ESG Scores and Environmental Protection Investment: Evidence from Listed Companies in China

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Abstract. The ESG concept has increasingly permeated the day-to-day management and strategic choices of companies in recent years. Within industries, regions and company sizes, all organizations have been allocating more resources to improving ESG. How does ESG scores affect corporate environmental investment? Exploring this question allow us to better understand the activities of corporate environmental investment, also be aware of the effectiveness of government's environmental regulation and industry regulation. Based on a panel of 615 Chinese listed corporates from 2019-2021 from CSMAR, the paper found: (1) For EPI of A-share listed companies, the amount was generally sufficient from 2019 to 2021, which is incompatible with previous discoveries. (2) There is a statistically significant relationship between the score of ESG and the amount of EPI. (3) The additional effect of centralized shareholding on the positive relationship remains unclear after robustness test. The findings above not only broaden the research perspective of EPI and ESG, but also enrich academic research on environmental management.

Keywords: ESG, EPI, GLS regression.

1. Introduction

Since the acronym “ESG” (environmental, social, and governance) was coined, recently, its fortunes were steadily growing. More companies have started to take it seriously so far from 2019, the ESG concept has increasingly permeated the day-to-day management and strategic choices of companies, and it has entered the public domain, with, for example, a quintuple increase in internet searches for ESG [1]. ESG has somewhat replaced CSR (Corporate Social Responsibility), or rather upgraded the CSR concept, with more reflections on corporate involvement rather than core changes in operating models. Within industries, regions and company sizes, all organizations have been allocating more resources to improving ESG.

In the newly released "2022 China ESG Development Innovation White Paper", the latest interpretation of ESG concepts and practical policies in China are updated. The goal of sustainable finance is the pursuit of sustainable development [2]. Around sustainable finance, China has continued to promote the development and application of diversified sustainable financial instruments in recent years, mainly green finance and inclusive finance, including industrial finance, supply chain finance and internet finance, to achieve and enhance the integrated economic, social and environmental values of economic agents through rational asset allocation by financial means.

Many countries worldwide have been hit by extreme weather and climate events once in a century in 2022, with droughts lasting more than 70 days in many parts of the middle and lower reaches of the Yangtze River in China. With ecological issues firmly afflicting global agricultural cultivation and economic development, China has incorporated solutions to climate change issues into national strategies and top-level design. Several ministries and commissions have made practical moves to promote the green and low-carbon transformation of the economy and industrial energy and to achieve institutional carbon reduction to meet the requirements of the construction of a beautiful China ecological civilization and high-quality economic and social development [2]. This year, national policies have placed increasing emphasis on green, low-carbon and environmental development, and the regulatory regime for companies has gradually become stricter. The country requires the company to reduce energy and carbon and increase efficiency, and make a breakthrough in scientific and technological innovation. After clearly proposing to achieve breakthroughs in key industries and areas of low-carbon key core technologies by 2025, companies in various industries are required to increase their actions such as scientific and technological support for green and low-carbon energy transition, and technological breakthroughs in low-carbon and zero-carbon industrial process reengineering. Organizations will face severe resource allocation problems and technology R&D costs will increase significantly while maintaining corporate survival. This paper argues that a company's understanding of ESG policies can be reflected in the extent to which the company implements low carbon and, as a result, achieves a higher ESG score. the ESG score should show a correlation with corporate investment in environmental protection.

Based on a panel of 615 Chinese listed corporates from 2019-2021 from CSMAR, this paper focuses on how ESG contributes to environmental protection investment. The four sections of this essay are as follows: Part I, Introduction; Part II, Literature Review; Part III, Research Design; Part IV, Empirical Analysis; and Part V Summary.

