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THE IMPACT OF ENVIRONMENTAL POLICIES ON CHINESE ENTERPRISES: A COMPARATIVE ANALYSIS OF RESOURCE TAXATION AND ESG ASSESSMENT ON THE FIRM PERFORMANCE AND PRODUCTION BEHAVIOR OF HEAVY POLLUTING ENTERPRISES

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ABSTRACT

This paper investigates and compares the impact of environmental policy and ESG scores in Chinese publicly listed firms. Over the past few years, China has placed greater emphasis on promoting environmental preservation and sustainable growth. It provides an interesting policy system setting for the present research because as a socialist nation, the Chinese government wields significant influence in policymaking. The sample for analysis is 1,117 listed firms in the heavy pollution industry, and the data involves their financial performance and environmental actions between 2012 and 2020. Utilizing time fixed-effects models, lagged effects models, and Oaxaca-Blinder decomposition, our analysis reveals a robust positive association between environmental policy and financial performance. Additionally, we identify a noteworthy positive implication of ESG scores on both financial and environmental performance. Overall, our evidence suggests that the influence of ESG ratings is prominently stronger than that of policy. This may suggest that policies seem to have limited direct effects on companies, whereas ESG ratings, influenced by capital investments, play a more substantial and beneficial role in enhancing overall corporate performance in these domains.

Keywords: Environmental policy, ESG, Firm performance, Environmental action, Heavy pollution industry, Chinese publicly listed firms.

1. INTRODUCTION

1.1. Background

1.1.1 The ESG is increasingly important.

ESG rating refers to the assessment of companies' performance based on environmental, social, and governance factors. It relies on data derived from the ESG information disclosure of each firm. This rating provides investors with insights into the long-term growth potential of companies and their ability to address risks, making it a significant consideration for investors. It was first proposed by the United Nations in 2004 as an independent concept and policy practice discourse system and has increasingly garnered attention from various investment organizations and institutions (Yao and Jiang, 2023). This criterion is gaining significant importance, driven by the growing emphasis on the ESG information disclosure system by governments, companies, and investors (Setó-Pamies, 2015). National governments in various countries are currently paying

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increasing attention to sustainable development, including the Chinese government, which is implementing various environment-related policies and regulations (Zhang and Wen, 2008). These policies aim to promote environmentally friendly practices, encourage the adoption of renewable energy, and reduce carbon emissions. Furthermore, there is a growing consensus among governments that environmental protection should be equally prioritized alongside economic development. In the past, economic growth was often pursued without adequate consideration of the environmental consequences. However, the detrimental impacts of environmental degradation, climate change, and resource depletion have become increasingly apparent. As a result, governments are shifting their focus towards more sustainable development and environmentally responsible practices. For instance, the Chinese central government has recently devoted increasing attention to capacity building for environmental protection and sustainable development, primarily through the enactment of new legislation on the environment and development at various levels (Zhang et al., 2008).

Companies, especially listed companies, are fond of disclosing their ESG information as it is associated with numerous economically meaningful effects. Specifically, ESG disclosures are linked to several favorable outcomes, including lower capital constraints (Cheng, Ioannou, and Serafeim, 2014), reduced cost of capital (Dhaliwal et al., 2011), and decreased analyst forecast errors (Dhaliwal et al., 2012). Therefore, ESG disclosure is found to be positively relevant to firms' future financial performance (Khan, Yoon, and Serafeim, 2016). Regarding investors, their interest in ESG data has grown rapidly. ESG performance serves as a critical indicator for assessing future financial performance and devising risk mitigation strategies (Rupamanjari and Sandeep, 2022). A company's heightened focus on environmental and social concerns, along with its operational capabilities, reflects how well it can navigate changes in environmental and labor resources in the future. It also reveals the firm’s long-term value and sustainability investment (Lee, S.-S.-P and Isa, M., 2023). As a result, investors are expected to place greater emphasis on firms that disclose comprehensive ESG data.

1.1.2 Policy in China

The Chinese government has demonstrated a significant shift in its policies from economic growth towards environmental issues since 1989 when the Environmental Protection Law of the People's Republic of China was promulgated. This change can be attributed to various factors, including the recognition of the detrimental effects of pollution and environmental degradation on public health and socioeconomic development. The government has increasingly prioritized environmental protection and sustainability in its policy agenda, as demonstrated in Table 1.

