

ESG Performance, Financing Constraints and Firm Capital Efficiency

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Abstract

Taking all A-share listed companies in Shanghai and Shenzhen from 2018 to 2022 as samples, this paper studies the impact of ESG performance on corporate capital efficiency and the moderating role of financing constraints in it. The empirical results show that ESG performance is positively correlated with corporate capital efficiency, and the better ESG performance is, the higher corporate capital efficiency is. The results are still significant after changing the core variables, lagging one to two periods and PSM. Further research shows that the promotion effect of ESG performance on capital efficiency is more obvious when the enterprise is non-state-owned, non-heavy polluting and non-high-tech. The research conclusions extend the research on the economic consequences of ESG performance and the influencing factors of corporate capital efficiency, and have certain theoretical and practical significance.

Keywords

China, ESG Performance, Capital Efficiency, Financing Constraints, Corporate Governance

1. Introduction

Capital is the key factor to promote macroeconomic growth and the survival and development of enterprises. The government report points out that we should adhere to the focus of economic development on the real economy, so how to improve the capital efficiency of the real economy has become an urgent problem to be solved. As the ESG performance that organically integrates social and economic development, environmental protection, corporate governance and social responsibility, it is highly consistent with the concept of ecological civilization construction in China. Improving the ESG performance of listed enter-

prises and other economic entities has important theoretical value and practical significance for realizing sustainable economic development. At present, there are relatively few scholars studying the relationship between enterprise ESG performance and capital efficiency. The existing research on enterprise ESG performance mostly focuses on the economic consequences of enterprise ESG and enterprise value, enterprise performance, financing cost and other aspects. There is no research on the relationship between enterprise ESG performance and capital efficiency. It also explores the relationship between environmental responsibility, social responsibility or corporate governance and investment efficiency or financing efficiency. In view of this, this paper studies the impact of ESG performance on corporate capital efficiency from the perspective of financing constraints. The main contributions of this paper are as follows: first, it complements the research on the relationship among ESG performance, financing constraints and capital efficiency. Second, it extends the research on the economic consequences of ESG performance and the research on the influencing factors of capital efficiency, providing new analytical ideas for subsequent research.

2. Theoretical Mechanism and Research Hypotheses

2.1. ESG Performance and Enterprise Capital Efficiency

Capital efficiency refers to the relationship between the capital input and the corresponding output of the enterprise, that is, the ability of the enterprise to create value by using the capital invested by shareholders and creditors. Return on capital efficiency is an important indicator to evaluate the operating performance of enterprises, which is usually measured by the ratio of “return on total capital” to “average value of total capital.” High return on capital efficiency represents high operation efficiency of funds, high profitability and strong market competitiveness of enterprises.

Good ESG performance is conducive to establishing a positive corporate image, gaining a good reputation, enhancing enterprise competitiveness, enhancing enterprise value and sustainability, thus improving long-term enterprise performance and increasing capital return. Secondly, ESG performance enhances investors' confidence in enterprise operation through signal transmission effect, reduces information asymmetry between enterprises and stakeholders, effectively supervises management, encourages them to improve management efficiency, alleviates agency problems and information opacity, reduces the possibility of managers hiding bad news, reduces managers' self-interested behavior, and thus reduces agency costs. Improve the efficiency of capital operation and improve capital efficiency. In addition, the improvement of ESG performance helps to reduce the total risk of corporate debt financing costs and financial risks, including implicit costs such as damage to supplier cooperation and reputation and explicit costs such as liquidated damages, which directly leads to the reduction of comprehensive capital costs of enterprises, thus improving total capital efficiency. The

initiative of enterprises to undertake ESG-related responsibilities does not mean high cost and high expenditure, but will improve the capital efficiency of enterprises, because the active investment of enterprise managers in ESG will build an excellent and responsible corporate image, reduce the cooperation cost with various stakeholders, promote the improvement of financial performance, which is conducive to the long-term and sustainable development of enterprises.

Based on the above analysis, this paper puts forward hypothesis 1: a firm's ESG performance is positively related to capital efficiency, and the better the firm's ESG performance is, the higher the capital efficiency is.

