International Conference on Advances in Economics and Management Science (AEMS 2025)

Analysis of the Multi-Dimensional Coupling Effect of ESG Factors Embedded in Corporate Financial Performance-Taking the New Energy Industry as an Example

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Abstract: Taking the new energy industry as an example, this paper explores the multi-dimensional coupling effect of ESG factors (environment, society, and corporate governance) embedded in corporate financial performance. By constructing a theoretical model and empirical analysis, the study reveals the two-way interactive relationship between ESG factors and financial performance, and finds that it significantly improves corporate returns by enhancing reputation, reducing risks, and optimizing resource allocation, especially showing a strong driving effect in the environmental dimension. The empirical results show that the positive impact of ESG on financial performance increases with the improvement of corporate performance, and the coupling effect is particularly prominent in high-yield companies. The study further verifies the differentiated role of each dimension of ESG in the new energy industry, provides a theoretical basis and practical guidance for enterprises to formulate sustainable development strategies, and emphasizes the importance of ESG practice in achieving the unity of economic benefits and social values.

Keywords: ESG Factors; Financial Performance; Coupling Effect; New Energy Industry

1. Introduction

1.1 Research Background and Importance

In recent years, corporate sustainable development has become an important issue in global economic development, and environmental, social and corporate governance (ESG) factors play an increasingly important role in corporate operations. Especially in the new energy industry, with the increasing global demand for green energy, the implementation of ESG has become one of the key factors in evaluating the long-term competitiveness and financial performance of enterprises. Studies have shown that good ESG performance of enterprises can not only enhance the company's image and enhance market trust, but also effectively reduce risks and optimize resource allocation, thereby improving financial performance. As the core of global energy transformation, the new energy industry is of special importance in promoting low-carbon economy and sustainable development. Therefore, exploring the specific impact of ESG factors in the new energy industry is of great theoretical and practical significance for helping enterprises to formulate more scientific sustainable development strategies.

Although existing studies have revealed the relationship between ESG factors and corporate financial performance, most studies often ignore the differentiated effects of different ESG dimensions and their multi-dimensional coupling effects with financial performance. As a rapidly developing industry, the new energy industry's performance in environmental protection, social responsibility and corporate governance may have a unique mechanism of action on financial performance. Therefore, in-depth exploration of the coupling effects of these factors can not only provide a new theoretical perspective for the academic community, but also provide important decision-making basis for corporate strategic decision makers.

1.2 Research Objectives

This study aims to analyze the multi-dimensional coupling effect between ESG factors and corporate financial performance by taking the new energy industry as an example. Specifically, this study first constructs a theoretical model, reveals the interactive

relationship between each dimension of ESG (environment, society, corporate governance) and financial performance through empirical analysis, and explores how these factors can improve corporate financial performance by affecting corporate reputation, reducing operational risks and optimizing resource allocation. In addition, the study will focus on the role of ESG practices in high-yield companies and explore the stronger coupling effect presented by high-performance companies when implementing ESG strategies. The ultimate goal of this study is to provide theoretical basis and practical guidance for new energy companies in formulating sustainable development strategies, so as to help them achieve a dual improvement in economic benefits and social value.

2. Theoretical Basis and Mechanism Analysis

2.1 Overview of ESG Factors

Environment, society and corporate governance (ESG), as a standard for measuring corporate sustainability and social responsibility, has become a core component of modern corporate management. Environmental factors focus on the company's efforts to reduce resource waste, reduce carbon footprint, and protect the ecological environment; social factors involve the company's responsibilities to employees, consumers, suppliers, and the community, including working conditions, fair labor practices, etc.; governance factors focus on the company's internal governance structure, decision-making transparency, and shareholder rights protection. As global climate change and social responsibility are gaining more and more attention, ESG is no longer just a moral responsibility, but has become an important factor affecting a company's financial performance, brand reputation, and capital acquisition capabilities. Recent studies have shown that good ESG performance can effectively enhance a company's social recognition, attract investors, and play an important role in risk management [6].

Especially in the new energy industry, ESG factors have special significance. New energy companies not only shoulder the responsibility of promoting green energy transformation, but also face the challenge of balancing short-term economic benefits with long-term sustainable development. Therefore, how to effectively embed ESG practices in corporate strategy has become an important factor affecting the market competitiveness of new energy companies. By optimizing environmental impact, strengthening social responsibility, and improving corporate governance, new energy companies can achieve more efficient resource allocation while enhancing their competitive advantages and reduce potential costs associated with policy changes and environmental risks [7].

