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The impact of corporate ESG disclosure quality on sustainability performance: a study based on time series analysis

Jiarui Ai[1,*]
[1] School of Economics and Management, Maanshan University, Maanshan, Anhui, 243000, China
Corresponding authors: (e-mail: aijiarui@masu.edu.cn).

Abstract The trend of green transformation of economic development puts forward higher requirements on the sustainable development ability of enterprises, ESG, as an important concept of enterprise operation under sustainable orientation, can make up for the shortcomings of traditional financial performance evaluation and make a full evaluation of the sustainability ability of enterprises. This paper combines the existing research and the actual situation, and designs a set of corporate sustainable development performance evaluation system with 7 primary indicators and 30 secondary indicators. At the same time, the entropy value method and the superiority and inferiority solution distance method are chosen as the method of assigning index weights. Listed companies in M industry are selected as the research object, with corporate performance (ROA) as the explanatory variable and ESG performance (ESG) as the core explanatory variable. Through correlation analysis and multicollinearity test, the development status of M industry listed companies is initially exposed and multicollinearity is avoided. Subsequently, research hypotheses are proposed and empirical analysis is carried out by linear regression with stability test. Good ESG performance will increase the economic efficiency of enterprises to a certain extent, in which the regression coefficient between ESG performance (ESG) and corporate performance (ROA) is 0.0007, which is significantly positive at 1% level.

Index Terms quality of ESG disclosure, sustainability performance, entropy method, superior and inferior solution distance method

I. Introduction

ESG (Environmental, Social and Governance) is becoming more and more important in enterprises, and for enterprises aiming at sustainable development, ESG has a far-reaching impact on enterprise development [1]. In the past, corporate performance evaluation focused more on financial aspects, and the evaluation of non-financial parts was more researched from the perspective of social responsibility, and less ESG-based performance evaluation was researched.

Currently, the Chinese government vigorously promotes the new development of low carbon and green, actively encourages enterprises to make sustainable green investment, and provides relevant enterprises with preferential policy support [2], [3].The development of ESG has been elevated to the important strategic level of national development, so it is necessary for enterprises to organically integrate the sustainable development with the country's development strategy in order to realize a win-win situation [4]-[6]. Constructing a performance evaluation system based on the ESG concept to make an objective and comprehensive evaluation of enterprise performance and optimize enterprise management according to the evaluation results is of great significance in focusing on the economic benefits of the enterprise while taking into account the environmental protection as well as the development of social responsibility [7]-[9].

Moreover, ESG disclosure not only helps to enhance the image of corporate social responsibility, but also increases investors' trust in the enterprise [10], [11]. This requires that enterprises still need to further strengthen supervision and information disclosure in the fulfillment of social responsibility and optimize management in corporate governance [12], [13]. Therefore, it is of great practical significance to study the impact of ESG disclosure on corporate performance, which helps to promote enterprises to pay more attention to ESG disclosure and make more progress in sustainable development [14]-[16].

This paper firstly combines the existing research and the actual situation, and proposes a set of enterprise sustainable development performance evaluation system containing 7 first-level indicators and 30 second-level indicators from 7 perspectives. Then, it elaborates the basic principles and operational steps of the entropy value

method and the superiority and inferiority solution distance method, and determines the weights of the indicators of the designed enterprise sustainable development performance evaluation system. Subsequently, the listed enterprises in M industry from 2013 to 2023 are selected as the research sample, and several research variables are set. Based on the research sample, descriptive statistics, correlation analysis and multiple covariance test are successively conducted. Finally, three research hypotheses on the impact of corporate ESG disclosure quality on their sustainability performance are proposed, which are verified using regression analysis and stability test.

II. Enterprise sustainable development performance evaluation system

II. A. Construction of enterprise sustainable development performance evaluation system

This paper constructs the enterprise sustainable development performance evaluation system from seven dimensions: profitability situation, asset quality level, debt service risk situation, operational growth situation, social performance, corporate governance performance, and environmental performance, and takes the seven dimensions as the first-level indicators.

In terms of the structure of the second-level indicators, the specific influencing factors are summarized, which are operating profit margin, net profit margin, gross profit margin, total return on assets, total asset turnover, accounts receivable turnover, inventory turnover, asset-liability ratio, current ratio, speed ratio, operating income growth rate, operating profit growth rate, net asset growth rate, wage payment rate, employee's occupational health and safety training hours, equal employment rate , natural gas consumption, and disclosure quality. Due to the existence of qualitative research in the influencing factors, in order to quantify are transformed. Finally, an evaluation system of 30 specific indicators in seven aspects, namely, profitability situation, asset quality level, debt service risk situation, business growth situation, social performance, corporate governance performance, and environmental performance, is derived. The detailed elements of the index system are shown in Table 1.