2.2. The Moderating Effect of Financing Constraints on ESG Performance and Corporate Capital Efficiency

Financing constraints are the key issues restricting the development of enterprises, and enterprises actively disclose high-level ESG information, which can effectively reduce the internal and external information asymmetry of enterprises, release the signal that enterprises attach importance to green and sustainable development to the outside world, enhance the investment confidence of stakeholders, gain the trust and resource support of stakeholders, and thus ease the financing of enterprises. When enterprises are faced with strong financing constraints, their investment behaviors are usually limited by insufficient funds, which makes enterprises lose the optimal investment opportunities. The greater financing constraints of enterprises reduce the range of financial investment, such as external equity and creditor's rights, and the profitability and dividend distribution of the invested units are not optimistic, resulting in a low return on capital of corporate investment activities. Alleviating corporate financing constraints and preventing underinvestment in fixed assets, intangible assets and other long-term assets can improve the scale efficiency and production efficiency of enterprises, thus increasing the return on capital from investment activities and improving corporate capital efficiency. In addition, alleviating corporate financing constraints can also reduce corporate transaction costs, settlement costs and comprehensive capital costs, play a positive signaling effect, increase market value and corporate operating activities return on capital, and thus improve capital efficiency. In a word, the degree of financial constraints plays a negative moderating role in capital efficiency and ESG performance.

Based on the above analysis, this paper puts forward Hypothesis 2: financial constraints play a negative moderating role in the relationship between ESG performance and capital efficiency, and financial constraints inhibit the promotion effect of ESG performance on capital efficiency.

2.3. Degree of Role of Environment (E), Social Responsibility (S) and Corporate Governance (G) on Capital Efficiency

Environmental performance refers to the company's performance in environmental protection, including energy conservation and emission reduction, clean

production, green innovation, etc. In order to improve environmental performance, enterprises need to update environmental protection equipment, increase environmental protection materials, introduce environmental protection technology, and conduct staff training, which all need to spend a lot of money, so improving environmental performance may not bring positive returns in the short term. Enterprises need to pay more costs to undertake social responsibility, thus inhibiting the improvement of corporate value. Qiu (2019) explored the impact of ESG on corporate financing capacity from the perspectives of environment, social responsibility and corporate governance, and found that improving the environment and corporate governance capacity could significantly reduce corporate financing costs. Reducing the problem of information asymmetry and agency conflict attracts financial suppliers and investors, which can absorb the financial resources needed by the company at a lower interest rate and reduce the ratio of capital cost.

Based on the above analysis, this paper proposes Hypothesis 3: environment (E), social responsibility (S) and corporate governance (G) have different degrees of effect on capital efficiency.

3. Research Design

3.1. Sample Selection and Data Sources

As the financial data of some listed enterprises in 2023 has not been updated to ensure the timeliness of the data, this paper selects all A-share listed enterprises in Shanghai and Shenzhen Stock exchanges from 2018 to 2022 as the research objects, and sorts out and clean-out the research samples according to the following steps: 1) Eliminate the enterprise samples with abnormal status such as ST and *ST; 2) According to the Guidelines on Industry Classification of Listed Companies issued by CSRC, samples of companies in the financial and insurance industry are excluded; 3) Eliminate the samples with serious missing of ESG performance rating, capital efficiency or control variables, which are the main variables of the study; 4) In order to avoid the influence of outliers on the research results, all continuous variables are winsorized at the 1% and 99% quantiles. The final sample number was 12,637 groups. Among them, the ESG performance score data of enterprises come from Shanghai China Securities Index Information Service Co., LTD., and the financial data and other control variables used for calculation come from WIND, CSMAR and CNRDS databases. In this paper, Stata17.0 is used for data calculation and processing.

3.2. Variable Definition

3.2.1. Explained Variable

Corporate capital efficiency is total capital efficiency (TCE), which is expressed by dividing the return on total capital of operating activities by the total capital of operating activities with reference to the literature of scholars such as Dai et al. (2023) and the practice of Wang et al. (2017) in which the capital input is

based on assets minus business liabilities. For ease of calculation, the obtained capital efficiency is taken as a percentage.