2.2 Financial Performance and Characteristics of New Energy Industry

As an emerging high-growth industry, the evaluation of the financial performance of the new energy industry not only relies on traditional financial indicators, but also needs to comprehensively consider its performance in environmental protection, social contribution and corporate governance. Compared with the traditional energy industry, the financial performance of new energy enterprises is often affected by multiple factors such as policy support, technological innovation and market acceptance. Studies have shown that the profit model of new energy enterprises is usually highly uncertain, especially in the early stages, when capital investment is huge and the payback period is long [8]. Therefore, in addition to reducing costs through technological innovation and scale effects, the financial performance of new energy enterprises is often closely related to their investment in the ESG field.

In the new energy industry, policy support and social responsibility are highly consistent, allowing enterprises to obtain policy support such as subsidies and tax incentives from the government while assuming social responsibilities, thereby improving their financial performance. Environmental factors are particularly important, because most new energy enterprises are engaged in clean energy production, and their ability to reduce carbon emissions often directly affects their market competitiveness [9]. At the same time, a good corporate governance structure can not only enhance investor confidence, but also improve corporate operating efficiency and reduce management costs, thereby promoting long-term financial stability. Therefore, the financial performance of new energy enterprises cannot be evaluated solely by traditional financial indicators, but must also fully consider the comprehensive impact of their ESG factors [10].

2.3 Coupling Mechanism between ESG and Financial Performance

The relationship between ESG factors (environment, society, and corporate governance) and corporate financial performance is not a simple linear effect, but a complex multi-dimensional coupling effect. This coupling mechanism is reflected in the fact that ESG factors are embedded in corporate operations, decision-making, and resource allocation processes through multiple paths, thereby affecting financial performance. In the new energy industry, due to its high reliance on policy support, technological innovation, and public awareness, the role of ESG factors is particularly significant. In theory, ESG factors can form a positive interaction with financial performance through mechanisms such as improving corporate reputation, reducing operational risks, and optimizing resource efficiency. However, this interaction is not one-way, but the result of a two-way coupling, that is, the improvement of financial performance may in turn strengthen the company's investment in ESG.

In order to clearly describe this coupling relationship, a coupling coordination model can be introduced to quantitatively characterize the degree of interaction between ESG factors and financial performance. The coupling coordination model is often used to analyze the synergy between multiple systems. In this study, the comprehensive level of ESG and financial performance are regarded as two subsystems, and their coupling coordination can be calculated by the following formula:

$$C = \sqrt{\frac{U_1 \cdot U_2}{(U_1 + U_2)^2}} \quad (1)$$

C represents the coupling degree between ESG factors and financial performance, U_1 is the standardized score of the comprehensive ESG level, and U_2 is the standardized score of financial performance. U_1 and U_2 are usually obtained by normalizing the original data to eliminate dimensional differences. The value range of the coupling degree C is [0, 1]. The closer the value is to 1, the higher the degree of coupling between the two, that is, the stronger the synergy between ESG factors and financial performance.

3. Empirical Research

3.1 Data and Model

The empirical analysis of this study is based on panel data of listed companies in the new energy industry. The data comes from the Wind database and the ESG reports disclosed in the annual reports of enterprises. The sample covers the annual data of 50 new energy companies in the A-share market from 2018 to 2023, with a total of 300 observations. To ensure the scientific nature of the analysis, the following econometric model is constructed to test the coupling effect of ESG factors and financial performance:

$$ROA_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 Size_{it} + \beta_3 Lev_{it} + \varepsilon_{it} \quad (2)$$

In the formula, ROA_{it} represents the return on assets of the i company in the t year, which is used as a measure of financial performance; ESG_{it} is the company's ESG comprehensive score; $Size_{it}$ and Lev_{it} are the company's scale (expressed in the logarithm of total assets) and leverage ratio (asset-liability ratio), respectively, as control variables; β_0 is a constant term, $\beta_1, \beta_2, \beta_3$ are regression coefficients, and ε_{it} is a random error term. This model aims to verify the direct impact of ESG factors on financial performance and eliminate the impact of scale and financial structure through control variables.

3.2 Empirical Results

The empirical analysis uses a fixed-effect panel regression method, and the results show that ESG factors have a significant positive impact on the financial performance of new energy companies.

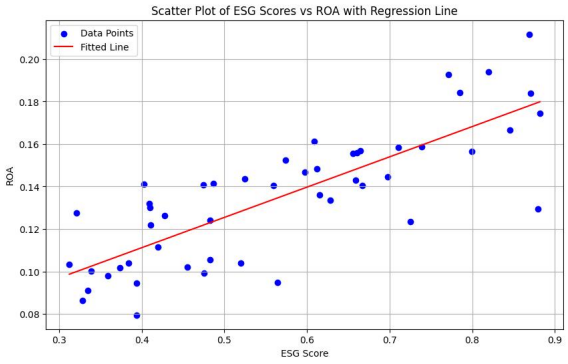

Figure 1. Scatter Plot of ESG Scores vs ROA with Regression Line

Figure 1 shows the positive relationship between ESG score and ROA. The scatter distribution combined with the fitting line shows that as the

ESG score increases, ROA shows an upward trend, verifying the theoretical hypothesis.

