

The Impact of Green Investment on Financial Performance of Heavy Polluting Enterprises

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Abstract. Economic development has brought about numerous environmental issues, prompting scholars to conduct research on green investment. By selecting data from heavily polluting enterprises and innovatively applying factor analysis using SPSS software, we analyze the impact of green investment on their financial performance and derive a comprehensive scoring formula. We also conduct a longitudinal analysis of how green investment measures have influenced the financial performance of these enterprises in recent years. Ultimately concluding that green investment has a positive impact on the financial performance of heavily polluting enterprises.

Keywords: green investment, heavily polluting enterprises, financial performance, factor analysis.

1. Introduction

Economic development has led to prominent environmental problems, and heavy polluting enterprises, as key subjects of environmental governance, have attracted widespread attention to their green development behavior. The relationship between green investment and corporate financial performance has been a hot topic in academic research, and scholars at home and abroad have formed three main conclusions: positive correlation, negative correlation and insignificant correlation. Some studies hold that green investment can improve corporate technological level and brand image to boost financial performance [1-5]; others believe that green investment increases short-term operating costs and causes financial pressure, leading to performance decline [6-9]; a third view points out a U-shaped relationship between the two, where green investment inhibits first and then promotes financial performance [10-13].

Most macro-level analyses lack targeted research on heavy polluting industries; the research on the impact mechanism of green investment on financial performance is not in-depth enough. Based on this, this paper takes heavy polluting enterprises as the research object, uses factor analysis to quantify financial performance, and deeply analyzes the impact of green investment on their financial performance, which enriches the relevant research in this field.

2. Relevant Concepts and Research Methods

Green investment refers to the corporate investment behavior for sustainable development, with R&D investment as the core measurement indicator, including expenditures on energy-saving and emission-reduction equipment upgrading, green technology R&D, and environmental protection facility construction; heavy polluting industries in this paper refer to the 16 industries including paper, textile, pharmaceutical, chemical and coal defined in the Environmental Information Disclosure Guide for Listed Companies issued by the Ministry of Environmental Protection in 2010; corporate financial performance is a comprehensive reflection of corporate operating conditions, evaluated from four core dimensions of profitability, solvency, operational capability and development capability in this research.

This paper adopts factor analysis, and combines the characteristics of heavy polluting enterprises to construct an evaluation index system of green investment on financial performance with 13 indicators from five dimensions of profitability, solvency, development capability, operational capability and green investment, whose core indicators include return on equity, quick ratio, total asset growth rate, inventory turnover and R&D investment, covering the key dimensions of corporate operation and green investment behavior.

Table 1. Evaluation Index System of Green Investment on Financial Performance

| Review content | Evaluation Metrics | Calculation formula |
|------------------------|-------------------------------------|---|
| Profitability | Return on equity | Net profit / average shareholders' equity |
| | net profit margin | Net Profit / Revenue |
| | return on assets | (Total Profit - Financial Expenses) / Average Total Assets |
| solvency | Debt-to-asset ratio | Total Assets / Total Liabilities |
| | Quick Ratio | Quick Assets / Current Liabilities |
| | Interest Coverage Ratio | (Net Profit + Financial Expenses) / Financial Expenses |
| development capability | Total Asset Growth Rate | Increase in Total Assets / Total Assets at Beginning of Year |
| | Net profit growth rate | (Current period net profit - Previous period net profit) / Previous period net profit |
| | Revenue Growth Rate | Increase in operating revenue / total operating revenue of the previous year |
| operational capability | Inventory Turnover | Operating Costs/Ending Inventory Balance |
| | Accounts Receivable Turnover | Operating Revenue / Ending Balance of Accounts Receivable |
| | Total Asset Turnover | Operating Revenue / Average Total Assets |
| green investment | Research and Development Investment | |

3. Data Sources and Empirical Analysis

Based on the 2012 CSRC industry classification and the scope of heavy polluting industries, this paper initially selects 1,481 related enterprises, excludes ST/*ST enterprises and enterprises with serious missing financial data, and finally obtains a valid sample of 91 heavy polluting enterprises, and selects three typical steel enterprises of Shougang, Baosteel and Angang for in-depth case analysis, with the research period set as 2010 to 2021 by taking 2010 (the end of the 11th Five-Year Plan) and 2021 (the end of the 13th Five-Year Plan) as key time nodes to analyze the dynamic changes of green investment and financial performance, and the financial data and green investment data of enterprises are mainly from the Guotai An (CSMAR) Database and supplemented by manual verification of enterprise annual reports and official website information to ensure the accuracy and completeness of the data.