3.2.2. Explanatory Variables

ESG performance (ESG) refers to the performance of a company's behavior under related topics such as environment, social responsibility and corporate governance. The ESG data of this paper adopts the ESG index rating of China Securities Co., LTD. The evaluation system is constructed from top to bottom based on China's information disclosure situation and company characteristics, covering all A-share listed companies. According to the ESG performance of the evaluated subjects, this paper divides them into nine grades, which are AAA, AA, A, BBB, BB, B, CCC, CC and C, respectively from excellent to second, and assigns scores from 1 to 9 to measure the degree of ESG responsibility fulfillment of enterprises.

3.2.3. Moderating Variables

This paper uses the SA index to measure financial constraints, the main reason is that the SA index only includes two variables with strong exogeneity and little change over time, which are conducive to measuring the degree of financial constraints from a long-term perspective. In addition, because the SA index does not contain endogenous financing variables such as cash flow level and asset-liability ratio, the interference of endogeneity can be avoided. SA index has also been widely used in academic research in China. When the SA index is negative, the larger its absolute value is, the more serious the corporate financing constraints are.

3.2.4. Control Variables

Referring to the authoritative literature on relevant topics, this paper selects company Size (Size), audit Opinion (Opinion), asset-liability ratio (Lev), listing years (ListAge) and the shareholding ratio of the largest shareholder (Top1) as control variables (Table 1).

3.3. Model Design

In order to test the relationship between ESG performance and capital efficiency TCE, panel fixed model (1) is set to test Hypothesis 1:

$$TCE_{i,t} = a_0 + a_1ESG_{i,t} + a_n \sum Controls_{i,t} + \sum Year + \varepsilon_{i,t} \quad (1)$$

In order to test the moderating effect of financial constraints, the moderating effect test model (2) is set to test Hypothesis 2:

$$TCE_{i,t} = a_0 + a_1ESG_{i,t} + a_2SA_{i,t} + a_3ESG_{i,t} \times SA_{i,t} + a_n \sum Controls_{i,t} + \sum Year + \varepsilon_{i,t} \quad (2)$$

where i represents the enterprise, t represents the time, Year represents the time dummy variable, Controls is the set of control variables, ε is the random error term, and both models control the time (Year) fixed effect.

Table 1. Selection and measurement of variables.

Variable type	name	Symbol	measurement	Source of data
Explained variable	Efficiency of capital	TCE (%)	$100 \times \text{Return on total capital/average value of total capital}$	WIND, CSMAR and CNRDS databases
Explanatory variables	ESG performance	ESG	The nine grades of ESG performance of the company are assigned a score of 9 to 1 from excellent to poor	China Securities esg rating official website
Moderating variables	Constraints on financing	SA	$-0.737 \times \text{Size} + 0.043 \times \text{Size}^2 - 0.040 \times \text{Age}$	CSMAR databases
Control variables	Size of company	Size	Natural logarithm of annual total assets	CSMAR databases
	Opinion of the auditor	Opinion	If the company's financial report of the current year is issued with standard audit opinions, the value is 1; otherwise, it is 0	
	Asset-liability ratio	Lev	Year-end total responsibility/year-end total assets	
	Years on the market	ListAge	$\text{Ln}(\text{Year of the year} - \text{year of listing} + 1)$	
	Shareholding ratio of the largest shareholder	Top1	Number of shares held by the largest shareholder/total number of shares	

a. Return on total capital = total profit + financial expenses + $R \times$ investment income of associated enterprises and joint ventures—exchange gains and losses. Total capital = total assets + (inventory depreciation reserve + other receivables impairment reserve + prepaid accounts impairment reserve + accounts receivable impairment reserve) – (Notes payable + accounts payable + prepaid accounts + employee compensation payable + taxes payable + other payables + other current liabilities + transactional financial liabilities + projected liabilities + deferred income tax liabilities + other non-current liabilities).

In order to test the effect of environment (E), social responsibility (S) and corporate governance (G) on capital efficiency, the ESG indicators in Models 1 and 2 are replaced with the sub-data indicators of E, S and G to test Hypothesis 3.