Table 1: Enterprise sustainable development performance indicators based on ESG

Primary index	Secondary index
(H1) Profitability situation	(H11) Operating profit margin
	(H12) Net profit margin
	(H13) Gross profit margin
	(H14) Return on total assets
(H2) Asset quality level	(H21) Total asset turnover ratio
	(H22) Accounts receivable turnover rate
	(H23) Inventory turnover rate
(H3) Debt repayment risk situation	(H31) Asset-liability ratio
	(H32) Current ratio
	(H33) Quick ratio
(H4) Business growth status	(H41) Growth rate of operating income
	(H42) Growth rate of operating profit
	(H43) Net asset growth rate
(H5) Environmental Performance indicators	(H51) Greenhouse gas emissions (10,000 tons)
	(H52) Wastewater discharge volume (10,000 tons)
	(H53) Hazardous waste emissions (10,000 tons)
	(H54) Total electricity consumption (ten thousand kilowatt-hours)
	(H55) Natural gas consumption (10,000 cubic meters)
	(H56) Water resources consumption (10,000 tons)
(H6) Social performance indicators	(H61) Wage payment rate
	(H62) Duration of occupational health and safety training for employees (h)
	(H63) Equal employment Rate (Proportion of female employees)
	(H64) Number of employee training sessions
	(H65) The social insurance coverage rate of employees
	(H66) R&D investment amount (billion yuan)
	(H67) Number of national patents obtained
(H7) Corporate governance indicators	(H71) Proportion of independent directors
	(H72) Number of board meetings
	(H73) Number of meetings of the Supervisory Board
	(H74) Quality of Information Disclosure

II. B.Entropy method

This paper utilizes the entropy weight method to assign weights to each indicator. For a given sustainable development performance evaluation indicator, the greater the data difference between different sample indicators, the greater the impact of this performance evaluation indicator on the final evaluation results, the greater the impact of changes in the value of its indicators on sustainable development performance, and the greater the weight assigned to it. And this paper divides sustainable development performance into 7 level indicators, in which there are qualitative indicators and quantitative indicators. And the data measurement method between the first-level indicators is different, can not be directly compared, and its degree of influence on the evaluation of enterprise sustainable development performance is also different, so with the help of entropy value method. First of all, all the secondary indicators are standardized to make them comparable. Secondly, after standardization, there is the possibility of negative data values, so the data are shifted, and then the proportion of dimensionless. Finally, the data entropy value difference coefficient and weight are calculated.

Its quantitative analysis method is based on the degree of variability of the index and finally the target weighting. When n different probabilities can not be determined, the greater the entropy of a factor, the less its variability, the less information, the less influence on the evaluation, so the weight of the factor will be smaller. On the contrary, if it can play a greater role, the weight of this factor will be greater. The entropy weighting method gives each indicator the corresponding information according to its weight size, thus providing a reference for the comprehensive evaluation of each indicator. Therefore, the method is more objective. Its assignment goes through as shown below:

Step 1: Data standardization

The scale and unit of each indicator are different and cannot be directly compared and calculated, so it needs to be standardized and processed before the weight of each indicator is calculated.

When the indicator is a positive indicator, its standardization formula is equation (1):

$$x_{ij}^{*} = \frac{x_{ij} - x_{j}^{\min}}{x_{j}^{\max} - x_{j}^{\min}} \tag{1}$$

When the indicator is negative, the normalization formula is equation (2):

$$x_{ij}^{*} = \frac{x_{j}^{\max} - x_{ij}}{x_{j}^{\max} - x_{j}^{\min}} \tag{2}$$

When the indicator is a moderate indicator, the normalization formula is equation (3):

$$x_{ij}^{*} = 1 - \frac{\left| x_{ij} - d_{i} \right|}{\max \left| x_{ij} - d_{i} \right|} \tag{3}$$

where d_i is the determined standard value.

