ESG Performance and Technological Innovation of Textile Listed Companies under China's Carbon Peaking and Carbon Neutrality Goals

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Abstract: Based on the data of China's Shanghai and Shenzhen A-share textile companies in 2017-2022, this paper empirically tests the influence of ESG performance of textile listed companies on their technological innovation ability and the specific action process. The results show that ESG performance has a significant positive impact on the technological innovation ability of textile listed companies, and the financing constraint plays an intermediary role in this process. This paper not only enriches the economic consequences of ESG performance and studies of technological innovation of textile listed companies, but also provides empirical evidence and theoretical support for textile listed companies to attach great importance to ESG performance to improve their own technological innovation ability.

1. Introduction

With global warming, the greenhouse effect intensifies, and the issue of carbon emissions has been widely concerned. To solve this problem, many countries have proposed measures to reduce carbon emissions. China has also actively responded to this problem and implemented the strategy of "carbon peaking" and "carbon neutrality" to promote the green transformation of whole society.

Nowadays, China is one of the world's largest textile producers and exporters. As a pillar industry of national economic and social development, the textile industry not only guarantees the basic demand of domestic residents, but also plays an important role in health care, environmental protection, transportation, soil construction, safety protection and agriculture and many other different fields. However, the traditional textile industry still has problems such as large carbon emissions, lack of independent innovation ability, and shortage of some key technologies. Therefore, how to stimulate the innovation potential and promote the transformation of textile companies has become a very important issue.

The CPC party's 20th report emphasizes the core role of innovation in China's overall modernization drive. Only by enhancing the ability of independent innovation and mastering key core technologies can enterprises have core competitiveness. To focus on innovation is to focus on development and to pursue innovation is to look to the future. Innovative development has become the only way to promote the development of China's textile industry.

At present, there are many papers studying the influence of ESG performance on enterprises. In regard to the impact of ESG performance on enterprise value, Linlin Wang et al[1] analyzes the positive impact of corporate ESG performance on corporate value through three factors: alleviating financing constraints, improving corporate efficiency and reducing corporate risk. In regard to the impact of ESG performance on enterprise performance, Jinglin Li et al[2] test the positive correlation between corporate ESG performance and corporate performance from the perspective of corporate innovation. In regard to the impact of ESG performance on the green technology innovation of enterprises, Yunmeng Zhang[3], based on the theory of information asymmetry and sustainable development theory, better ESG performance can significantly promote the green technology innovation of enterprises, and financing constraints play an intermediary effect in it.

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According to the existing research, many scholars are based on a single dimension, and few are studied from a multi-dimensional perspective. Only a few scholars can carry out ESG performance research through the self-built ESG evaluation system, but the self-built indicators lack authority and accuracy. Secondly, the research objects of the existing literature are too wide, and the research is rare for a certain industry. In view of this, this paper selects the listed companies in Shanghai and Shenzhen A-share textile industry in China from 2017-2022 as the sample to empirically test the impact of ESG performance of listed textile companies on technological innovation ability, as well as the intermediary effect of financing constraints.

2. Theoretical analysis and research hypothesis

2.1. ESG Performance and Technological Innovation

Innovation is the driving force for the survival and development of an enterprise, and it is also the inevitable requirement for an enterprise to enhance its popularity and expand its reputation. If the textile listed companies want to make great progress and have more competitive advantages, innovation is the objective requirement and the inevitable way out. In the innovation management of textile listed companies, the sustainable development can create a more stable innovation environment, and provide continuous resources and power for the company's innovation activities. The good ESG performance can promote the sustainable development of the company. Therefore, the performance of listed textile companies in ESG is bound to have a positive impact on their technological innovation ability.[4]

Based on the stakeholder theory and signal theory, the improvement of ESG performance is conducive to improving the reputation of the company, releasing a signal that the company is green and environment friendly, and it actively undertakes its social responsibility and it has a good corporate governance, so as to arouse the positive attention and response of the company stakeholders. This will also help the company to obtain the relevant heterogeneous resources required for innovation, and improve the company's technological innovation ability.

