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Analysis of ESG's impact on the environment based on the financial assessment perspective

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Abstract. In recent years, financial performance evaluation has been regarded as one of the methods to measure a company's achievement of its performance goals, but its effectiveness has always been questioned. This has prompted people to hope to use ESG as a better indicator to replace financial performance. This article uses a dual weight evaluation model to demonstrate the impact of ESG on the environment. Secondly, this article establishes an environmental model, forms the Environmental Index (CI), and studies its changes. The results showed that adopting ESG can significantly reduce the rate of environmental degradation, indicating that it can be an important tool to help achieve sustainable development.

Keywords: Financial performance; ESG; Dual weight evaluation model; Environmental model.

1. Introduction

ESG assessment [1] is an evaluation method that focuses on the environmental, social, and governance aspects of a company. After the country proposed the "dual carbon" goal [2], this method has become an important reference for measuring the sustainable development of a company. In the past five years of research, it has been shown that there is a correlation between ESG performance and financial performance, and it has been found that ESG performance is positively correlated with return on equity (ROE) [3]. Through these studies, it can be found that there are specific advantages to transforming performance evaluation methods, but the specific advantages of this transformation have not been elaborated in previous research. This article uses modeling to clarify this specific advantage.

In traditional financial performance evaluation, there are several evaluation methods: profit margin analysis [4], cost control evaluation [5], cash flow evaluation [6], capital turnover evaluation [7], debt ratio analysis [8], return on investment analysis [9], and financial risk management analysis [10]. However, traditional financial performance evaluation only focuses on economic growth and ignores environmental, social, and other factors. Unlike financial performance, ESG performance is a new investment concept and comprehensive evaluation standard for enterprises, and it is also a value concept that keeps up with the times. This article first applies a dual weight evaluation model, using entropy weight method and ANP algorithm [11] to calculate the weights of the three aspects of ESG and their respective influencing factors, and then uses TOPSIS method [12] to evaluate their degree of environmental change. Secondly, in order to study the impact of ESG on the environment, this article selected three environmental related indicators: greenhouse gas emissions, land use efficiency, and biodiversity, and generated an environmental index. By observing the trend of changes in these indicators, the final conclusion was drawn. This conclusion can provide better regulation of the economy and environment for enterprises and environmental workers, as well as better response to the call for national sustainable development.

The use of ESG performance evaluation can enable companies to have stronger market competitiveness and risk resistance, clarify this specific advantage, and provide a traceable plan for future development.

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2. Symbol Explanation

Many variables need to be used in the article, so we will annotate them with symbols for future reference, as shown in Table 1.

Table 1. Symbol Explanation

symbol	illustrate
ESG	Environmental performance evaluation indicators
ERM	Environmental indicators
ERM_e	Energy factors
ERM_w	Water factors
ERM_s	Land resource factors
SOC	Social indicators
SOC_c	Community Relations Factors
SOC_s	Employee well-being factors
SOC_{cl}	Customer satisfaction factors
GOV	Corporate Governance Indicators
GOV_b	Board Structure Factors
GOV_d	Transparency factor
GOV_{ic}	Internal control factors
IC	Environmental Index

3. Double-weight evaluation model

3.1. Calculation of the weights of the three aspects of ESG

ESG evaluates performance from three aspects, including E (environment): refers to the evaluation of the company's production and operation status from the perspective of environmental friendliness, S (social): refers to the relationship between the enterprise and various stakeholders from the dimension of the company's social contribution, and G (governance): refers to the ability of the enterprise to maintain the company's sustainable operation and protect the interests of all parties in the company from the perspective of corporate governance. where E is y_1, S is y_2, and G is y_3.

Because we have multiple indicators that need to be evaluated, and the importance of each indicator is not the same. The entropy weight method can integrate multiple factors, and determine the importance of each index to the comprehensive evaluation by calculating the weight of each index. Therefore, we use it to determine the weights of each indicator, and the calculation steps are as follows:

Step 1 Data Normalization:

$$x' = x / (Xmax - Xmin) \tag{1}$$

Step 2 Calculate the variation index:

$$P_{ij} = x' / \sum(x') \tag{2}$$

Step 3 Calculate the information entropy:

$$e = -k \times \sum(p \times lnp) \tag{3}$$

Step 4 Calculate the weights:

$$w = (1 - e) / \sum((1 - e)) \tag{4}$$

The weights of the indicators are calculated in Table 2.