The KMO and Bartlett tests are conducted on the data of 2010 (Data 1) and 2021 (Data 2) respectively, and the results are shown in Table 2 and Table 3. The KMO values of Data 1 and Data 2 are 0.642 and 0.650 respectively, both greater than 0.6; the P-values of Bartlett test are both 0.000 < 0.05, which indicates that the sample data meets the requirements of factor analysis and is suitable for further factor extraction.

Table 2. KMO and Bartlett's Test for Data 1

| | | |
|---|------------------------|---------|
| Kaiser-Meyer-Olkin measure of sampling adequacy | | .642 |
| Bartlett's test of sphericity | Approximate Chi-Square | 649.086 |
| | df | 78 |
| | Sig. | .000 |

Table 3. KMO and Bartlett's Test for Data 2

| | | |
|---|------------------------|---------|
| Kaiser-Meyer-Olkin measure of sampling adequacy | | .650 |
| Bartlett's test of sphericity | Approximate Chi-Square | 475.601 |
| | df | 78 |
| | Sig. | .000 |

The common factor variance test shows that the extraction values of most indicators in Data 1 and Data 2 are greater than 0.6, meaning the extracted common factors can well explain the information of the original variables with good factor analysis effect, the total variance explanation result shows

that the cumulative variance contribution rates of the first five principal components of Data 1 and Data 2 are 77.263% and 70.779% respectively, which can reflect the main information of the 13 original indicators, so the first five principal components are selected as common factors, and after orthogonal rotation of the initial factor loading matrix, the five common factors are named F1 (Profitability Factor), F2 (Development Capability Factor), F3 (Solvency Factor), F4 (Operational Capability Factor) and F5 (Green Investment Factor) combined with the economic significance and factor loading size.

Based on the component score coefficient matrix obtained by SPSS analysis, the score functions of the five common factors for Data 1 and Data 2 are derived respectively. Taking the proportion of the variance contribution rate of each common factor to the cumulative variance contribution rate as the weight, the comprehensive financial performance score models of 2010 (F) and 2021 (F') are constructed:

$$F=|F1|*20.951/77.263+|F2|*20.392/77.263+|F3|*14.044/77.263+|F4|*12.346/77.263+|F5|*9.530/77.263 \quad (1)$$

$$F'=|F'1|*17.741/70.779+|F'2|*16.101/70.779+|F'3|*15.506/70.779+|F'4|*11.081/70.779+|F'5|*10.349/70.779 \quad (2)$$

4. Results

4.1 Horizontal Comparative Analysis within the Same Industry

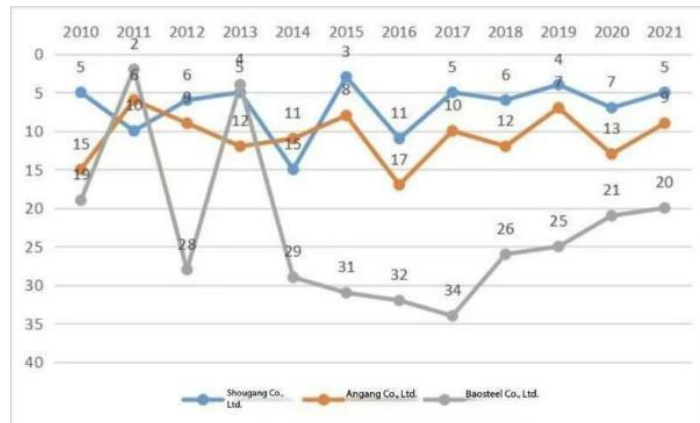


Figure 1. Ranking of comprehensive scores from 2010 to 2021

Based on the comprehensive score model, the financial performance comprehensive scores of 91 sample enterprises from 2010 to 2021 are calculated and ranked, and the analysis of the ranking changes of Shougang, Baosteel and Angang shows that the rankings of the three steel enterprises have shown a steady upward trend since 2016 with their comprehensive financial performance continuously improved and ranking among the top of the heavy polluting industry, and the ranking fluctuation of the three enterprises before 2016 was mainly affected by external factors such as the steel industry downturn and market oversupply while the continuous improvement of their ranking after 2016 is closely related to the increase of green investment and continuous technological upgrading, with Shougang's release of the first "Implementation Plan for the Green Action Plan" in 2015 becoming an important node for the green development of the three enterprises and their green investment showing a significant upward trend since then with Shougang leading in investment scale.