It is mainly reflected in the following aspects. First, the good performance of corporate ESG, to some extent, indicates that enterprises are actively fulfilling their social responsibilities, and the government will therefore provide more preferential policies and financial support to such enterprises to help them carry out further research and development activities. Second, the good performance of enterprise ESG, to some extent, indicates that the enterprise has a high degree of environmental protection, its products are more popular with consumers, and consumers are more willing to give suggestions for enterprise technological innovation and provide new ideas for enterprise technological innovation. Third, enterprise ESG performs well, and suppliers are more inclined to cooperate with enterprises in business and technological innovation, so as to help enterprises to transform and upgrade technological transformation and upgrading. Fourth, the ESG of enterprises performs well, and creditors and shareholders have increased confidence in the future development of the enterprise, enabling the enterprise to absorb more funds and then help them to carry out technological innovation activities. Fifth, the good performance of enterprise ESG makes enterprises more likely to be favored by social environmental protection organizations, so as to reduce information asymmetry, make enterprises obtain more sufficient information, and further improve the technological innovation ability of enterprises.In summary, the following hypothesis H1 is proposed.

H1: ESG performance has a significant positive impact on technological innovation ability.

2.2. Intermediary effect of financing constraint

When the internal capital is limited, the enterprise must ensure the normal innovation activities through external financing channels, such as bank loans, equity financing, venture capital and other external financing. Theoretically, good ESG performance can ease financing constraints by reducing information asymmetry, releasing positive signals, eliminating market doubts caused by information asymmetry, and encouraging investors to take active investment behaviors. In addition,

good ESG performance can improve corporate reputation and brand image, thus increasing the diversity of financing sources and reducing financing costs. More funds will flow to enterprises, while enterprises will have enough funds to invest in research and development activities, so as to promote the development of enterprise technological innovation activities and improve the level of technological innovation. Therefore, the following hypothesis H2 is proposed.

H2: Financing constraints play an intermediary role in the impact of ESG performance on technological innovation.

3. Study Design

3.1. Sample selection and data source

In this paper, A-share textile listed companies in Shanghai and Shenzhen from 2017 to 2022 are selected as research samples to excluding samples with incomplete financial data, ST and*ST enterprises, the bidirectional tail reduction treatment of 1% of each continuous variable.Finally acquired effective total sample size of 232 listed companies in the textile industry. Among them, the ESG rating data of listed companies in the textile industry comes from Wind financial database, and the rest of the data are from CSMAR database. The empirical analysis is processed by EXCEL and STATA.

3.2. Variable measurement

3.2.1. The explained variable

Technological Innovation of listed companies. When evaluating the technological innovation ability of companies, the existing literature mainly evaluates the technological innovation ability of listed companies from the perspectives of innovation input and innovation output. However, the innovation research and development activities of listed companies mostly are high risk, long cycle.The innovation return of listed companies can more directly reflect the innovation results of the company, and the innovation of listed companies can provide specification, detailed information. This paper draws on the relevant research of domestic and foreign scholars, measures the innovation ability of listed companies through the number of patent applications of listed companies (the sum of invention patents, utility model patents and demonstration patent applications), and the method of applying the natural logarithm in the regression model is adopted.

3.2.2. The explanatory variable

ESG Performance (ESG). Currently, the performance of domestic ESG is mostly measured by third-party ratings based on ESG reports disclosed by the company. Among many third-party rating agencies, the CSI ESG rating is based on the domestic capital market and refers to the foreign mainstream ESG evaluation framework, to measure the ESG performance of domestic listed companies more accurately. Moreover, the CSI ESG rating range has covered all listed companies' A-shares in China, which has the characteristics of wide coverage and strong timeliness. Therefore, this paper selects the ESG rating system of CSI as an indicator to measure the ESG performance of listed companies, measures the ESG rating index "AAA~C" of CSI from high to low ("9~1") to represent the ESG performance of the company, and scores the ESG information report disclosed by the selected sample enterprises and evaluates it in turn.

3.2.3. The mediation variable

Corporate financing constraints (FC). In this paper, the logarithm after the absolute value of the SA index is taken as the alternative variable of the financing constraint. The specific calculation formula of SA is as follows:

$$SA = -0.737*Size + 0.043 *Size^2-0.04 *Age$$

Size is the natural logarithm of the total assets of the enterprise, and Age is the difference between the enterprise research year and the establishment year.

3.2.4. The controlled variable

In the empirical model of this paper, the indicators closely related to the innovation ability of the listed companies are selected as the control variables, such as the Age of the listed company, equity concentration (TOP10) and various financial indicators of the listed company. Among them, the company's solvency is measured by asset-liability ratio (LEV), the company's profitability is measured by return on assets (ROA), the company's growth capacity is measured by operating profit growth rate (Growth), and the company's R&D expenditure is measured by R&D expenses (R&D). In addition, a year dummy variable (Year) was created to control for time effects. The definition and interpretation of each variable are shown in Table 1.