Step 2: Data panning

In order to eliminate negative values for panning, some indicators of the value of the standardization process, there may be smaller values or negative values, in order to calculate the unity and convenience of the standardization of the value of the standardization of the value of the panning process as in equation (4), so as to eliminate the above situation.

$$x_{ij}^{*} = H + x_{ij}^{*} \tag{4}$$

where H is the magnitude of the indicator shift, generally take 0.01.

Step 3: Use the specific gravity method to dimensionless the data as in equation (5):

$$y_{ij} = \frac{x_{ij}^{*}}{\sum_{i=1}^{n} x_{ij}^{*}} \tag{5}$$

Step 4: Calculate the entropy value of the j th indicator as in equation (6):

$$e_{j} = -\frac{1}{\ln n} \sum_{i=1}^{n} y_{ij} \ln y_{ij} \tag{6}$$

Step 5: The coefficient of variation for the j th indicator is shown in equation (7). Where, $j=1,2,\cdots,p$

$$g_j = 1 - e_j \tag{7}$$

Step 6: The weight of the j th indicator is as in equation (8). Where, $j=1,2,\cdots,p$

$$\omega_j = \frac{g_j}{\sum_{j=1}^{p} g_j} \tag{8}$$

II. C.Advantageous and disadvantageous solution distance method

TOPSIS can be directly translated as a ranking method that approximates the ideal solution, generally known as the Distance to Superior and Inferior Solutions (DSS) method, which is a method that composes the optimal solutions in the computational hierarchy into a positive ideal solution, and the worst solution into a negative ideal solution, and then calculates the virtual distance of each indicator relative to the positive and negative ideal solutions, so as to carry out the ranking.

The method of distance between superior and inferior solutions (TOPSIS) is an important method for comprehensive evaluation problems, and its specific operation steps are simple, the process is clear, can fully utilize the complete information of the data, and the results can be simply and effectively sorted to reflect the strengths and weaknesses of each target. Therefore, as mentioned earlier, the hierarchical analysis method (AHP) decision-making factors can not be too many, it is not easy to use the data to accurately illustrate the shortcomings. Then the method of distance between superiority and inferiority solutions (TOPSIS) is used in conjunction with it to overcome this drawback. Its calculation method is mainly divided into the following steps:

(1) Construct the decision matrix

If there are n objects to be evaluated and there are m evaluation indicators, then a decision matrix X is built, where x_{ij} will denote the value of the j evaluation indicator of the ith object to be evaluated, $j=1,2,\cdots,m$, see Equation (9).

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{bmatrix} \tag{9}$$

(2) Data normalization

In TOPSIS, all indicators need to be transformed into very large (efficiency) indicators for easy comparison and ranking. Then it is necessary to transform the very small, intermediate and interval type indicators into very large indicators. In this paper, we mainly use very large indicators and interval-type indicators, of which the interval-type indicators are normalized as shown in equation (10):

$$y_i = \begin{cases} 1 - \dfrac{a - x_i}{M}, & x_i < a \\ 1, & a \le x_i < b \\ 1 - \dfrac{x_i - b}{M}, & x_i > b \end{cases} \tag{10}$$

where $M = \max\{a - \min(x_i), \max(x_i) - b\}$.

After the normalization process, the matrix Y after the normalization process is obtained, see equation (11).

$$Y = \begin{bmatrix} y_{11} & y_{12} & \cdots & y_{1m} \\ y_{21} & y_{22} & \cdots & y_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ y_{n1} & y_{n2} & \cdots & y_{nm} \end{bmatrix} \tag{11}$$

The main significance of normalization is to facilitate the comparative analysis of normalization.

(3) Standardization of data

In order to achieve the comparability of the data, it is necessary to standardize the data, that is, for the data to go to the scale, so that the data can be compared, which standardized processing, see equation (12):

$$z_{ij} = \frac{y_{ij}}{\sqrt{\sum_{i=1}^{n} y_{ij}^2}} \left(i = 1,2,\cdots,n; j = 1,2,\cdots,m\right) \tag{12}$$

After normalization the normalized normalized matrix Z is obtained, see equation (13).

$$Z = \begin{bmatrix} z_{11} & z_{12} & \cdots & z_{1m} \\ z_{21} & z_{22} & \cdots & z_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ z_{n1} & z_{n2} & \cdots & z_{nm} \end{bmatrix} \tag{13}$$

(4) Weighting of data

For the evaluation indicators in the matrix Z according to the hierarchical analysis method (AHP) derived weights $w_1, w_2, \cdots, w_m$, through the data weighting process, we have obtained the weighted standardized normalization matrix D, see formula (14).