2. Literature Review

2.1. ESG

ESG is an acronym coined in a statement in 2004 in response to an appeal by UN Secretary-General Kofi Anon. ESG provides stakeholders with a framework for helping them gain insight into the way an organization manages the risks and opportunities associated with environmental, social and governance criteria [3]. Over the years, the ESG philosophy has guided several policies and strengthened the company's sense of social responsibility and sustainable development. Recently, the concept of "double carbon" has become familiar, short for "peak carbon" and "carbon neutral". "Carbon peak" by 2030 and "carbon neutral" by 2060, is a fundamental strategic decision based on China's responsibility to facilitate the construction of a shared human destiny and the inherent requirement to achieve sustainable development. " Double carbon" is included in the ESG, and its realization has become one of the key issues in the ESG due to the threat of climate warming facing humanity. The importance of ESG is growing. Since the concept of ESG was proposed, it has undergone extensive study, usage, and amplification in the realm of application, and attract many scholars to come into notice. Some scholars have studied the relationship between ESG and corporate financial performance, while others have analyzed the correlation between the extent of ESG fines and the willingness of companies to implement the relevant regulations. The literature concentrates on ESG investment [4], the relationship between ESG and SRI (socially responsible investment) [5], how ESG scores influence corporate performance on sustainability [6], and the functions of ESG in the financial decision-making process [7]. The ESG review focuses on the specific aspect of the acronym and ignores an integral view of the framework which will cause deviation in the daily management of the company.

2.2. Environmental Protection Investment

Environmental protection investment (EPI) is a straight indicative monitoring index in the growth of ecologically responsible firms [8]. Green development has grown in importance to businesses in recent years. To comply with the demands of green development, pollution firms start acquiring green resources, technology, or management experience through green mergers and acquisitions [9]. With the rapid growth of China's economy, increased awareness of environmental protection and greater efforts to protect the environment in recent years, China's environmental protection industry has seen greater development. The environmental protection industry in China's cities has always grown at a relatively fast pace, driven by the increasing attention and continued increase in revenue from the state and governments at all levels, as well as the large market demand that accompanies industrial development. According to the State Environmental Protection Administration, EPI is the financial resources that businesses employ to avoid and control pollution as well as to safeguard and improve our natural surroundings. More and more companies voluntarily disclose EPI data, including expenditure on R&D and renovation of eco-friendly technologies, installations and establishments on pollution abatement, and expenditure on cleaner production, etc. There are many pieces of literature analyzing the factors that influence EPI. Fu et al. researched that ecology regulation can promote innovation and achieve both the positive effect of EPI on corporate pollution control and the improvement of economic performance [10]. Meanwhile, in enterprises with concentrated equity, ESG has a positive impact on environmental investment. Wei et al. concluded that good government-business ties make it easier for businesses to acquire environmental subsidies and mortgage financing, which raises their EPI [11].

2.3. ESG and Environmental Protection Investment

An external factor that affects investments in environmental protection is the ESG principle, which is a form of environmental and governmental regulation. Unfortunately, little study has been done to show how ESG affects EPI. ESG principle is becoming more and more important and is a mainstream of corporate and environmental governance. Policy and regulation related to ESG will filter the project and product firms intend to undertake and guide investors to a promising direction [12]. Therefore, it is meritorious to study the mechanism of how the policy affects practical cash flow and the consequence of the sustainable development problem. There hasn't been any research done to determine whether EPI can be promoted by ESG strategy. The integration of ESG into supervision is a key means to improve corporate ESG performance, and a unified ESG disclosure standard is an important tool to effectively promote the sustainable development process. Considering banks and investment financial institutions, tilting capital towards ESG, providing diverse green financial products and embedding ESG into the investment decision-making process can give full play to the capital market's support for development goals. As for enterprises, they can obtain real long-term sustainable business benefits by increasing ESG technology research, development and innovation in their daily production and operation with the goal of energy saving and emission reduction, and integrating ESG development concepts into their corporate strategy system. This paper is going to fill a vacancy to analyze the correlation between ESG and EPI and deliver effective advice on governing. The research already done can serve as crucial theoretical resources for the effect path analysis.

3. Research Design

3.1. Research Hypothesis

Environmental protection investment is a special type of investment for enterprises, the pursuit of which includes economic, environmental and social benefits. Corporate expenditures in environmental protection are not only challenging to turn into immediate monetary inflows to businesses, but also necessitate significant financial outlays to acquire environmental protection infrastructure and conduct out environmental technology advancement, which makes companies not actively willing to carry out environmental management and environmental protection investment [13]. However, since the ESG evaluation criterion has been introduced, this passage believes the ESG score plays a significant role in urging corporates to increase investment in this aspect. Getting higher ESG grade can assist to construct a better corporate image, and gain favor from investors and customers. Small and medium enterprise need to confront homogeneous competition because of the parallel product. Therefore, coming out on top under the strict regulation and limited cash inflow is life-and- death. Referring to Tang's article, where they examine the relationship between environmental regulation and environmental investment. Referring to Tang's article, they studied the relationship between environmental regulation and environmental investment, as well as Zhu’s research, they discovered the negative relationship between ownership concentration and EPI, this paper draws on their research methodology and constructs its own regression model [13, 14].