Table 1 Variable definition table

Type of Variable	Variable name	Variable symbol	Variable-definition
The Explained Variable	Innovation ability of listed companies	Innovation	The total number of applications for invention, utility model and design patents plus a natural log of 1
The explanatory Variable	ESG expression	ESG	According to the ESG rating of China Securities, the value is 1 to 9, and the data of each year is the average of the four quarters of that year
Mediation variables	Enterprise financing constraints	FC	The absolute value of the SA index was taken as the log
The Controlled Variable	Age of listed company	Age	The natural logarithm of the number of establishment of a listed company
	Debt paying ability	LEV	Total liabilities / total assets
	Research and development intensity	R&D	R & D expenditure / operating revenue
	Growth ability	Growth	(Operating income of the current period-previous operating income) / previous operating income
	Number of board meetings	Meeting	Number of board meetings held by the listed company that year
	Profitability	ROA	Net income / total assets
	Equity concentration	Top10	The sum of the shareholding ratio of the top ten shareholders
	Year	Year	Virtual variable, take 1 when the variable belongs to period i, or 0 otherwise

3.3. Variable measurement

In order to study the influence of ESG performance of listed companies on the technological innovation ability of enterprises and the intermediary role of enterprise financing constraints, this paper based on Zhonglin Wen[5] the proposed mediation effect test procedure sets the following three regression models. Where, α_0 is the model constant term, α_1~α_8 is the coefficient of the explanatory, mediating and control variables and ε is the random error term.

(1) Model construction of enterprise ESG performance and technological innovation: $Innovation = \alpha_0 + \alpha_1 ESG + \alpha_2 Age + \alpha_3 LEV + \alpha_4 ROA + \alpha_5 R\&D + \alpha_6 Growth + \alpha_7 TOP10 + \sum Year + \varepsilon$

(2) Model construction of enterprise ESG performance and financing constraints:

$FC = \alpha_0 + \alpha_1 ESG + \alpha_2 Age + \alpha_3 LEV + \alpha_4 ROA + \alpha_5 R\&D + \alpha_6 Growth + \alpha_7 TOP10 + \sum Year + \varepsilon$

(3) Model construction of the mediation effect of financing constraints:

$Innovation = \alpha_0 + \alpha_1 ESG + \alpha_2 FC + \alpha_3 Age + \alpha_4 LEV + \alpha_5 ROA + \alpha_6 R\&D + \alpha_7 Growth + \alpha_8 TOP10 + \sum Year + \varepsilon$

4. Study Design

4.1. Descriptive statistical analysis

Descriptive statistics results are shown in Table 2.Innovation maximum value is 7.023, the minimum value is 0.693, combined with the standard deviation can be concluded that there are large differences between the innovation ability of listed companies.The average variable ESG score is 4.217, indicating that the average ESG performance of listed companies in China is between B-BB rating, there is still a large room to rise. The average value of the intermediary variable FC is 2.459, the maximum value is 2.745, the minimum value is 2.243, and the standard deviation is 0.131, indicating that the listed companies in the textile industry as a whole are still facing a large financing constraint problem. Among the control variables, LEV with an average value of 33.9%, indicating that the debt level of listed companies in China's textile industry is relatively low. The average R & D intensity is 3%, indicating that the overall level of R & D investment of listed companies in China's textile industry is relatively low, the R & D activities should be improved. The average profitability (ROA) is 4.4%, indicating that the profit level of listed companies in China's textile industry is not high, and the utilization effect of corporate assets needs to be strengthened.

Table 2 Descriptive statistical results

Variable	Sample	Average	Standard deviation	Min	Max
Innovation	232	3.918	1.319	0.693	7.023
ESG	232	4.217	1.109	1.5	6.75
FC	232	2.459	0.131	2.243	2.745
Age	232	7.601	0.002	7.596	7.606
LEV	232	0.339	0.147	0.071	0.66
R&D	232	0.03	0.014	0.003	0.06
Growth	232	0.079	0.218	-0.388	0.88
Meeting	232	8.31	2.839	4	21
ROA	232	0.044	0.064	-0.228	0.213
Top10	232	0.567	0.178	0.238	0.894