4. Empirical Research Results and Analysis

4.1. Descriptive Statistics

Table 2 shows the descriptive statistics of all variables. The minimum value of capital efficiency (TCE) is -39.357% , and the maximum value is 29.023% , indicating that the sample enterprises show great differences in audit fees. The minimum value of enterprise ESG performance (ESG) is 1, and the maximum value is 6, that is, the worst ESG rating is CCC, and the highest rating is A, indicating that the sample enterprises also show great differences in ESG, which confirms from the side that the sustainable development ability of listed companies in China is not perfect, and the quality of ESG disclosure is low. The sample mean of financial constraints SA is -3.897 , indicating that the degree of financial constraints of listed companies in China has little difference.

4.2. Benchmark Regression Results

Table 3 lists the regression analysis results. Column (1) shows the regression results without adding control variables, and columns (2) and (3) show the

Table 2. Descriptive statistical results.

Variables	number	Mean	Standard deviation	minimum	maximum
TCE	12637	6.018	9.228	-39.357	29.023
ESG	12637	4.234	1.077	1.000	6.000
SA	12637	-3.897	0.242	-4.516	-3.190
Size	12637	22.475	1.318	20.245	26.537
Opinion	12637	0.978	0.148	0.000	1.000
Lev	12637	0.443	0.184	0.091	0.872
ListAge	12637	2.080	0.918	0.000	3.367
Top1	12637	0.326	0.143	0.086	0.722

Table 3. Results of benchmark regression analysis.

Variables	(1) TCE	(2) TCE	(3) TCE
c_ESG	0.9502*** (10.2696)	0.2335*** (2.6651)	0.2335*** (2.6675)
c_SA			-3.0779*** (-6.1114)
XZ_c			-1.2432*** (-3.7135)
cons	6.6107*** (31.4489)	-47.1895*** (-17.6199)	-51.0283*** (-18.6057)
year	Yes	Yes	Yes
Controls	Yes	Yes	Yes
N	12637	12637	12637
R2	0.0125	0.1104	0.1130

a. *p < 0.1, **p < 0.05, ***p < 0.01, and the figures in parentheses are t values (the same in the following table).

regression results with adding control variables. Column (1) is the preliminary regression, which centralizes ESG and SA to obtain c_ESG and c_SA, that is, the test results of regression Model (1). Column (2) is the benchmark regression with five control variables added, and the correlation coefficient is 0.2335, which is more accurate than the preliminary regression, and the correlation coefficient is reduced but still significant at the level of 1%. Columns (1) and (2) show that a firm's ESG performance is significantly positively correlated with its capital efficiency. Column (3) shows the regression results with the addition of moderating variable financial constraints, and the results show that it is still significant at the level of 1%. All are significantly negative, indicating that the moderating variable

financial constraints weakens or inhibits the relationship between ESG and TCE, and financial constraints have a significantly weakening and inhibiting effect on the relationship between ESG and TCE, with a significantly negative moderating effect. The higher the degree of financing constraints, the smaller the positive relationship between ESG and TCE. Hypothesis 2 is preliminarily verified.

4.3. Separate Regressions of Environment (E), Social Responsibility (S) and Corporate Governance (G)

ESG data as well as the disaggregated data on environment, social responsibility and corporate governance are from the Bloomberg database. The value range of Bloomberg ESG data is [0, 100], with higher scores indicating higher quality of ESG-related information of listed companies. Since the Bloomberg ESG database only contains some listed companies, the sample size decreases greatly after eliminating the missing values, and the sample size of the benchmark model is 1890. Environment, social responsibility and corporate governance have different effects on corporate capital efficiency, among which corporate governance (G) has the most significant effect of 0.1282 on capital efficiency, so Hypothesis 3 is established (Table 4).

4.4. Robustness Test

4.4.1. Replacing Core Variables

One is to replace the explained variable with the index of capital efficiency. Referring to the practice of Zhang et al. (2020) and Wang et al. (2021), return on total assets (ROA) is used to replace total capital efficiency for regression test, and the research conclusions do not change substantially. Where, return on total assets is equal to net profit divided by the average of total assets at the beginning and end of the year. The second is to change the explanatory variables. The ESG rating data are replaced by Bloomberg score from China Securities score, and the regression results are shown in Columns (3) and (4) of Table 5. After the replacement, the empirical test results are the same as the above, indicating that the research results of this paper are relatively robust.