In conclusion, two assumptions are put forward as follows:

Hypothesis 1: ESG grades could enhance EPI. There is a statistically significantly positive relationship between ESG rating and the scale of enterprise environmental investment.

Hypothesis 2: Compared with enterprises with centralized shareholdings, ESG ratings of firms with decentralized ownership have a more positive relationship with EPI.

3.2. Basic Regression Model

To explore the effect of ESG on environmental protection investment, this paper constructs the fixed effects model as follows, and estimate it by ordinary least squares method:

$$invest_{it} = \beta_0 + \beta_1 ESGnum_{it} + \sum \beta_k control_{it} + \varepsilon_{it} \quad (1)$$

Where i represents companies while t represents years, the explained variable $invest_{it}$ represents the level of environmental protection investment, explanatory variable $ESGnum_{it}$ represents the ESG score companies gain every year and $control_{it}$ represent several control variables, which include size (use natural logarithm of the total asset amount of companies), investment opportunity (quantified by data of TobinQ), leverage (quantified by the ratio of liabilities to assets), profitability (represented by ROA), proportion of independent directors and shareholding centralization (use TOP1). To overcome the endogenous problem, a method of lagging for one period has been adopted for the micro characteristic variable opportunity. Considering that the model may have other factors excluded or changing over time, this article also adds the annual dummy variable $\gamma \mathrm{dum}$ to estimate the two-way fixed model.

The Huazheng ESG indicator system is chosen in this study, integrating the widely used ESG evaluation framework from abroad with the realities of the Chinese capital market and the traits of various types of listed companies. A total of 26 key indicators are then set for ESG evaluation using the industry-weighted average method, updated on a quarterly basis, encompassing all listed companies. In this paper, the corresponding grades of the nine grades of ESG rating of China Securities (from low to high, C, CC, CCC, B, BB, BBB, A, AA and AAA respectively) are assigned as 1 to 9. The explanatory variable (ESGnum) is structured based on the above ratings using the assignment method, i.e., ESG=1 when the rating is C, ESG=2 when the rating is CC, ESG=3 when the rating is CCC, and so on [15].

In addition, social survey data inevitably have missing values, which we have replaced with zeros in this article. A missing message is a no message. Sometimes a missing value represents "nothing", in which case we can safely and responsibly replace this missing value with a zero. Suppose a respondent is asked to provide grades in four different categories: junior high school, high school, college and graduate admissions. If someone lists data for the first three, perhaps they left the last one blank because they did not pursue graduate school. Therefore, here we add the missing information as 0. We believe that the missing information does not exist and it simplifies the study in this paper.

4. Empirical Analysis

4.1. Descriptive Statistics

It is to be noted that we drop the missing value of EPI here to better investigate sample data. From Table1, there is no clear distinction between overall sample and annual ones. The average EPI of overall sample is 215.9385 and the median number is 229, in other words, a considerate population of selected enterprises has reached intermediate level, which indicates that listed companies in China have attached importance on EPI during recent years, in a reversal of earlier findings [13]. Apparently, a huge gap exists between the minimal and maximal among four groups, using STATA we can draw a conclusion from Fig.1 that EPI may not satisfy normal distribution, with significant individual difference.

Table 1. Basic statistics of enterprises' EPI scale in ¥10,000 (without missing data)

Year	Obs	Average	Median	Min	Max	Sd
2019	44	210.4545	216	3	422	127.1266
2020	62	227.5161	248	12	437	133.6982
2021	73	209.411	216	3	434	139.7203
Total	179	215.9385	229	3	437	134.1563

