use of multiple linear regression cannot well explain the influence of each variable on the operating capacity score. Therefore, this paper uses the operating capacity score, ESG score, E score, S score, and G score to do univariate linear regression respectively. The results are shown in table 3.

Table 3. Topsis_score benchmark regression results

Variables	Topsis_score is used as the explained variable							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ESG_score	0.704***				0.601** *			
	(7.557)				(4.366)			
E_score		0.696** *				0.664* **		
		(7.382)				(4.090)		
S_score			0.594** *				0.403**	
			(5.619)				(3.234)	
G_score				0.417**				0.269*
				(3.495)				2.704
cost_to_revenue					-0.216	- 0.345* *	-0.199	-0.138
					(-2.080)	(- 3.195)	(-1.795)	(- 1.155)
current_ratio					-0.056	-0.022	-0.063	-0.208
					(-0.396)	(- 0.151)	(-0.420)	(- 1.350)
top 10 shareholders					- 1.056** *	- 1.036* *	- 1.134** *	- 0.716* *
					(-5.213)	(- 5.039)	(-5.130)	(-3.00)
Total capital					0.718**	0.778* *	0.633*	0.123
					(2.892)	(2.979)	(2.782)	0.484
ROE					0.054	-0.102	-0.005	0.038
					(0.505)	(-.987)	-0.043	-0.138
constant term	(- 6.143***)	(- 3.488**)	(- 3.406**)	(- 3.150**)	(-1.240)	(1.929)	(0.734)	(- 1.337)
quarterly fixation	YES	YES	YES	YES	YES	YES	YES	YES
constituent stock fixation	YES	YES	YES	YES	YES	YES	YES	YES
N	1680	1680	1680	1680	1680	1680	1680	1680
Adj.R2	0.487	0.476	0.341	0.16	0.647	0.635	0.599	0.578

It was found that ESG scores, E scores, S scores, and G scores were all statistically significantly positively correlated with operational capability score at the $p < 0.001$ level, this may be related to the main business of environmental enterprises. The regression analysis outcomes reveal that superior ESG performance is frequently accompanied by outstanding operational capability within enterprises. Moreover, ESG scores and E scores perform better than G scores and S scores. The regression results support our H1 hypothesis that the ESG performance of an environmental firm can promote the firm's operational capability.

To substantiate the H2 hypothesis, a univariate linear regression is executed, with the cost of goods sold (COGS) serving as the dependent variable and the ESG, E, S, and G scores as independent variables.

$$COGS_{ts} = \alpha_0 + \beta_1 ESG_{ts} + \alpha Con_{ts} + \varepsilon_{ts} \quad (10)$$

If β_i is significantly negative, H2 is supported, indicating that excellent ESG performance can reduce the cost of goods sold (COGS) of enterprises, thus improving the performance of operating capacity. The regression results are shown in table 4.

Table 4. COGS benchmark regression results

Variables	COGS is used as the explained variable							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ESG_score	-0.601**				- 0.567*			
	(-2.85)				(-2.42)			
E_score		-0.432*				- 0.406*		
		(-2.11)				(- 1.97)*		
S_score			0.275				0.231	
			(1.38)				(1.14)	
G_score				-0.545**				- 0.456**
				(-3.02)				(-2.31)
cost_to_revenue					0.123	0.103	0.084	0.065
					(0.94)	(0.81)	(0.67)	(0.53)
current_ratio					0.001	-0.003	-0.005	-0.007
					(0.01)	(-0.03)	(-0.05)	(-0.07)
top 10 shareholders					0.321	0.342	0.364	0.385
					-1.16	-1.25	-1.34	-1.43
Total capital					-0.039	-0.042	-0.045	-0.048
					(-0.32)	(-0.34)	(-0.36)	(-0.38)
ROE					0.017	0.014	0.011	0.008
					(0.14)	(0.12)	(0.1)	(0.08)
constant term	(- 10.27)***	(- 9.42)***	(- 8.56)***	(- 7.70)***	(-1.36)	(-1.56)	(0.672)	(-1.11)
quarterly fixation	YES	YES	YES	YES	YES	YES	YES	YES
constituent stock fixation	YES	YES	YES	YES	YES	YES	YES	YES
N	1680	1680	1680	1680	1680	1680	1680	1680
Adj.R2	0.302	0.292	0.307	0.169	0.487	0.464	0.441	0.318

It was found that ESG scores, E scores, S scores, and G scores were all statistically significantly negatively correlated with cost of goods sold (COGS) at the $p < 0.005$ level. This shows that when ESG performs well, the cost of goods sold by enterprises tends to decline. The regression results support our hypothesis H2 that the excellent ESG performance of environmental enterprises will improve the operating capacity of enterprises by reducing the cost of goods sold.

5. Conclusion

Based on the quarterly data of environmental protection enterprises in China from the first quarter of 2010 to the fourth quarter of 2023, this paper studied the impact and mechanism of ESG performance of environmental protection enterprises on their operational capabilities. The article used the Topsis model to calculate the comprehensive scores of financial and operational capabilities of different enterprises, as well as the ESG score of Huazheng on the company. The article concluded that the ESG performance of environmental protection enterprises can significantly improve their operational capabilities. The test results of the simultaneous mechanism of action indicate that the

ESG performance of environmental protection enterprises improves profitability by reducing sales costs.

In the context of the strong development of ESG concepts and the government's strong promotion of sustainable development concepts, based on the research findings of this article, this paper proposed the following conclusions:

One is that enterprises should develop clear ESG strategies, integrate ESG concepts into their core business strategies, and improve their ESG governance system based on the personalized development of different enterprises by reducing their pollutant emissions, assuming corporate social responsibility, and focusing on internal structural governance.

The second is to improve the level of information disclosure and transparency of enterprises. Environmental protection enterprises should regularly release ESG reports, comprehensively disclosing their performance in E (environment), S (social), and G (government) aspects. ESG reform should be made public to stakeholders of the enterprise to enhance their understanding of the enterprise, attract investor interest, and broaden and enhance the financing situation of environmental protection enterprises.

The third is to enhance and improve the ESG regulatory mechanism. For the national government, corresponding ESG evaluation institutions and regulatory departments should be established to comply with policies, encourage and supervise the implementation of ESG reform in enterprises, and reject the phenomenon of enterprises turning green; For individual enterprises, an internal regulatory and governance system should be established and improved to increase operational efficiency and form effective supervision.

Authors Contribution

All the authors contributed equally, and their names were listed in alphabetical order.

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