$$D = \begin{bmatrix} d_{11} & d_{12} & \cdots & d_{1m} \\ d_{21} & d_{22} & \cdots & d_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ d_{n1} & d_{n2} & \cdots & d_{nm} \end{bmatrix} \tag{14}$$

(5) Determine the positive and negative ideal solutions

Take the maximum value in each column of the weighted normalized normalized matrix D as the positive ideal solution and take the minimum value as the negative ideal solution, respectively, see Eqs. (15)-(16).

$$U^+ = (d_1^+, d_2^+, \cdots d_m^+) \tag{15}$$

$$U^- = (d_1^-, d_2^-, \cdots d_m^-) \tag{16}$$

which have equations (17)-(18):

$$d_j^+ = \max_{1 \le i \le n}(d_{ij}) \left(i = 1,2,\cdots,n; j = 1,2,\cdots,m\right) \tag{17}$$

$$d_j^- = \min_{1 \le i \le n}(d_{ij}) \left(i = 1,2,\cdots,n; j = 1,2,\cdots,m\right) \tag{18}$$

(6) Calculate the Euclidean distance

The Euclidean distance of each scenario's indicators to the positive and negative ideal solutions is calculated separately, see Eqs. (19)-(20).

$$S_i^+ = \sqrt{\sum_{j=1}^{m} (d_{ij} - d_j^+)^2} \left(i = 1,2,\cdots,n; j = 1,2,\cdots,m\right) \tag{19}$$

$$S_i^- = \sqrt{\sum_{j=1}^{m} (d_{ij} - d_j^-)^2} \left(i = 1,2,\cdots,n; j = 1,2,\cdots,m\right) \tag{20}$$

(7) Calculation of relative closeness

Finally, the score of the evaluation object is also calculated as the relative closeness, both according to the calculation of the value from largest to smallest for sorting, in which the program with the highest score is the optimal program. See equation (21).

$$T_i = \frac{S_i^-}{S_i^+ + S_i^-} \left(i = 1,2,\cdots,n; j = 1,2,\cdots,m\right) \tag{21}$$

II. D.Determination of indicator weights based on the entropy weight method

Data processing was carried out with the help of entropy weighting method and the results of indicator weights were obtained as shown in Table 2.

Table 2: Evaluation index weights based on the entropy weight method

Primary index	Secondary index	Information entropy value	Information utility value	Weight(%)
(H1)	(H11)	0.839	0.163	2.484
	(H12)	0.825	0.177	2.596
	(H13)	0.832	0.17	2.488
	(H14)	0.848	0.154	2.245
(H2)	(H21)	0.743	0.259	3.793
	(H22)	0.818	0.184	2.69
	(H23)	0.821	0.181	2.647
(H3)	(H31)	0.792	0.21	3.077
	(H32)	0.641	0.361	5.294
	(H33)	0.733	0.269	3.945
(H4)	(H41)	0.848	0.154	2.255
	(H42)	0.767	0.235	3.444
	(H43)	0.806	0.196	2.868
(H5)	(H51)	0.823	0.179	2.614
	(H52)	0.811	0.191	2.798
	(H53)	0.851	0.151	2.2
	(H54)	0.686	0.316	4.632
	(H55)	0.775	0.227	3.326
	(H56)	0.775	0.227	3.32
(H6)	(H61)	0.701	0.301	4.407
	(H62)	0.72	0.282	4.135
	(H63)	0.495	0.507	7.349
	(H64)	0.759	0.243	3.561
	(H65)	0.802	0.2	2.922
	(H66)	0.713	0.289	4.24
(H7)	(H67)	0.836	0.153	3.527
	(H71)	0.791	0.25	2.274
	(H72)	0.683	0.347	3.68
	(H73)	0.627	0.251	2.575
	(H74)	0.783	0.298	2.614

Using TOPSIS-grey correlation method, using the standardized processed data and the weight of each indicator, the evaluation value of each evaluation indicator can be calculated and the results of the posting progress ranking of each indicator are shown in Table 3.