Obs: number of observations
Sd: standard deviation of sample data

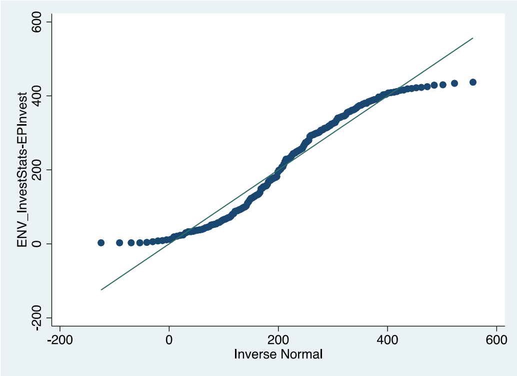

Figure 1. Normal Quantile-Quantile Plot of EPI

Table2 lists the descriptive statistical results for the main variables: The average TobinQ (represented by variable opportunity) of sample data is 2.0467, which is greater than the median of 1.3907, indicating that general value level of domestic firms is quite high; the maximal value is 29.1670 while the minimum is 0.6413, with the standard deviation at 1.9908, clearly the firm value fluctuates in different industries. As for ESG rating from 3 to 7, the median number is 4, that is, the overwhelming majority of chosen companies scored over B-level; mean data is 3.9209 and standard deviation is .8313, indicating the individual difference is also significant for ESG behavior. For the sample enterprises, the average ESG rating ascends in first 2 years, firms dedicate to environment, social responsibility and governance as environmental-friendly policies exert a significant influence on ESG disclosure; however, the ESG rating experience a substantial transformation in the second period, with standard deviation between different firms soaring and some individual rating in free fall (Fig.2). When it comes to the remainder, the average size is 24.0650 and average leverage is 49.8595%; the maximal ROA is 37.7044% and minimal one is -199.4467%, which is a great spread. Average TOP1 is 35.9837%, hence shareholdings carry much weight and the level of ownership centralization is quite high in the sample data. In addition, the mean proportion of independent directors (represented by variable Dir) in Table2 is 38.41163%, in other words, over 1/3 of the BOD is independent directors for most firms.

Table 2. Descriptive statistical results for the main variables

variable	Obs	Average	Median	Min	Max	Sd
ESGnum	1845	3.920867	4	3	7	.8313432
size	1845	24.06499	23.87569	20.80728	28.63649	1.283594
opportunity	1845	2.046735	1.390728	.641347	29.16699	1.990811
leverage	1845	.498595	.5108538	.0142676	1.420436	.1898324
ROA	1845	.0389187	.0392069	-1.994467	.3770437	.1013454
Dir	1845	38.41163	36.36	25	80	6.294463
TOP1	1845	35.98366	34	4.08	83.41	16.3296

Obs: number of observations
Sd: standard deviation of sample data

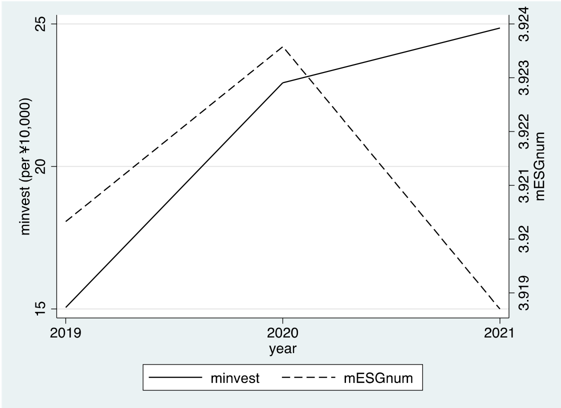

Figure 2. Mean EPI and mean ESG rating of overall sample from 2019 to 2021

4.2. Multiple Linear Regression

In order to get a preliminary understanding of the effect of ESG on environmental protection investment (EPI), we conducted a benchmark regression, and the results are reported in Table 3. Table 3 Column (1) shows that the estimate of ESGnum is statistically significant, with coefficient at 12.75, therefore ESG score does have a positive influence on EPI. For companies with good ESG performance, on the one hand they respond to policy requirement by conserving energy consumption and reducing resource use, on the other hand they accommodate themselves to embrace the crying demand of stakeholders, which sends positive signals (such as "responsible" and "conscientious") to the market. Both behaviour requires constant eco-investment. However, those firms somehow receive less cost on the EPI than much potential benefit in the long run.

Columns (2) is the function with added control variables, of which the coefficient remains strongly significant. All control variables have the positive correlation with EPI except leverage and the proportion of independent directors —— a giant, wealthy, promising enterprise is more welcomed among investors, which preliminarily verifies Hypothesis 1. Although the correlation between shareholding centralization contradicts previous studies, as Zhu et all found a significantly negative correlation weakening over time [14].

Further grouping is made according to the nature of enterprise ownership. In Table3, enterprises are divided into two types as Column (3) and Column (4) based on the amount of TOP1 (centralized companies with above average amount and vice versa): ESGnum’s coefficient of centralized firms is significant at 5% while of the decentralized is strongly significant at 1% level.