4.2 Longitudinal Analysis of Green Investment and Financial Performance

The statistical analysis of the green investment data of the three enterprises from 2016 to 2021 and the correlation with their financial performance shows that the green investment of the three

enterprises has maintained a continuous upward trend from 2016 to 2021 with Shougang leading in investment scale followed by Baosteel and Angang, and even under the impact of the COVID-19 pandemic in 2020, the three enterprises did not reduce green investment and maintained high investment intensity in energy-saving and emission-reduction and green technology R&D, and there is a significant positive correlation between the scale of green investment and financial performance of the three enterprises, where the increase of green investment has effectively promoted corporate technological upgrading with Shougang improving the competitiveness of strategic products such as electrical steel, Baosteel breaking through the technical barriers of silicon steel and realizing steel lightweighting, Angang developing ultra-wide duplex stainless steel and filling the domestic gap, and such technological upgrading further reduced the environmental governance costs of enterprises, improved product added value and market competitiveness, and ultimately boosted the continuous improvement of financial performance.

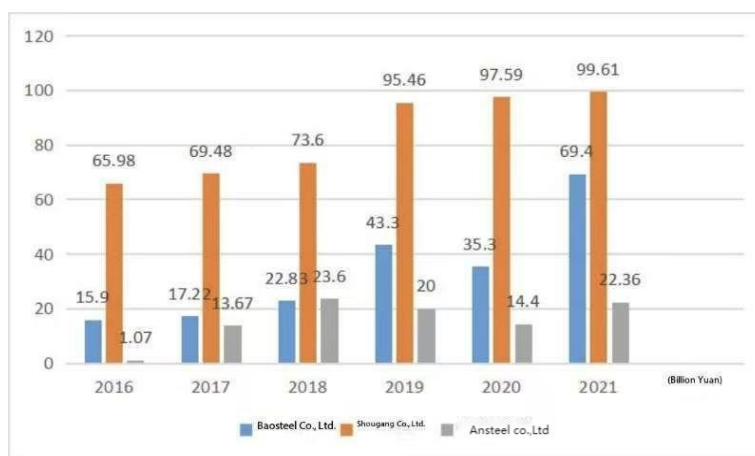


Figure 2. Green Investment of Three Selected Enterprises from 2016 to 2021

4.3 Impact Mechanism of Green Investment on Financial Performance

Combined with the empirical results of 91 sample enterprises and the case analysis of the three steel enterprises, green investment affects the financial performance of heavy polluting enterprises through three key paths with technological upgrading as the core link of the whole mechanism: green investment in energy-saving and emission-reduction equipment and green technology can reduce environmental fines of enterprises, optimize corporate energy management, reduce energy consumption costs, and thus lower the overall operating costs of enterprises; under the background of oversupply of low-end products in the heavy polluting industry, green investment drives enterprises to carry out R&D and production of high-end and environmentally friendly products, which effectively improves product added value and market share, and further boosts the profitability of enterprises; green investment helps heavy polluting enterprises establish a good social image of environmental protection, meet the environmental demands of the government, consumers and other stakeholders, enhance corporate brand value and core competitiveness, and lay a solid foundation for the long-term improvement of financial performance.

5. Conclusion

Green investment has a significant positive impact on the financial performance of heavy polluting enterprises and the continuous increase of green investment scale is conducive to the steady improvement of corporate financial performance, that although the financial performance of heavy polluting enterprises is affected by external market fluctuations and other factors, green investment can effectively enhance enterprises' resilience to external risks and enterprises with high green investment intensity show better performance stability in the face of industry downturn and external shocks, that green investment improves the financial performance of heavy polluting enterprises

through three key mechanisms of cost reduction, profit improvement and image enhancement with technological upgrading as the core link connecting green investment and financial performance improvement and running through the whole impact process, and that the green investment behavior of heavy polluting enterprises in China since 2016 has achieved remarkable results and the combination of green investment and technological innovation has become the key path for the green transformation and high-quality development of heavy polluting enterprises.

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