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Table 1. Environmental policy in China

Year	Policy	Institution
2013	The "Air Pollution Ten Measures" action plan to reduce PM2.5 concentrations.	Ministry of Environmental Protection
2014	Accelerating the promotion and application of new energy vehicles	Central government portal
2016	The Action Plan for Water Pollution Prevention and Control to implement regional differentiated environmental access	The Ministry of Environmental Protection, the National Development and Reform Commission, the Ministry of Housing and Urban-Rural Development, and the Ministry of Water Resources
2021	The supervision and management of data quality in the national carbon emission rights trading market	The General Office of the Ministry of Ecology and Environment
2023	Recommending advanced solid waste and soil pollution prevention and control technologies	The General Office of the Ministry of Ecology and Environment
2023	The national ecological and environmental standards of the Technical Code for Two-dimensional Code Identification of Pollutant Discharge Outlets of Pollutant Discharging Units	Ministry of Environmental Protection

2. LITERATURE REVIEW

2.1 ESG actions and company financial performance

There is a substantial amount of recent research investigating the relationship between ESG actions and related company performance. In general, these studies suggest that ESG action is positively connected with company financial performance, and this correlation can be explained by the improvement of three key factors of financial performance: operational efficiencies, stock performance, and a lower cost of capital (Whelan et al., 2021). Operational efficiency is positively affected by the governance actions of a company (Shaikh, 2022). For example, reducing the emission of greenhouse gases raises the operational efficiency of logistics companies (Michael, 2019). This ESG action improves cost savings, and resource efficiency, and contributes to a better brand reputation for taking environmentally friendly actions.

Additionally, regarding stock performance, which is determined by stock returns, abnormal returns rise with higher ESG scores (Engelhardt et al., 2021). As investors increase their demand for companies to be more socially and environmentally responsible, a higher ESG score represents

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better sustainable and responsible practices, as well as an ability for risk control. This attracts more investor interest and leads to better stock performance. Last, concerning the cost of capital, high ESG-rated companies experience a lower cost of capital. This can result in a higher company valuation and lower cost of debt because they can access debt financing at a lower interest rate to promote sustainability and achieve a higher stock price, which, in turn, lowers the cost of production (Giese et al., 2019).

2.2 ESG ratings and environmental actions

Some research focuses on exploring the answers to the question of whether the ESG rating is a good evaluation of a company's actual environmental actions. As has been discussed, environmental actions are significantly and positively related to economic sustainability performance, as revealed by the ESG score (Alsayegh et al., 2020). Regarding the measurement of environmental actions, studies have examined environmental performance measures (Dixon-Fowler et al., 2012; Albertini, 2013) or more specifically, environmental processes or outcomes (Endrikat et al., 2014).

ESG ratings reflect a company's environmental actions by considering its environmental policies and practices, its environmental impact, resource management, and environmental innovation to provide a comprehensive score. There is evidence to show that firms with higher environmental ratings statistically tend to be larger in size and belong to more environmentally sensitive industries compared to companies with lower scores (Galani et al., 2012).

2.3 In the Chinese context, policy, and environmental action

Environmental policy has become a crucial instrument in response to the deteriorating global environment. Governments, in particular, frequently employ this policy to regulate heavily polluting industries due to their significant role in environmental degradation (Tang & Yang, 2019). For instance, since the 11th Five-Year Plan period, China has integrated environmental governance into government performance assessments. As a result, many local governments have taken various measures to regulate the environmental performance of local enterprises, especially state-owned enterprises. They have employed measures such as warnings and interviews to hold enterprises accountable if they fail to meet environmental targets (Sun et al., 2023). Furthermore, the government encourages environmentally friendly enterprises, particularly state-owned ones, to take on more social and environmental responsibilities by providing financial subsidies, credit support, and other policy-based assistance and incentives (Huang & Wu, 2021). Specifically, tax policies are crucial regulatory tools for promoting enterprise investment activities and optimizing investment structures. In recent years, the Chinese government has actively improved its tax system, implementing a series of tax reforms, such as the reform of the tax-sharing system and expanding the scope of value-added tax (Guo, 2022).