Table 3. Basic regressions

	Total sample		Centralized	Decentralized
	(1)invest	(2)invest	(3)	(4)
ESGnum	12.75*** (2.118)	11.42*** (2.367)	10.75** (3.636)	11.29*** (3.102)
Size		1.253(1.892)	0.335(2.726)	2.532(2.624)
Opportunity		0.356(0.992)	-1.545(1.581)	2.211(1.259)
Leverage		-1.590(12.34)	-13.22(19.99)	6.325(15.43)
ROA		18.41(20.61)	-4.504(40.49)	27.19(23.05)
Dir		-0.0650(0.284)	-0.188(0.408)	0.136(0.399)
TOP1		0.156(0.112)		
_cons	-29.05***(8.488)	-57.75(40.79)	-8.477(59.34)	-100.7(57.86)
N	1845	1845	858	987
R2	0.019	0.022	0.015	0.030
adj. R2	0.019	0.018	0.008	0.024

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In both regressions (1) (2), VIF for each explanatory variable is smaller than 2, this could be conceived as neglectable multicollinearity. The p-value of Wooldridge test couldn't lead to rejection of the null hypothesis (H_0: no first order autocorrelations), thus the regression (2) will not bothered by autocorrelation problem. Nevertheless, the modified Wald test and Pesaran's test are verified to reject null hypothesis at the 1% significance level, which confirms the suspicion of groupwise heteroskedasticity and cross-sectional dependence.

Table4 with two different models is attached below. To begin with, a Least Squares Dummy Variable (LSDV) approach is selected to compare the pooled regression and fixed effect model: since the result of F-test is significant at the 1% level, therefore the model has an individual fixed effect. Meanwhile, using Breusch-Pagan LM test the null hypothesis is strongly rejected at 1% level, representing individual random effect. Further discussion is made through Hausman test —— compare fixed-effect model with random-effect model instead. On account of groupwise heteroskedasticity and cross-sectional independence, this paper chooses a more viable apparatus, the robust Hausman test, to replace the previous one and p-value (0.272) is still not statistically significant. Furthermore, the F-test for the joint significance of time dummy variables reject the null hypothesis at the 10% level, indicating the existence of time effect. Eventually, original regression should be modified as random-effect model, incorporating time effects to optimize the estimation.

Table 4. The influence of ESG score on EPI

	FE		RE	
	(5)	(6)	(7)	(8)
ESGnum	-10.79(9.296)	-11.09(9.285)	10.27***(2.800)	10.61***(2.801)
Size	12.15(9.567)	1.676(10.78)	2.138(2.220)	1.338(2.239)
Opportunity	1.303(2.009)	0.482(2.047)	0.653(1.099)	0.229(1.110)
Leverage	-22.79(35.50)	-23.45(35.52)	-4.854(14.25)	-3.882(14.24)
ROA	-4.247(26.75)	1.076(26.82)	12.92(20.45)	15.03(20.44)
Dir	-0.0345(0.589)	-0.0531(0.589)	-0.0605(0.320)	-0.0598(0.319)
TOP1	-0.309(0.579)	-0.0378(0.592)	0.141(0.134)	0.165(0.134)
_cons	-207.8(234.1)	32.50(260.4)	-72.94(48.00)	-61.44(48.16)
ydum	uncontrolled	controlled [2.60]	uncontrolled	controlled [7.30]*
N	1845	1845	1845	1845
R2	0.004	0.008		
adj. R2	-0.502	-0.498		
F test	1.92 *** (0.00)	1.92 *** (0.00)		
Breusch-Pagan LM test			98.62***(0.00)	100.39***(0.00)
Hausman test	9.21(0.24)	7.11(0.63)		

1) Standard errors in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

2) The value in ( ) is the robust standard error of the estimated coefficient

3) The value in [ ] is the F statistic value of the joint significance of the time dummy variable γdum

4) Column (5) (7) are regressions with uncontrollable time effects while column (6) (8) add time dummy variables into regressions

5) FE and RE represent fixed-effect model and random-effect model, respectively

6) The null hypothesis of F-test and the Breusch-Pagan LM test is "pooled regression is acceptable" while the null hypothesis of the Hausman test is "no individual random effects".