III. Impact Analysis of Corporate ESG Disclosure on Sustainability Performance

III. A. Study design

III. A. 1) Data sources

In this study, listed companies in China's M industry during the period of 2013-2023 were selected as the research sample. Prior to the regression analysis, the following preprocessing was performed on the dataset: first, firms with missing samples were excluded in order to ensure the completeness and accuracy of the data. Second, firms with inconsistent year information were further excluded in order to maintain the consistency of the time series. In addition, firms identified by ST and *ST were removed in consideration of market risk and uncertainty. In order to reduce the potential impact of extreme values on data analysis, the relevant continuous variables were subjected to an upward and downward 1% shrinkage, resulting in 14,362 valid observations.

III. A. 2) Variable selection

(1) Explained Variables

Since the return on total assets can more accurately reflect the overall economic efficiency and operational efficiency of the enterprise, this paper refers to the selection of the return on total assets (ROA) to measure the performance of the enterprise, and the return on net assets (ROE) is used as a replacement of the explanatory variables in the subsequent robustness test.

(2) Explanatory variables

In the process of constructing the assessment system, the development trend of China's capital market is fully considered, which can reflect the comprehensive performance of Chinese local enterprises in the three key dimensions of environment, society and governance (ESG). There is also an exhaustive breakdown in the three core areas of ESG, covering diversified topics and specific indicators. In order to facilitate quantification and analysis, CSI's ESG ratings are assigned a numerical value from 1 to 9 on a scale from “C” to “AAA”. The higher the value, the higher the rating level and the better the ESG performance of the company.

(3) Moderating Variables

Digital word frequency is constructed from five aspects: artificial intelligence, big data, cloud computing, blockchain, and digital technology. Measure the degree of digital transformation (Dig) by taking the natural logarithm after adding 1 to the number of words involving digital keywords in the annual report, and examine its impact on corporate ESG performance and the channel of impact.

Table 3: The evaluation results of each indicator

Index	d+	d-	r+	r-	C_i^+	Sort
(H11)	0.00692	0.04722	0.94965	0.47451	0.66414	15
(H12)	0.00571	0.04088	0.70362	0.26771	0.84717	4
(H13)	0.00363	0.09412	0.79504	0.34403	0.715	13
(H14)	0.0046	0.06267	0.0808	0.48599	0.29892	25
(H21)	0.00221	0.05287	0.71044	0.226	0.28629	26
(H22)	0.00912	0.05424	0.76972	0.75813	0.60211	16
(H23)	0.00138	0.07709	0.41323	0.20444	0.03052	30
(H31)	0.0092	0.04626	0.98933	0.50763	0.69297	14
(H32)	0.00251	0.05962	0.1335	0.46204	0.82231	6
(H33)	0.00293	0.02511	0.84667	0.99502	0.77566	9
(H41)	0.00598	0.05922	0.90575	0.37304	0.47603	18
(H42)	0.00667	0.03014	0.95255	0.68801	0.83263	5
(H43)	0.00781	0.06762	0.69723	0.99171	0.73743	11
(H51)	0.00258	0.0303	0.16665	0.02258	0.4319	21
(H52)	0.00605	0.04642	0.96685	0.16059	0.94148	3
(H53)	0.04406	0.05046	0.41242	0.25747	0.40431	22
(H54)	0.00318	0.02635	0.34616	0.86157	0.11213	27
(H55)	0.00406	0.08278	0.29976	0.70433	0.45494	20
(H56)	0.00282	0.0178	0.00604	0.21757	0.96329	1
(H61)	0.00936	0.05209	0.99253	0.97091	0.37696	23
(H62)	0.0059	0.06645	0.04121	0.17536	0.94407	2
(H63)	0.00491	0.04348	0.35681	0.75707	0.03514	29
(H64)	0.00161	0.00957	0.48594	0.95894	0.46259	19
(H65)	0.00512	0.02928	0.72581	0.24514	0.80728	8
(H66)	0.00124	0.06492	0.98251	0.42784	0.31299	24
(H67)	0.00115	0.03657	0.61898	0.86712	0.7646	10
(H71)	0.00157	0.02934	0.84428	0.10276	0.47623	17
(H72)	0.00917	0.00994	0.24023	0.43758	0.06713	28
(H73)	0.00991	0.04157	0.36844	0.22488	0.81835	7
(H74)	0.0094	0.04363	0.87528	0.4556	0.72057	12