4.2. Multiple regression analysis

Table 3 Results of the multiple regression

Variable	Model(1)		Model(2)		Model(3)	
	Innovation		FC		Innovation	
ESG	0.209***	(2.64)	0.048***	(8.43)	0.014	(0.13)
FC					4.029***	(3.42)
Age	128.819***	(2.84)	16.769***	(4.37)	61.253	(1.27)
LEV	1.420**	(2.47)	0.362***	(9.14)	-0.038	(-0.05)
RD	2.504	(0.39)	-3.137***	(-9.30)	15.145**	(2.21)
Growth	-1.136**	(-2.39)	-0.079*	(-1.81)	-0.819*	(-1.66)
Meeting	-0.039	(-1.46)	-0.002	(-0.64)	-0.032	(-1.03)
ROA	4.460***	(2.81)	0.383**	(2.27)	2.917	(1.48)
Top10	0.4	(0.75)	0.109***	(3.23)	-0.04	(-0.08)
Costant	-976.682***	(-2.84)	-125.278***	(-4.29)	-471.916	(-1.29)
Year	controlled		controlled		controlled	
Sample size	232		232		232	
adj_R2	0.162		0.162		0.162	

*, **, *** Represents significant at the 10%, 5%, and 1% levels, respectively.

As shown in the Model (1) in Table 3, the regression coefficient of ESG and Innovation was 0.209, showing significant results at the 1% statistical level, indicating that ESG performance has a significant positive impact on the technological innovation ability of listed companies in the textile industry, confirming the hypothesis H1. Test whether financing constraints play an intermediary

role in the impact of ESG performance on the innovation ability of listed companies in the textile industry,the regression results are shown in the model (1) ~ (3) in Table 3. It shows that financing constraints play a role of intermediary effect in the influence of ESG performance on the technological innovation ability of enterprises, which confirms the hypothesis H2.

4.3. Robustness test

Replace the control variable ROA with ROE. ROA measures the profitability of the total assets of the enterprise, while ROE reflects the profitability of the shareholders' net assets, and focuses more on the investment return of the shareholders. The regression results are shown in Table 4, which still support H1, indicating that the results are robust.

In 2020, COVID-19 occurred in full force, not only affecting human health, but also affecting various commercial entities of various types in China, including many textile enterprises that are faced with the loss of labor and capital, cash flow and credit, and the inability to supply, and a large number of layoffs. Therefore, the data of 2020 may have data distortion problems, so this paper deleted the data of 2020 and again conducted regression analysis. The regression results are shown in Table 4, which still support H1 and H2, indicating that the results are robust.

Table 4 Robustness test results

Variable	Replace ROA with ROE		Delete data of 2020	
	Innovation		Innovation	
ESG	0.224***	(2.81)	0.218**	(2.37)
FC				
Age	134.969***	(3.00)	136.715***	(2.72)
LEV	1.150**	(2.00)	1.570**	(2.58)
RD	2.589	(0.40)	3.014	(0.40)
Growth	-0.916*	(-1.95)	-1.786***	(-2.83)
Meeting	-0.044	(-1.61)	-0.051*	(-1.92)
ROE	1.861**	(2.08)	4.263**	(2.59)
Top10	0.528	(0.98)	-0.245	(-0.40)
Costant	-1,023.379***	(-2.99)	-1,036.188***	(-2.71)
Year	controlled		controlled	
Sample size	232		191	
adj_R2	0.154		0.153	

*, **, *** Represents significant at the 10%, 5%, and 1% levels, respectively.

5. Conclusion and revelation

From 2017 to 2022, the correlation of ESG performance, enterprise technology innovation ability and financing constraints, and the following conclusions: (1) Good ESG performance can promote the improvement of technological innovation ability of listed textile companies; (2) The financing constraint plays the intermediary role in the influence of ESG performance on the technological innovation of listed textile companies.

Based on the above conclusions, this paper puts forward the following enlightenment: (1) For enterprises, we should formulate a comprehensive ESG strategy, integrate the ESG concept into the daily operation practice, and pay attention to cultivating and leaving excellent ESG talents. At the same time, enterprises should continue to lead the development of ESG performance, and constantly improve ESG performance and technological innovation ability, in order to adapt to the changing market environment.(2) For the government, appropriate policies should be formulated to encourage enterprises to actively practice the ESG concept and supervise the standard disclosure of enterprises. The government should reward companies that disclose full information and perform well, such as lowering interest rate loans, providing financial subsidies, and reducing taxes, and actively guide those who need to disclose false information to promote their sustainable

development.(3) For consumers, they can choose more products and services that meet the requirements of sustainable development, so as to promote enterprises to actively practice ESG performance. In short, the implementation of ESG concept requires the joint efforts of enterprises, the government and consumers, through strengthening cooperation, innovation incentive mechanism and strengthening information disclosure, to realize the deep integration of ESG and enterprise activities, and promote the sustainable development of economy and society.

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