4.4.2. Lag Test

In order to alleviate the endogeneity problem, the ESG performance of enterprises is regressed by lagging one and two phases, respectively. After one to two lags, ESG performance of enterprises is still significantly positively correlated with capital efficiency, and financing constraints still show a significantly negative moderating effect.

4.4.3. PSM Test

Considering that the size, profitability and board size of the enterprise will have a certain impact on the ESG performance of the enterprise, this paper uses one-to-one neighbor matching to conduct PSM matching test, so as to reduce the impact of the characteristic differences of the sample companies on the

Table 4. Results of separate regression analysis of environment, social responsibility and corporate governance.

Variables	E Regression		S Regression		G Regression	
	(1) TCE	(2) TCE	(3) TCE	(4) TCE	(5) TCE	(6) TCE
c_BloombergE	0.0653*** (3.9311)	0.0707*** (4.0705)				
c_BloombergS			0.0976*** (3.1104)	0.1045*** (3.2768)		
c_BloombergG					0.1301*** (2.7291)	0.1282*** (2.6659)
c_SA		-4.4137*** (-3.4027)		-4.5778*** (-3.5480)		-4.2058*** (-3.1715)
XZ_E		-0.0799* (-1.7815)				
XZ_S				-0.1198 (-1.4998)		
XZ_G						-0.2409* (-1.8109)
cons	-34.1550*** (-4.1852)	-44.5715*** (-4.9041)	-36.1815*** (-4.2949)	-46.9119*** (-5.0343)	-39.4461*** (-4.9163)	-50.4610*** (-5.5127)
year	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	1890	1890	1890	1890	1890	1890
R2	0.1213	0.1231	0.1205	0.1226	0.1228	0.1261

Table 5. Robustness test.

variables	Replacing core variables				Lag test			
	Change the explained variable		Replacement of explanatory variables		One-period lag test		Second-period lag test	
	(1) ROA	(2) ROA	(3) TCE	(4) TCE	(5) TCE	(6) TCE	(7) TCE	(8) TCE
c_ESG	0.0015*** (2.5835)	0.0015*** (2.5918)						
c_BloombergESG			0.0576*** (2.6694)	0.0647*** (2.9748)				
L.c_ESG					0.5522*** (6.5180)	0.5116*** (6.0361)		
L2.c_ESG							0.4207*** (4.1046)	0.3592*** (3.4864)

Continued

c_SA	-0.0221*** (-6.4520)	-3.9556*** (-4.1507)	-2.6600*** (-6.0094)	-2.4443*** (-4.4478)				
XZ_c	-0.0075*** (-3.5036)	-0.1641*** (-3.2893)	-1.8672*** (-5.3165)	-2.6158*** (-5.8876)				
cons	-0.3146*** (-17.8602)	-0.3404*** (-18.9067)	-13.3901*** (-2.8753)	-27.1228*** (-4.8420)	-41.4754*** (-18.8039)	-46.8039*** (-19.8396)	-42.4613*** (-16.7288)	-48.3676*** (-17.5464)
year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	12637	12637	3606	3606	8767	8767	6026	6026
R2	0.1414	0.1442	0.1087	0.1136	0.1768	0.1834	0.1779	0.1863

research results. The mean value of ESG rating is taken as the critical point, and the dummy variable ESG1 is constructed with negative values of 1 and 0, where 1 is the experimental group receiving the treatment behavior, and 0 is the control group not receiving the treatment behavior. Taking company Size (Size), audit Opinion (Opinion), asset-liability ratio (Lev), listing years (ListAge) and shareholding ratio of the largest shareholder (Top1) as covariates, the 1:1 nearest neighbor matching is carried out, and the balance test is carried out on the matched data, and the t-stat value is $4.85 > 2.58$. It shows that the matching is significant at the level of 1%, the bias values after the balance test are all less than 10%, and the p values are all greater than 0.05, which passes the balance test. The regression results obtained after matching are shown in **Table 5**, in which the coefficients of ESG1 are significantly positive, and the coefficients of financing constraints and the interaction term are significantly negative, which further proves Hypotheses 1 and 2, indicating that the research results of this paper are relatively robust.