Table 2. ESG Weight Table

index	weight
y_1	0.43
y_2	0.30
y_3	0.27

3.2. Calculation of the weights of the three influencing factors of ESG

3.2.1. Environment.

Natural resource factors refer to the reduction in the number of natural resource entities due to the development and utilization of natural resources by economic activities, that is, the depletion and depletion of natural resources, including the depletion of land resources, energy resources and water resources. This is an important factor to be taken into account in the model.

(1) Energy resource factors

Through corresponding research, it has been shown that in order to calculate energy and resource factors, the first step is to obtain the energy consumption amount E_c and the corresponding unit price p of the energy. After correcting it through the energy price index EPIof each country, the energy unit cost P_{epi} of each country can be obtained. Multiplying them together can obtain the energy and resource cost.

$$\mathrm{ERM_e} = E_c \times P_{epi} \tag{5}$$

(2) Water resource factors

The water resource factor (ERM_w) is calculated using the resource price of natural water plus the water conservation and protection fee (wrcps) plus the water macro-management fee WP [13] (Mfwr), and the basic natural water price varies from country to country and is subject to availability.

$$\mathrm{ERM_w} = WP + wrcps + Mfwr \tag{6}$$

(3) Land resource factors

The calculation of land resource factors is relatively diverse, and there are three main calculation methods.

1. The direct market method evaluates the value of resources and environment according to their market price, and its calculation formula is: land resource factor = land price / area. Among them, the land price is the transaction price or appraised value in the market, and the area is the actual area or valuation area of the land.

2. The formula for calculating the alternative market approach varies depending on the specific application. A common alternative market method is calculated as follows: Land Resource Factor = (Alternative Land Price - Target Land Price) / Area. Among them, the alternative land price is the market price of the substitute with similar functions and attributes to the target land, the target land price is the market price of the target land, and the area is the actual area or valued area of the land.

Compared with the first two methods, the third method is more flexible and has a larger audience.

3. It is assumed that the formula for calculating the market method varies depending on the results of the survey. A common hypothetical market method is calculated as follows: land resource factor (ERM_s) = average willingness to pay (α) / area ($area$). Among them, the average willingness to pay is the average amount of users or consumers who are willing to pay for resources and environment obtained in the survey, and the area is the actual area or valuation area of the land.

So, we choose the third method as the method of calculating the cost of land consumption.

$$\mathrm{ERM_s} = \alpha \div area \tag{7}$$

Among them, the average willingness to pay () is analyzed through the analysis of the average willingness to pay in different countries in many countries through market research, and the following data are obtained, as shown in Table 3.

Table 3. Average willingness to pay table

land resource type	Average willingness to pay (yuan/square meter)
agricultural land	500
residential land	1000
commercial land	1500
industrial land	800

The ANP algorithm is used to calculate the weights of three aspects:

Step 1: Construct a hypermatrix W, where rows represent sinks and columns represent sources. According to the interaction and feedback information in the network structure, the relative preference and importance of the source to the sink are solved by comparing the elements in the sink based on the source.

Step 2: Each element of the hypermatrix W is a normalized eigenvector obtained based on a pairwise judgment comparison matrix, and the sum of the columns is 1, but W_{ij} W is not a normalized matrix. Therefore, using the control element ps as the criterion, the importance of each element group under the control element ps is compared, and a normalized sort of vector is obtained C_j:

$$A = \begin{bmatrix} a_{11} & L & a_{1N} \\ M & O & M \\ a_{N1} & L & a_{NN} \end{bmatrix} \tag{8}$$

Step 3: Multiply the matrix A by W to obtain the weighted hypermatrix:

$$W' = a_{ij} W_{ij} \tag{9}$$

Step 4: According to the ANP analysis method, to reflect the dependencies between elements, the weighted hypermatrix W needs to be stabilized, that is, the limit relative ranking vector is calculated:

$$\lim_{n\to\infty} (1/N \sum_{k=1}^{N} W^K) \tag{10}$$

The calculation shows that the limit converges and is unique, that is, the j column element of W^{∞} is the relative ranking of the limits of each element in the network layer under the control element for element j. The calculated weights of the indicators are as follows, as shown in Table 4.

Table 4. Weight Table of Environment Influencing Factors

Index	Weight
$\mathrm{ERM_e}$	0.19
$\mathrm{ERM_w}$	0.54
$\mathrm{ERM_s}$	0.27

3.2.2. Social.

(1) Community relations factors

The community relationship factor is a metric that quantifies how close a community member is to each other, and is calculated as:

$$SOC_c = IF + IQ + CI + MT + CB \tag{11}$$

(11) where: (CRA) is the affinity of community relations, (IF) is the frequency of interaction, (IQ) is the quality of interaction, (CI) is common interest, (MT) is member trust, and (CB) is community belonging.