(4) Mediating variables

E (Environment) focuses on improving environmental performance by establishing eco-friendly concepts and developing environmental management strategies. Green innovation allows for green product innovation and process innovation in energy saving, environmental protection and waste recycling to address environmental issues. By organizing and classifying the patent information of A-share listed companies, the number of green patent applications (Gpatent) of enterprises is used to measure the level of green innovation of enterprises.S (Social) mainly balances and coordinates the relationship between enterprises and various stakeholders, emphasizing that enterprises should pay more attention to the long-term interests of the society in addition to the pursuit of the established financial goals, and realize the benign interaction between social subjects. The number of searches for keywords such as the full name and stock code of listed companies used in the CNRDS network

search index database is used to represent the third-party attention (Attention) of the public to the enterprise. G (Corporate Governance) concentrates on the internal governance structure and mechanism of the enterprise, supervising the remuneration of employees and corporate ethics, etc., to carry out the power constraints and balances with the scientific and reasonable governance system that enhances the level of governance. Drawing on the practice of Yang Fanzheng and Xu Luhui, we use the "Internal Control Index of Chinese Listed Companies" plus one to take the logarithm (IC) to measure the internal control ability of enterprises.

(5) Control Variables

In order to enhance the rationality of the model construction, firm size (Size), gearing ratio (Lev), firm age (FirmAge), cash flow ratio (Cashflow), fixed asset share (Fixed), operating income growth (Growth), independent director ratio (Indep), and firm shareholding concentration (Top1) are selected as the control variables. Industry (Industry) and year (Year) were also controlled.

The details of the above variables are shown in Table 4.

Table 4: Definitions and explanations of main variables

Variable nature	Variable	Computing method
Variable being explained	ROA	Average balance of net profit/total assets
Explaining variable	ESG	ESG ratings are used for scoring
Regulated variable	Dig	The logarithm is taken by adding 1 to the number of digital keywords in the annual report
	Gpatent	The number of green patent applications
	Attention	The search volume for keywords such as the stock code and full name of an enterprise
	IC	The enterprise internal control index plus 1 takes the natural logarithm
Control variable	Size	The annual total assets are taken as the natural logarithm
	Lev	Total liabilities at the end of the year/Total assets at the end of the year
	FirmAge	ln(Year of the current year - Year of company establishment +1)
	Cashflow	Net cash flows from operating activities/total assets
	Fixed	Net fixed assets/Total assets
	Growth	Increase in operating income/Total operating income of the previous year
	Indep	Independent directors/Number of directors
	Top1	The number of shares held by the largest shareholder/the total number of shares
	Industry	
	Year	

Table 5: Descriptive statistics

Variable	Sample capacity	Mean value	Standard deviation	Minimum	Maximum
ROA	444	0.04	0.09	-0.23	0.4
ESG	412	70.6	5.8	52.31	82.26
Dig	421	0.39	0.06	0.32	0.7
Gpatent	421	2.2	0.24	1.62	2.72
Attention	444	0.43	0.19	0.069	0.94
IC	404	1.74	4.36	-0.6	27.1
Size	448	0.07	0.1	-0.13	0.36
Lev	421	21.86	1.06	19.53	25.31
FirmAge	448	0.33	0.8	-1.67	3.79
Cashflow	517	16.3	6.26	1	33.01
Fixed	413	0.24	0.43	0	1
Growth	469	9.34	19.63	0	85.05
Indep	437	10.4	5.74	0	3.89
Top1	422	20.3	1.68	1	4.12
Industry	403	0.79	5.23	0	80.71
Year	10	10	-	-	-

III. B. Preparation of empirical analysis

III. B. 1) Descriptive statistics

The descriptive statistics of the sample companies are shown in Table 5, in which the maximum value of the return on total assets (ROA) of the sample companies is 0.4, the minimum value is -0.23, and the standard deviation is

0.09, which indicates that there is a big difference in the financial performance among the listed companies, and some of the companies' ROA is less than 0, which is a lower level, and there is an imbalance of financial performance in the industry. Meanwhile, the maximum value of ESG performance is 82.26, the minimum value is 52.31, and the standard deviation is 5.80, in which some enterprises can reach the level of more than 60 points, while some enterprises have not reached 60 points, indicating that the ESG performance of listed companies in this industry is mixed, and the ESG performance of the industry as a whole needs to be improved.

III. B. 2) Correlation analysis

Table 6 shows the correlation analysis between the variables. Without controlling for other variables, agribusiness financial performance (ROA) is positively correlated with ESG performance (ESG), which is in line with the hypothesis. Among the control variables, gearing ratio (Lev), internal control capacity (IC), enterprise size (Size), and the company's years of establishment (Eps) are all significantly positively correlated with financial performance (ROA), which suggests that larger enterprises with improved operating income and sufficient cash flow can not only bring higher levels of returns to shareholders, but also have a significant promotion effect.