5. Extended Research

5.1. Heterogeneity Analysis

5.1.1. Nature of Property Rights

The ownership nature of enterprises may affect the promotion effect of ESG performance on capital efficiency and the moderating effect of financing constraints (see **Table 6** for the regression results). *Nie et al. (2023)* shows that there is a strong correlation between the capital efficiency of state-owned enterprises and the information disclosed by enterprises. As shown in Columns (1) and (3) of **Table 7**, the ESG coefficient value in the group of state-owned enterprises is 0.3446, significant at the level of 1%, and the ESG coefficient in the group of non-state-owned enterprises is 0.3501, significant at the level of 1%, indicating that in non-state-owned enterprises, ESG performance of enterprises has a more significant role in promoting capital efficiency. This is because the excessive

Table 6. Regression results of PSM matching test.

variables	(1) TCE	(2) TCE	(3) TCE
ESG1	0.8744*** (4.0985)	0.9151*** (4.5717)	0.9324*** (4.6705)
c_SA			-2.3610*** (-4.8756)
XZ_c			-1.1013*** (-2.7470)
cons	6.3841*** (22.7083)	-36.1076*** (-15.9995)	-39.5771*** (-16.9966)
year	Yes	Yes	Yes
Controls	Yes	Yes	Yes
N	6295	6295	6295
R ²	0.0057	0.1252	0.1300

Table 7. Based on the analysis of different enterprise ownership.

variables	State-owned enterprises		Non-state-owned enterprises	
	(1) TCE	(2) TCE	(3) TCE	(4) TCE
c_ESG	0.3446*** (2.8240)	0.3480*** (2.8353)	0.3501*** (3.2002)	0.3477*** (3.1878)
c_SA		-3.9643*** (-4.5759)		-1.5682** (-2.5144)
XZ_c		-0.6329* (-1.6991)		-1.4233*** (-3.1915)
cons	-29.4588*** (-7.5225)	-38.8993*** (-8.4281)	-64.6852*** (-17.5780)	-65.5176*** (-17.8535)
year	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
N	3442	3442	9140	9140
R ²	0.1197	0.1265	0.1086	0.1093

intervention of the government will affect the decision-making and development of enterprises, and the particularity of state-owned enterprises leads to the lack of obvious willingness of innovation and development. At the same time, the influence mechanism of financial constraints exists in both state-owned and non-state-owned enterprises, and the moderating effect of financial constraints in non-state-owned enterprises is more significant than that in state-owned en-

terprises. This is because state-owned enterprises themselves have better reputation effect and higher awareness of environmental protection and social responsibility, while non-state-owned enterprises are worse than state-owned enterprises in taking responsibility in all aspects. For some non-state-owned listed companies and listed companies with foreign investment needs, improving ESG performance can attract institutional investors, reduce the cost of capital use, and alleviate financing constraints.

5.1.2. Degree of Pollution

An important measure of a company's ESG performance is whether the company takes into account environmental benefits. Referring to the research of Li Qingyuan and Xiao Zehua, this paper divides the samples into heavy-polluting enterprises and non-heavy-polluting enterprises according to the Guidelines for Environmental Information Disclosure of Listed Companies and conducts regression (see **Table 8** for the results). As shown in Columns (1) and (3) of **Table 8**, the value of ESG coefficient in the group of heavily polluting enterprises is 0.2834, which is significant at the level of 5%, and the value of ESG coefficient in the group of non-heavy polluting enterprises is 0.4460, which is significant at the level of 1%, indicating that in non-heavy polluting enterprises, ESG performance has a more prominent role in promoting capital efficiency.