4.3. Random-Effect Model with Time Effects

To better explore the effect of ESG on environmental protection investment, this paper constructs the random-effect model with time effects as follows, and estimate it by ordinary least squares method as well:

$$invest_{it} = \beta_i + \beta_1 ESGnum_{it} + \sum \beta_k control_{it} + \lambda_t + \varepsilon_{it} \tag{2}$$

Where λ_t represents time effects, ε_{it} symbolizes random effects and two random residuals β_i and ε_{it} satisfiy the assumption $\begin{cases} E(\beta_i) = \beta \\ \beta_i = \beta + \vartheta_i \end{cases}$, in which ϑ_i is a random variable. The sample data we use is short panel data, then a random-effects GLS regression, in line with the typical framework used by Hoechle (2007), is geared towards further optimization [16]: from regression (9) in Table5, the correlation between ESGnum and invest is statistically significant at 10% level and for TOP1 at 5% level, that is to say, a strongly positive relation between ESG score and EPI exists, consistent with Hypothesis 1; firms with more centralized shareholding may have more EPI, also in consistence with previous results. As for regression (10) and regression (11), the positive correlation is statistically significant at 10% for centralized enterprises but insignificant for the decentralized, contradicting Hypothesis 2. Therefore, Hypothesis 2-1 is confirmed that ESG ratings of firms with centralized ownership have a more positive relationship with EPI.

Table 5. Random-effect model with time effects after improvement

	Total sample	Centralized	Decentralized
	(9)invest	(10)invest	(11)invest
ESGnum	10.61*(0.063)	10.55*(1.416)	9.969(4.194)
Size	1.34(0.607)	-0.0343(2.756)	3.087(2.602)
Opportunity	0.23(0.788)	-1.944(1.119)	2.332(0.604)
Leverage	-3.88(0.524)	-13.48*(3.128)	4.619(10.97)
ROA	15.03(0.190)	-0.677(7.906)	21.71(6.379)
Dir	-0.06(0.881)	-0.225(0.563)	0.235(0.211)
TOP1	0.16**(0.037)		
N	1845	858	987

1) Standard errors in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

2) The improvement includes heteroskedasticity correction and cross-sectional independence correction

4.4. Robustness Test

The following modifications are made to better test the robustness of given model.

4.4.1 New classification code on ESG-Rating

The ESG performance is rescored from the perspective of ESG management and negative events frequency. Enterprises with good management and minor negative events are rated A and BBB, with a value of 3; ones with average management and few negative events are rated BB and B, with a value of 2; the rest with weak management and a host of negative events are rated CCC, CC and C, with a value of 1. Regression results are listed in Table6 as follows: it is well established that for all companies in the sample, coefficient of ESG rating is still statistically significant at 5% level, same with that in regression (9) —— the new categorized ESG score boosting EPI is still robust; for TOP1, the positive coefficient is also significant at 5% level, similar to the former result. When it comes to the ownership centralization, the significance results are in consistence with the GSL regressions, with Hypothesis 2-1 verified.

Table 6. Random-effects GLS regression with new ESG classification code

	Total sample	Centralized	Decentralized
	(12) invest	(13) invest	(14) invest
ESGnum_new	13.65**	15.82*	10.88
	(0.038)	(2.120)	(5.816)
Size	2.24(0.468)	0.619(3.248)	4.219(2.509)
Opportunity	0.34(0.705)	-1.936(1.117)	2.581(0.624)
Leverage	-4.87(0.399)	(3.003)	4.098(10.80)
ROA	13.98(0.221)	-3.689(6.815)	21.54(6.270)
Dir	-0.03(0.937)	-0.186(0.563)	0.245(0.204)
TOP1	0.18**(0.038)		
N	1845	858	987

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.4.2 Instrumental variable analysis

The apparatus is adapted in accordance with Zhu (2014), replacing TobinQ with PB value ($PB = \frac{stock\ price}{EPS}, EPS = \frac{total\ asset - intangible\ asset - liability - preferred\ equity}{outstanding\ shares}$) in the random-effect model [17]. In Table7, we could easily conclude a statistically significant correlation between ESG-rating and EPI at 1%, Hypothesis 1 holds and firms with higher ESG scores would have more EPI; unfortunately, the decentralized companies now have a statistically significant correlation between ESG rate and EPI, Hypothesis 2-1 is disproved after all.