These comprehensive environmental policies have effectively contributed to the improvement of ESG performance among corporations in the construction industry. This paper summarizes several influential environmental-related policies and regulations in recent years.

The implementation of environmental policy in China has already had some positive influence. These policies have helped promote ecological conservation, the growth of renewable resources, the reduction of carbon emissions, and more. For example, policies known as the "three magic weapons" are designed to control pollution resulting from industrial activities (Sinkule et al., 1995). There is also empirical support for the positive impacts of local energy-saving regulations

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and two environmental standards, as evidenced by regression analysis of a sample of 26 provinces and four centrally-controlled municipalities over ten years (2002-2011) (Zheng et al., 2015). Furthermore, a study of three different economic regions—Eastern, Western, and Middle—shows that environmental regulation is positively related to either corporate innovation or corporate competitiveness (Zhao, 2016).

Nevertheless, despite the positive outcomes of environmental policy implementation, they also exhibit several distinctive characteristics that tend to make implementation difficult. These include time lag, resulting in benefits only in the long run, outcomes that are often invisible and unmeasurable, lengthy and uncertain economic restructuring, stark trade-offs against economic growth, organizational challenges (Eaton et al., 2014), and extra spending on the prevention and control of environmental pollution, which can decrease corporate advantages (Zhao et al., 2015).

3. RESEARCH QUESTIONS

Although companies frequently disclose their environmental actions and ESG scores, there is still a lack of sufficient and comprehensive measurement to accurately assess the real impact of these actions on the environment and society. Due to the absence of comprehensive studies investigating this relationship, this paper will primarily explore the influence of environmental-related policies, as well as ESG ratings, on heavily polluting companies in China.

What is the impact of ESG ratings on firms?

Companies take ESG actions in response not only to the requirements of sustainable development, which are emphasized by society but also to enhance firm performance. This paper will also delve into the relationship between ESG actions and both financial performance and firm environmental action.

What is the influence of environmental policy in China?

The government of China has issued several environmental policies tailored to different conditions. This research will evaluate the effects of these policies by measuring their impact on the environment and firm performance. This question will be answered by investigating the relationship between representative Chinese environmental policies and both firm performance and the actual environmental actions of Chinese publicly listed companies in heavily polluted industries.

Therefore, we formulate our hypotheses:

H1: There is a positive relationship between ESG ratings and firm financial and environmental performance.

H2: There is a positive relationship between the intensity of environmental policy and firm financial and environmental performance.

H3: The impact of environmental policy on firms is stronger than that of ESG scores.

4. DATA AND METHODOLOGY

4.1 Sample

This paper derives data from both CSMAR, the China Stock Market and Accounting Research Database, and Hexun, the first organization to develop a social responsibility report evaluation in China. The dataset includes information from 1,117 publicly listed Chinese firms in heavily polluted industries, as presented in Table 2. Referring to Liu et al. (2015) and Pan et al. (2019) for the definition of heavily polluting industries, this paper selects 19 subsectors, including B (Mining), C (Manufacturing), and D (Electricity, Heat, Gas, and Water Production and Supply),

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as heavy polluting industries, following the "Guidelines on Industry Classification of Listed Companies" (2012).

This industry was chosen as the research focus due to the strong interrelation between environmental policies, ESG actions, and company performance. Additionally, it is easier for us to obtain more available data about companies' environmental actions. This is because companies in heavily contaminated industries are required to disclose their emission data related to pollutant discharge, environmental cleanup, and governance. Therefore, it is intuitive to observe the impact of environmental policies on firms' environmental actions and financial performance.