Table 8. Based on the analysis of pollution degree of different enterprises

variables	Heavy polluting enterprises		Non-heavy polluting enterprises	
	(1) TCE	(2) TCE	(3) TCE	(4) TCE
c_ESG	0.2834** (2.2445)	0.2726** (2.1822)	0.4460*** (3.7641)	0.4306*** (3.6390)
c_SA		-1.4903* (-1.7212)		-3.1557*** (-4.8817)
XZ_c		-1.6268*** (-3.4036)		-1.7328*** (-3.9417)
cons	-27.0337*** (-6.7786)	-30.0671*** (-7.1678)	-47.0784*** (-12.9198)	-51.9690*** (-13.8744)
year	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
N	2920	2920	7417	7417
R ²	0.0911	0.0913	0.0810	0.0852

The main reason may be that heavily polluting enterprises are affected by the nature of their business, and the quality of environmental information is poor, but at the same time, they are faced with great pressure of social supervision. They may have the behavior of forging environmental information and “green-

washing”, which to some extent increases the business risk of enterprises and the capital cost of enterprises. However, non-heavy polluting enterprises are affected by business operations, with relatively less environmental risks and environmental regulation costs, reduced operational risks of enterprises, and good ESG performance plays a more prominent role in promoting capital efficiency. As a moderating variable, financial constraints are more significant in non-heavy polluting firms. As shown in Columns (2) and (4) of **Table 8**, the coefficient value of financial constraints in the group of heavy polluting enterprises is -1.4903 , significant at the level of 10%, and the coefficient value of the interaction term is -1.6268 , significant at the level of 1%. In the group of non-heavy polluting enterprises, the coefficient value of financial constraints is -3.1557 , which is significant at the level of 1%, and the coefficient value of the interaction term is -1.7328 , which is significant at the level of 1%, indicating that the negative moderating effect of financial constraints on ESG performance and capital efficiency is more significant in non-heavy polluting enterprises.

5.1.3. Enterprise Scientific and Technological Level

An important measure of the technological attributes of firms may have an asymmetric impact on the relationship between capital efficiency and ESG performance. In order to verify the heterogeneity of enterprises with different technological attributes, this paper divides listed companies into two sample groups of “high-tech enterprises” and “non-high-tech enterprises” for regression, respectively. The regression results are shown in **Table 9**. The coefficient of ESG is significantly positive at the level of 1% in the sample group of “high-tech enterprises”

Table 9. Based on the analysis of the technological level of different enterprises in different industries.

variables	High-tech enterprises		Non-high-tech enterprises	
	(1) TCE	(2) TCE	(3) TCE	(4) TCE
c_ESG	0.5219*** (2.9552)	0.5198*** (2.9469)	0.5747*** (3.5068)	0.5546*** (3.4623)
c_SA		-1.3005^* (-1.7823)		-2.9919^{***} (-3.0606)
XZ_c		-1.4844^{***} (-3.0758)		-2.0601^{***} (-2.8365)
cons	-63.6197^{***} (-10.7176)	-64.6354^{***} (-10.9003)	-54.8887^{***} (-8.9063)	-58.0258^{***} (-9.5009)
year	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
N	4929	4929	2470	2470
R ²	0.0488	0.0487	0.1543	0.1594

and the sample group of “non-high-tech enterprises,” but the coefficient of “non-high-tech enterprises” is larger. The coefficient of the interaction term is significantly negative in the sample groups of high-tech enterprises and non-high-tech enterprises, but the absolute value of the coefficient in the sample group of non-high-tech enterprises is larger. On the one hand, compared with non-high-tech enterprises, high-tech enterprises have a stronger demand for innovation and need a large amount of innovation capital investment, so that enterprises can invest relatively little capital in ESG. On the other hand, high-tech enterprises can obtain more policy support and relevant preferential measures, obtain more resources and have more resource endowments than non-high-tech enterprises. In addition, it has the characteristics of low transaction costs, which can alleviate the level of financing constraints of enterprises. Therefore, ESG performance plays a greater role in improving the capital efficiency of non-high-tech enterprises. Therefore, in non-high-tech firms, ESG performance can more motivate firms to improve their level of capital efficiency.

5.2. Interaction Study

The initiative of enterprises to undertake ESG-related responsibilities does not necessarily mean high cost and high expenditure, but will improve the capital efficiency of enterprises, because the active investment of enterprise managers in ESG will create an excellent and responsible corporate image, reduce the cooperation cost with various stakeholders, promote the improvement of financial performance, and help improve the capital efficiency of enterprises. By improving the ESG rating of the enterprise, the enterprise transmits positive information, supplements the non-financial information of the enterprise, shows the sustainable development concept and strong development potential of the enterprise, reduces the capital cost of the enterprise operation, increases the return on capital, and improves the capital efficiency of the enterprise. In order to test this statement, this paper constructs Models (3) and (4).