Table 7. Random-effects GLS regression with instrumental variable

	Total sample	Centralized	Decentralized
	(13) invest	(14) invest	(15) invest
ESGnum	11.38***(0.000)	10.79**(3.637)	11.02***(3.139)
Size	1.49(0.446)	0.357(2.803)	3.052(2.724)
Opportunity_new	1.34(0.299)	-0.875(1.929)	3.569*(1.731)
Leverage	-0.61(0.960)	-12.77(20.00)	7.762(15.45)
ROA	13.66(0.516)	-8.926(41.44)	21.99(23.49)
Dir	-0.08(0.769)	-0.189(0.408)	0.0932(0.400)
TOP1	0.17(0.125)		
N	1845	858	987

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5. Conclusion

Using 615 A-share listed companies from 2019 to 2021 as sample data, this article empirically investigates the impact of ESG performance on EPI. A positive relationship is validated by structural analysis, however the influence of centralized degree in shareholdings remains unclear. Several suggestions are listed based on given results as follows:

Firstly, for listed companies, the one-sided view should be altered immediately, for environmental protection, assuming social responsibility and corporate governance improvement without a considerable cost. As policies tightened and supervision strengthened, there is a growing significance in the environmental performance. Therefore, by increasing ESG scores and EPI, the potential risks for companies can be alleviated.

Secondly, for local governments, a complete ESG information disclosure system is highly recommended. In addition, they are capable to reward or punish enterprises according to the ESG scores, to further promote relative policies.

References

[1] Pérez, L., Hunt, V., Samandari, H., Nuttall, R., & Biniek, K. Does ESG really matter—and why? The McKinsey Quarterly. 2022.

[2] China Asset Management Co., Ltd., & China Alliance of Social Value Investment (Shenzhen). 2022 China ESG Development Innovation White Paper. 2022.

[3] Gillan, S. L., Koch, A., & Starks, L. T. Firms and social responsibility: A review of ESG and CSR research in corporate finance. Journal of Corporate Finance, 2021, 66, 101889.

[4] Daugaard, D. Emerging new themes in environmental, social and governance investing: a systematic literature review. Accounting & Finance, 2020, 60(2), 1501-1530.

[5] Widyawati, L. A systematic literature review of socially responsible investment and environmental social governance metrics. Business Strategy and the Environment, 2020, 29(2), 619-637.

[6] Drempetic, S., Klein, C., & Zwergel, B. The influence of firm size on the ESG score: Corporate sustainability ratings under review. Journal of Business Ethics, 2020, 167, 333-360.

[7] Ziolo, M., Filipiak, B. Z., Bąk, I., & Cheba, K. How to design more sustainable financial systems: The roles of environmental, social, and governance factors in the decision-making process. Sustainability, 2019, 11(20), 5604.

[8] Zhang, W., & Li, G. Environmental decentralization, environmental protection investment, and green technology innovation. Environmental Science and Pollution Research, 2020, 1-16.

[9] Lu, J. Can the green merger and acquisition strategy improve the environmental protection investment of listed company? Environmental Impact Assessment Review, 2021, 86, 106470.

[10] Fu, T., Cai, C., & Jian, Z. The illusion of "win–win" solution: why environmental regulation in China promotes firm performance? Structural Change and Economic Dynamics, 2020, 52, 366-373.

[11] Wei, Z., Hongyu, W., & Dandan, Z. Discussion on the role of Chinese government in strengthening environmental protection investment. Energy Procedia, 2011, 5, 250-254.

[12] Aich, S., Thakur, A., Nanda, D., Tripathy, S., & Kim, H. C. Factors affecting ESG towards impact on investment: A structural approach. Sustainability, 2021, 13(19), 10868.

[13] Guoping Tang, Longhui Li, & Dejun Wu. Environmental regulation, industry attributes and corporate environmental investment. Accounting Research, 2013, (06), 83-89+96.

[14] Li Zhu, & Qiang Li. Ownership concentration, property right and environmental protection investment. Finance and Accounting Monthly, 2018, (12), 48-55.

[15] Jieying Gao, Dongxiao Chu, Yonghui Lian, & Jun Zhen. Can ESG performance improve enterprise investment efficiency? Securities Market Herald 2021, (11), 12.

[16] Hoechle D. Robust standard errors for panel regressions with cross–sectional dependence [J]. Stata Journal, 2007, 7(3): 281- 312.

[17] Naiping Zhu, Li Zhu, Yusheng Kong, & Yang Shen. Study on interaction of technological innovation investment and corporate social responsibility on corporate financial performance. Accounting Research, 2014, (02), 57-63+95.