Table 2. Descriptive statistics

VARIABLES	(1) Number	(2) Mean	(3) Standard Deviation	(4) Minimum	(5) Maximum
ROA	7,602	0.0479	0.142	-3.200	7.445
Market Capital	5,803	13.67	1.185	11.05	19.52
Tobin's Q	5,806	2.031	2.371	0.692	118.3
Policy	1,254	15.90	3.052	5.598	23.99
SOE	5,962	0.378	0.485	0	1
Net profit	5,450	18.90	1.647	12.64	25.50
Asset	6,192	22.24	1.448	17.28	28.64
List Age	6,180	11.83	7.915	-5	29
Number of companies	1,117	1,117	1,117	1,117	1,117

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Table 3. Descriptive statistics of environmental actions

Variable Name	Percent	
	No	Yes
Environment: Concept	56.6	43.4
Environment: Goal	83	17
Environment: Manage system	59.6	40.4
Environment: Education	89.2	10.8
Environment: Special act	84.3	15.7
Environment: Incident Response Mechanisms	62.4	37.6
Environment: Rewards	82	18
Environment: Three simultaneity	80.5	19.5
Environment: report	97.5	2.5
Annual report	7.1	92.9
Social response report	72.3	27.7
Certification: Pollutant emissions	0.4	99.6
Certification: ISO14001	71.6	28.4
Certification: ISO9001	71.5	28.5

Table 4. Descriptive statistics of environmental actions

Variable Name	Percent		
	No	Qualitative	Quantitative
Governance: Waste gas	45.9	35.9	18.2
Governance: Wastewater	46.8	36.3	16.9
Governance: Dust	64.3	23.8	12
Governance: Solid Waste Disposal	59.4	28	12.6
Governance: Noise, light, etc.	76.2	21.6	2.2

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Governance: Clean producing	71.5	25.8	2.6
Emission: Wastewater	44.4	36.8	18.7
Emission: COD	75.1	4.6	20.3
Emission: SO2	73.1	7.4	19.5
Emission: CO2	92.5	4.6	2.9
Emission: Dust	64.2	19	16.8
Emission: Industrial Solid Waste	93.6	5.1	1.2

4.2 Measurement

Company's financial performance

A company's financial performance is one of the outcome variables of interest, and in this paper, it is measured by net profit, Tobin's Q, and market capitalization. Net profit is a comprehensive variable for measuring the profitability of firms, and in this research, we take the logarithm of net profit. Tobin's Q is calculated as the market value of the firm divided by its estimated replacement cost of assets. It is examined as an indicator of the firm's effectiveness from an investment perspective across various top management games (Wolfe et al., 2003). Market capitalization is measured by multiplying the A-share by the closing price of the A-share for the current period, which is an intuitive variable for measuring the value of firms. The logarithm of market capitalization is used.

Measurement of Environmental Performance

Tables 3 and 4 demonstrate the descriptive statistics for variables used to measure environmental performance. We utilized these items to indicate a company's environmental actions, parameters, and results, including resources used and strategies for environmental protection. We constructed a comprehensive scale variable that measures all these items with the help of Cronbach's alpha, a reliable coefficient that signifies internal consistency among related variables. Table 5 shows the results for Cronbach's alpha.

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Table 5. Cronbach's alpha

Item	Obs	Sign	Item-test Correlation	Item-rest correlation	Average interitem covariance	alpha
Environment: Concept	6041	+	0.5002	0.4475	0.0760245	0.9005
Environment: Goal	6041	+	0.4885	0.4483	0.0772778	0.9008
Environment: Manage system	6041	+	0.5692	0.5221	0.0752267	0.8992
Environment: Education	6041	+	0.4412	0.4066	0.0782978	0.9016
Environment: Special act	6041	+	0.4647	0.4251	0.077625	0.9012
Environment: Incident Response Mechanisms	6041	+	0.647	0.6065	0.0743423	0.8976
Environment: Rewards	6041	+	0.4305	0.3869	0.0777566	0.9016
Environment: report	6021	+	0.3339	0.3152	0.0801761	0.9033
Environment: Three simultaneity	6041	+	0.478	0.4355	0.0772004	0.9009
Annual report	6021	+	0.2595	0.2271	0.0799463	0.9036
Social response report	6021	+	0.5154	0.4695	0.0763016	0.9002
Governance: Waste gas	6021	+	0.7854	0.7421	0.0685354	0.8933
Governance: Wastewater	6021	+	0.7811	0.7378	0.0687727	0.8934
Governance: Dust	6021	+	0.7197	0.6699	0.0704486	0.8954
Governance: Solid Waste Disposal	6021	+	0.7071	0.6548	0.0705508	0.8958
Governance: Noise, light, etc.	6021	+	0.5544	0.5069	0.0754333	0.8994
Governance: Clean producing	6021	+	0.5333	0.4812	0.0754024	0.8999
Emission: Wastewater	6021	+	0.763	0.7159	0.0689394	0.8941
Emission: COD	6021	+	0.6437	0.5735	0.0705663	0.8986
Emission: SO2	6021	+	0.6836	0.6202	0.0698652	0.8971
Emission: CO2	6021	+	0.3544	0.3076	0.0784465	0.9028
Emission: Dust	6021	+	0.7215	0.6668	0.0695524	0.8955
Emission: Industrial Solid Waste	6021	+	0.3762	0.3401	0.0788103	0.9024
Certification: Pollutant emissions	6021	-	0.0393	0.0304	0.0813449	0.9047
Certification: ISO14001	6021	+	0.3882	0.3354	0.0777003	0.9025