In order to test the relationship between capital efficiency TCE and enterprise ESG performance, panel fixed model (1) is set to test Hypothesis 1:

$$ESG_{i,t} = a_0 + a_1 TCE_{i,t} + a_n \sum Controls_{i,t} + \sum Year + \varepsilon_{i,t} \quad (3)$$

In order to test the moderating effect of financial constraints, the moderating effect test model (2) is set to test Hypothesis 2:

$$ESG_{i,t} = a_0 + a_1 TCE_{i,t} + a_2 SA_{i,t} + a_3 TCE_{i,t} \times SA_{i,t} + a_n \sum Controls_{i,t} + \sum Year + \varepsilon_{i,t} \quad (4)$$

Where i represents the enterprise, t represents the time, Year represents the time dummy variable, Controls is the set of control variables, ε is the random error term, and both models control the time (Year) fixed effect. The capital efficiency TCE is centralized, and the regression is carried out by introducing the interaction term of capital efficiency and financing constraints after centraliza-

tion. As shown in **Table 10**, the coefficients of ESG performance on capital efficiency are all positive and significant at the level of 1%, indicating that ESG performance plays a significant role in promoting capital efficiency. In addition, the coefficient of financial constraints is still negative but not significant, and the coefficient of the interaction term is negative and significant at the level of 1%, indicating that financial constraints play a negative moderating role in the impact of capital efficiency TCE and enterprise ESG performance but the significance is low.

Table 10. Regression analysis of interaction effects.

variables	(1) ESG	(2) ESG	(3) ESG
c_TCE	0.0099*** (8.9602)	0.0021* (1.8204)	0.0020* (1.7558)
c_SA			-0.0032 (-0.0515)
XZ_c			-0.0130*** (-2.9590)
cons	4.3285*** (194.1832)	-1.4272*** (-5.2876)	-1.4256*** (-5.1107)
year	Yes	Yes	Yes
Controls	Yes	Yes	Yes
N	12637	12637	12637
R2	0.0026	0.0172	0.0179

6. Conclusions and Suggestions

Based on the sample of all A-share listed companies in Shanghai and Shenzhen from 2018 to 2022, this paper empirically studies the impact of ESG performance on corporate capital efficiency and the moderating role of financing constraints. The results show that: (1) ESG performance is positively correlated with capital efficiency, and the better the ESG performance, the higher the capital efficiency. (2) Financial constraints play a negative moderating role in the relationship between ESG performance and capital efficiency, and the promotion effect of ESG performance on capital efficiency is more prominent in enterprises with low financial constraints. (3) Environment, social responsibility and corporate governance have different effects on corporate capital efficiency, among which corporate governance plays the most significant role. The results are still significant after the robustness tests, such as changing the core variable, lagging one to two periods, and PSM. Further analysis shows that ESG performance of non-state-owned, non-heavy polluting and non-high-tech enterprises has a more obvious role in promoting capital efficiency.

Based on the above research conclusions, this paper puts forward the following suggestions: First, enterprises should pay attention to the promotion effect of ESG performance on corporate capital efficiency, strengthen their own ESG behavior performance, improve the quality of information disclosure, improve environmental awareness, enhance the performance of social responsibility, improve corporate governance structure, reduce information asymmetry and investment risk, reduce capital cost, and improve the return on capital. Second, enterprises should effectively alleviate their own financing constraints, constantly enhance market attention, reduce financing difficulty and cost, ease financing constraints, and improve capital conversion rate. Third, relevant government departments should actively promote the construction of ESG evaluation system and unified official ESG evaluation system standards, and promote high-quality development of enterprises by improving the quality of ESG information disclosure. At the same time, the government should also pay attention to the supervision and management of corporate governance, improve the overall corporate governance structure to adjust the capital structure, reduce the cost of capital, and better improve the development quality of listed companies.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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