(2) Employee welfare factors

Employee benefits cannot be quantified because of the company's different payroll rules in different industries, so this paper evaluates the employee benefits factors according to the scoring method.

(3) Customer satisfaction factors

There are two influencing factors for customer satisfaction: customer experience (CE) and customer expectations (CEP). The formula measures the customer's satisfaction with the product or service, where CE refers to the customer's actual feeling about the product or service, and CEP is the customer's expectation of the product or service:

$$\mathrm{SOC_{cl}} = CE - CEP \tag{12}$$

The ANP algorithm is used to calculate the weights, and the results are as follows, as shown in Table 5.

Table 5. Weight Table of Social Influencing Factors

Index	Weight
SOC_c	0.43
SOC_s	0.22
SOC_{cl}	0.35

3.2.3. Governance.

(1) Board of directors structure factors

Since the size, industry, and development direction of each company are different, the structure cannot be quantified at that time, and this paper evaluates the board structure of the company by scoring (1-10).

(2) Transparency factor

To calculate a firm's transparency, this article takes into account the Residual Aggressiveness (EA) and Earnings Smoothness (ES) and uses their deciles to calculate the Company's Transparency (Trans). The calculation formula is as follows:

$$\mathrm{GOV_d} = \frac{(\mathrm{EA+ES})}{2} \tag{13}$$

The result of the $\mathrm{GOV_d}$ is a numerical value between 1 and 10. The higher the number, the higher the company's information transparency.

If the values of earnings aggressiveness and earnings smoothness are low (i.e., close to the norm or industry average), then their deciles will be higher, resulting in higher values of $\mathrm{GOV_d}$.

Conversely, if the values of earnings aggressiveness and earnings smoothness are high (i.e., far from the norm or industry average), then their deciles will be lower, resulting in lower values of $\mathrm{GOV_d}$.

(3) Internal control factors

A company's internal control is determined by three aspects:

1. Soundness and effectiveness of internal control system: Evaluate the integrity, compliance and implementation effect of the internal control system, including system design, process control, risk management, etc.

2. Perfection of internal audit and supervision mechanism: Evaluate the establishment and improvement of the internal audit and supervision mechanism of the enterprise, as well as the supervision and feedback effect of the implementation of the internal control of the enterprise.

3. Enterprise operation and management and external risk prevention capabilities: Evaluate the level of internal control of enterprises in daily operation and management, including risk management, compliance management, internal control capabilities, etc.

We evaluate each of the three aspects and finally evaluate the company's internal control with an overall score (1-10).

The ANP algorithm is used to calculate the weights, and the results are as follows, as shown in Table.6.

Table 6. Weights of Governance Influencing Factors

Index	Weight
$\mathrm{GOV_b}$	0.13
$\mathrm{GOV_d}$	0.16
$\mathrm{GOV_{ic}}$	0.71

3.3. The TOPSIS method evaluates ESG

Since we need to analyze ESG changes over time and evaluate them, there is a lot of data. TOPSIS, on the other hand, is a comprehensive evaluation method that accurately reflects the gaps between programmes. Therefore, we chose the TOPSIS method for ESG analysis.

Step 1 Forward Matrix:

Very large indicators: no need to convert, just use the original value.

Very Small Indicators:

$$x_{max} - x \tag{14}$$

Intermediate: takes the absolute value of the difference between the extreme values of the distance.

Step 2 Standardization Matrix:

$$z_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x_{ij}^2}} \tag{15}$$

Step 3 Find the distance between it and the optimal solution:

$$d_i^+ = \sqrt{\sum_{j=1}^{m} (z_{ij} - Z_j^+)^2} \tag{16}$$

Step 4 Find the distance from the worst solution:

$$d_i^- = \sqrt{\sum_{j=1}^{m} (z_{ij} - Z_j^-)^2} \tag{17}$$

Step 5 Define the proximity of the ith object:

$$f_i = \frac{d_i^-}{d_i^+ + d_i^-} \tag{18}$$

The results are as follows (taking Alibaba as an example), as shown in Table 7.

Table 7. Company ESG Rating Table

Year	Score
2012	1
2014	2
2016	4
2018	9
2020	12
2022	17

The results show that the overall ESG score is rising, proving that the company is improving its business model and contributing to sustainable development.