Table 6: correlation analysis

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1															
2	-0.114*	1														
3	0.137**	-0.029	1													
4	0.149***	-0.049	-0.543**	1												
5	-0.322***	-0.251**	-0.051	0.127**	1											
6	0.112**	0.065	-0.027	0.219***	-0.106**	1										
7	0.605***	-0.036	-0.058	0.166***	-0.109**	0.021	1									
8	0.118**	0.145****	-0.002	0.261***	0.261***	-0.123**	0.197***	1								
9	0.861***	0.196***	-0.064	0.138***	-0.260***	0.064	0.611***	0.238***	1							
10	-0.106**	-0.028	0.228***	-0.239***	-0.003	-0.033	-0.054	0.193***	-0.069	1						
11	0.001	0.056	0.123**	-0.183***	0.141***	-0.172***	0.075	0.154***	0.141***	-0.114*	1					
12	0.038	-0.136**	0.133**	0.137**	-0.078	0.405***	-0.09	-0.067	-0.030	0.137**	-0.183***	1				
13	0.236	-0.113	0.145	0.147	4.78	-0.267	0.369	-0.561	0.369	0.438	0.523	0.669	1			
14	0.000	0.456	0.123	0.856	0.63	0.874	0.741	0.694	0.00	0.748	0.689	0.743	0.478	1		
15	0.000	0.179	0.741	0.000	0.000	0.000	0.268	0.357	0.248	0.000	0.741	0.563	0.250	0.251	1	
16	-0.011	0.000	0.000	0.000	-0.17	0.000	-0.142	-0.369	-0.216	0.00	0.000	0.00000	-0.514	0.000	-0.111	1

III. B. 3) Multicollinearity test

Before the benchmark regression in order to avoid multicollinearity, this paper carried out the VIF analysis results are shown in Table 7, the VIF mean value is less than 2, much less than 10, indicating that there is no multicollinearity between the variables and the correlation coefficients between the variables are less than 1, which can be carried out for the follow-up study.

Table 7: VIF test result

Variable	VIF	1/VIF
ROA	2.02	0.49505
ESG	2.17	0.46083
Dig	1.74	0.57471
Gpatent	1.73	0.57803
Attention	2.16	0.46296
IC	1.67	0.59880
Size	1.43	0.69930
Lev	1.31	0.76336
FirmAge	1.09	0.91743
Cashflow	2.79	0.35842
Fixed	1.14	0.87719
Growth	2.74	0.36496
Indep	2.55	0.39216
Top1	2.06	0.48544
Industry	1.48	0.67568
Year	1.82	0.54945
Mean VIF	1.87	

III. C. Results of empirical analysis

Before analyzing the empirical results, the following research hypotheses are proposed in this section:

H1: ESG performance has a positive driving effect on the corporate performance of listed companies in China's M industry.

H2: There is a positive relationship between ESG performance and internal control of firms.

H3: Internal control plays a mediating role between ESG performance and firm performance.

III. C. 1) Regression analysis

The results of the empirical analysis of the sample enterprises are shown in Table 8. From column (1) of Table 8, the regression coefficient of ESG performance and corporate performance (ROA) is 0.0007, which is significantly positive at the 1% level, indicating that the corporate performance of listed enterprises in the M industry can be effectively improved if they have good ESG performance, which will increase the economic benefits to a certain degree, and verifies the hypothesis H1. As shown in column (2) of Table 8, the regression coefficient of ESG performance and internal control (Growth) is 3.8158 and is significant at 1% level, which indicates that good ESG performance promotes enterprises to identify shortcomings and potential risks, adjust corporate strategies in a timely manner, and positively affects the internal control of the enterprise, which verifies hypothesis H2. From column (3) of Table 8, the regression coefficient between ESG performance and firm performance is 0.0004, which is significant at the 5% level. The regression coefficient of internal control (IC) with firm performance is 0.0002, which is significant at 1% level. And the regression coefficients of ESG performance and corporate performance are reduced after adding internal control into the model, both of which are significant and the model fit is improved, indicating that the internal control variable plays a partly mediating role between ESG performance and corporate performance, which verifies the hypothesis H3.