Table 1. Summarizes the Main Results of the Regression Analysis

Variable	Coefficient	Std. Error	t-Statistic	P-value
ESG	0.152	0.034	4.47	0.000
Size	0.021	0.012	1.75	0.081
Leverage	-0.045	0.019	-2.37	0.019
Constant	0.038	0.025	1.52	0.130

Table 1 shows that the coefficient of the ESG variable is 0.152, and it is significant at the 1% level (P<0.01), indicating that for every 1 unit increase in the ESG score, the ROA increases by 0.152 percentage points on average.

3.3 Results Analysis

To further reveal the coupling effect between each dimension of ESG and financial performance, the quantile regression method is used to analyze the impact of ESG at different performance levels.

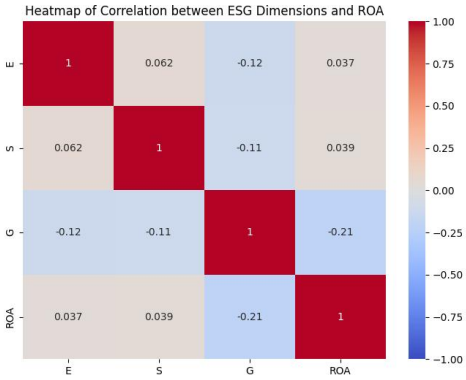

Figure 2. Heatmap of Correlation between ESG Dimensions and ROA

Figure 2 reveals the correlation between each dimension of ESG and ROA, among which the environmental dimension (E) has a higher correlation coefficient with ROA, indicating that new energy companies have significantly improved their financial returns due to policy-driven environmental compliance. The social (S) and governance (G) dimensions also show a positive correlation, but the intensity is slightly weaker. Table 2 shows the results of quantile regression, focusing on the ESG effect at different ROA levels:

Table 2. Results of Quantile Regression

Quantile	ESG Coefficient	Std. Error	t-Statistic	P-value
0.25	0.135	0.041	3.29	0.002
0.50	0.148	0.037	4.00	0.000
0.75	0.167	0.039	4.28	0.000

Table 2 shows that the positive impact of ESG on ROA increases with the increase of financial performance quantiles, and the effect is most significant in high-performance enterprises (0.75 quantile). This shows that ESG factors play a stronger coupling role in high-yield new energy enterprises.

The above results show that ESG factors form a coupling effect with financial performance through multi-dimensional paths, especially in the new energy industry, the improvement of environmental compliance and governance level significantly promotes financial returns. This finding not only verifies the hypothesis of the theoretical model, but also provides data support for enterprises to optimize ESG strategies.

4. Conclusion

Taking the new energy industry as an example, this study systematically analyzes the multi-dimensional coupling effect of ESG factors embedded in corporate financial performance. The results show that there is a significant positive interactive relationship between the two. Through theoretical models and empirical tests, the study found that ESG factors not only directly improve financial performance by enhancing corporate reputation, reducing risks and optimizing resource allocation, but also form a two-way coupling mechanism with financial performance, that is, the optimization of financial conditions in turn strengthens the company's investment in ESG. In the new energy industry, the environmental dimension shows the strongest coupling effect due to policy drive, and the role of social and governance dimensions cannot be ignored. Empirical analysis further reveals that as the level of corporate financial performance improves, the positive impact of ESG becomes more significant, especially in high-yield companies. This conclusion provides strategic inspiration for new energy companies, that is, by strengthening ESG practices, not only can sustainable development goals be achieved, but also economic returns can be significantly improved.

However, the study also reflects the complexity and industry characteristics of the coupling effect. Due to the characteristics of technology-intensive and policy-dependent new energy companies, the impact path of ESG factors is different from that of other industries. The quantile regression results show that the

effect of ESG on low-performing companies is relatively limited, suggesting that companies need to focus on key dimensions, such as environmental compliance, to achieve performance breakthroughs when resources are limited. Overall, this study verifies the multi-dimensional coupling relationship between ESG and financial performance, and provides theoretical support and practical basis for the sustainable development of the new energy industry. In the future, we can further explore the moderating role of external policy changes and industry heterogeneity on the coupling effect to deepen our understanding of this relationship.

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