4. Environmental model

The significance of climate mitigation mainly lies in environmental protection, including reducing greenhouse gas emissions. Global warming will lead to a series of serious environmental problems such as extreme weather, melting glaciers, and rising sea levels, which will have a great impact on the living environment of human beings and the earth's ecosystem. By mitigating climate warming, these impacts can be mitigated and the health and sustainable development of people and the planet's ecosystems can be protected. To solve this problem, we have built an environmental model to quantify its impact on the environment. In this model, we first propose the environmental index CI as a condition for assessing the climate. It is defined by the method of entropy weight-TOPSIS. The conclusion is then obtained by comparing CI with ESG and financial performance.

4.1. CI Indicator Selection

(1) Greenhouse gas emissions

Greenhouse gas emissions[14] (x_1) are gases released into the atmosphere that are able to absorb and reradiate heat, resulting in an increase in the temperature of the Earth's surface. The main greenhouse gases include carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), etc. The increase in greenhouse gas emissions is one of the main causes of global warming, so it is important to accurately measure and monitor its emissions.

(2) Land utilization rate

Land utilization rate [15] (x_2) is an indicator that reflects the degree of land use, which refers to the ratio of the area of land used to the total area of land, which is generally expressed as a percentage. This indicator can measure the degree of agricultural land use in a region or agricultural production unit, reflect the land occupied by non-agricultural land, measure the degree of cultivated land development and utilization, and the multiple cropping index.

(3) biodiversity

Biodiversity [16] (x_3) refers to the richness and diversity of biological species in a certain area, as well as the diversity of biological living environments. It includes all the plants, animals and microorganisms on the planet and all the genes and various ecosystems they possess. Biodiversity consists of three levels: genetic diversity, species diversity and ecosystem diversity. In simple terms,

biodiversity is the overall diversity and variability of living organisms and the systems they are made of.

4.2. Entropy weight method - Topsis

Because we have multiple indicators that need to be evaluated, and the importance of each indicator is not the same. The entropy weight method can use multiple environmental impact factors as evaluation indicators, and determine the impact of each index on the comprehensive evaluation by calculating the weight of each index. Therefore, we use it to determine the metric weights, and the results are as follows, as shown in Table 8.

Table 8. CI Index Weights

Index	Weight
x_1	0.375
x_2	0.311
x_3	0.314

There is a lot of data as we need to analyze and evaluate changes in CI over time. TOPSIS, on the other hand, serves as a comprehensive evaluation method that accurately reflects the gaps between programmes. Therefore, we chose the TOPSIS method for CI analysis, and the results are as follows (assuming a shift from 2017, rounding results), as shown in Table 9.

Table 9. Environmental Index Score Table

year	2012	2013	2014	2015	2016	2017
score	24	19	17	12	8	5
year	2018	2019	2020	2021	2022	2023
score	4	3	3	2	2	1

Overall, the climate has been deteriorating, but it can be seen that the rate of CI deterioration has slowed significantly after the shift from financial performance to ESG, indicating that this shift can indeed slow down climate deterioration and promote sustainable development.

5. Conclusion

This paper examines the environmental impact of a company's shift from financial performance to ESG assessment and its impact on sustainability. Since there are many aspects to consider in ESG, ESG can more comprehensively reflect the level of business development of a company. Nowadays, enterprises are facing many problems: over-exploitation and waste of natural resources, serious environmental pollution, imbalance of ecosystems, and so on. These problems not only pose a great threat to the survival and development of mankind, but also pose a huge challenge to the sustainable development of the economy. If we continue to follow the traditional economic development model, then enterprises will be in the predicament of unsustainable development. Therefore, after changing the assessment method, this paper finds that the rate of climate variability is significantly slower, and concludes that this transition is effective in mitigating climate variability. Therefore, article think it is very important to replace financial performance with ESG as an important indicator of the company's business development. This is also in line with the consensus and trend of the international community, and is conducive to enhancing the country's international image and competitiveness. In order to achieve this goal, a series of measures need to be taken. First of all, it is necessary to establish and improve the ESG accounting system, clarify the accounting methods and standards, and ensure the accuracy and credibility of the data. Second, it is necessary to strengthen supervision and management, and strictly control pollutant emissions and resource consumption. In addition, it is also necessary to promote the development and application of green industries and improve the efficiency and recycling rate of resources. Finally, replacing financial performance with ESG does not negate the importance

of financial performance, and in economic and social development, it is necessary to comprehensively consider various factors and balance the relationship between economic development and environmental protection. Only by achieving the harmony and unity of economic and ecological benefits can the great ambition of sustainable development be realized.

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