III. C. 2) Stability tests

(1) Replacement of explanatory variables

Given that return on equity (ROE), as an accounting indicator of financial performance, can effectively reflect the operation and asset management status of enterprises and their ability to cope with various types of risks. Therefore, the return on equity (ROE) indicator is taken as an explanatory variable to further test the direct impact of ESG performance on firm performance and to explore the mediating role of internal control between ESG

performance and firm performance. As shown in column (3) of Table 9, the regression coefficient of internal control and corporate performance after replacing the explanatory variables is 0.0003, which is significant at 1% level.

(2) Change the explanatory variables.

Referring to the practice of some scholars, the ESG score data of CSI is used to measure ESG performance. The results shown in Table 9 are the same as the initial test results, ESG performance and corporate performance show a significant positive impact, internal control variables play a mediating role between the two, which verifies the hypotheses H1, H2, H3, and again shows that the regression conclusions of this paper's research have a strong stability.

Table 8: Empirical analysis results

	(1) ROA	(2) IC	(3) ROA
ROA		0.562	
		(2.36)	
ESG	0.0007***	3.8158***	0.0005**
	(2.97)	(4.56)	(1.99)
Dig	0.0006***	0.7201**	0.0023***
	(6.06)	(2.18)	(3.14)
Gpatent	0.0398***	719.1123***	0.0011
	(3.55)	(15.79)	(0.08)
Attention	0.0081**	-26.0443**	0.0096***
	(2.47)	(-1.98)	(2.96)
IC			0.0002***
			(5.09)
Size	-0.1027***	-112.3996***	-0.0967***
	(-13.92)	(-3.78)	(-13.23)
Lev			0.658
			(3.12)
FirmAge			0.1426*
			(1.14)
Cashfolw	0.0041	0.0032	-0.147
	(0.15)	(-2.369)	(-0.112)
Fixed			0.389
			(1.469)
Growth	0.0022***	-1.2309	0.0023***
	(2.97)	(0.44)	(3.14)
Indep	0.7251**	2.568	3.478
	(2.43)	(1.46)	(1.254)
Topl			0.0416*
			(1.235)
Industry			0.572
			(1.114)
N	550	550	550
adj.R^2	0.3362	0.1008	0.3667

Note:*p<0.1,**p<0.05,***p<0.01

Table 9: Replace the stability test results of the explained variable

	(1) ROE	(2) IC	(3) ROE
ROA	0.0014***	3.8158***	0.0008*
	(2.81)	(4.56)	(1.67)
ESG	0.0045***	-1.2309	0.0048***
	(2.79)	(-0.44)	(3.17)
Dig	0.0011***	0.7201**	0.0010***
	(5.29)	(2.18)	(4.98)
Gpatent			-0.0689***
			(-4.18)
Attention			-1.123***
			(-3.78)
IC			0.0003***
			(7.52)
Size			-0.0498***
			(-3.19)
Lev			0.0099
			(1.34)
FirmAge			-26.0443**
			(-1.68)
Cashfolw			0.0148**
			(2.15)
Fixed			0.0183
			(0.73)
Growth	719.1123***	-0.1092***	0.0149**
	(15.79)	(-3.81)	(2.06)
Indep	0.1458***	0.1263	0.5269
	(2.43)	(-2.31)	(0.11)
Topl	0.478	0.789	0.996
	(2.63)	(1.25)	(1.03)
Industry	1.456	2.589	2.946
	(1.23)	(2.36)	(2.29)
N	550	550	550
adj.R^2	0.1151	0.1010	0.2081

IV. Conclusion

This paper proposes a set of corporate sustainability performance evaluation system with a total of 30 secondary indicators from seven perspectives: profitability, asset quality, debt service risk, business growth, social performance, corporate governance performance, and environmental performance. Taking the listed enterprises of M industry in 2013-2023 as the research object, we set corporate performance (ROA) as the explanatory variable and ESG performance (ESG) as the core explanatory variable to carry out the empirical analysis.

It is found that (1) the regression coefficient of ESG performance and corporate performance (ROA) is 0.0007, which is significantly positive at 1% level. (2) The regression coefficient of ESG performance and internal control (Growth) is 3.8158 and significant at 1% level. (3) The regression coefficient of internal control (IC) and firm performance is 0.0002 and significant at 1% level. It shows that ESG performance not only has a positive driving effect on the sustainable development performance of listed companies in M industry, but also has a positive relationship with internal control, which also plays a mediating role between ESG performance and corporate performance.

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