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Certification: ISO9001	6021	+	0.2726	0.2156	0.0790002	0.9045
Test scale					0.0751363	0.9032

ESG scores

ESG ratings are another key explanatory variable in our research. We directly use the ESG scores from Hexun (the variable CSR in the data set), which offers a comprehensive and objective criterion for evaluating the environmental, social, and governance performance of enterprises.

Environmental Policy

Environmental policy is the key independent variable in our research. Specifically, we focus on the resource tax amount paid by firms. We selected this particular variable due to its directness as a policy measure, providing a tangible means to gauge its influence on firms' ESG actions and financial performance.

Control variable

Our research also controls for the following variables: (1) the logarithm of total assets for the year, (2) list age, which measures the number of years since the firm was listed, (3) ROA (return on assets), and (4) SOE (state-owned enterprises), which accounts for whether the firm is state-owned. We use '1' to represent that the firm is state-owned and '0' to represent that the firm is not state-owned.

4.3 Time-fixed effects model

To investigate the relationship between ESG scores and both firm performance and actual environmental actions, we construct a time-fixed effects model:

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 Z_t + u_{it} \quad (1)$$

Equation (1) states the basic form of the fixed effects regression model. The dependent variable and independent variable are denoted as Y_{it} and X_{it} respectively. $_{It}$ is an unobserved variable that changes over time but is constant across entities. The presence of Z_t leads to a regression model in which each period has its intercept, thus.

$$Y_{it} = \beta_1 X_{it} + \lambda_t + u_{it} \quad (2)$$

Equation (2) has a different intercept, λ_t, for each period, which is known as time-fixed effects. We employ this regression model in our analysis:

$$FP_{it} = \alpha + \beta_1 ESG_{it} + \beta_2 C_{it} + \lambda_t + u_{it} \quad (3)$$
$$EP_{it} = \alpha + \beta_1 ESG_{it} + \beta_2 C_{it} + \lambda_t + u_{it} \quad (4)$$

Equation (3) assesses the relationship between ESG scores and firm performance, where ESG_{it} is the ESG score and FP_{it} is firm performance. Equation (4) assesses the relationship between ESG scores and environmental performance, where ESG_{it} is the ESG score and EP_{it} is environmental performance. C_{it} are the control variables.

Thus, based on the variable measurement, the detailed model for measuring the correlation between ESG scores and both firm performance and environmental performance is:

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$$Net\ profit_{it} = \alpha + \beta_1 ESG_{it} + \beta_2 SOE_{it} + \beta_3 Asset_{it} + \beta_4 Age_{it} + \beta_5 ROA_{it} + \lambda_t + u_{it} \quad (5)$$
$$Tobin's\ Q_{it} = \alpha + \beta_1 ESG_{it} + \beta_2 SOE_{it} + \beta_3 Asset_{it} + \beta_4 Age_{it} + \beta_5 ROA_{it} + \lambda_t + u_{it} \quad (6)$$
$$Market\ capital_{it} = \alpha + \beta_1 ESG_{it} + \beta_2 SOE_{it} + \beta_3 Asset_{it} + \beta_4 Age_{it} + \beta_5 ROA_{it} + \lambda_t + u_{it} \quad (7)$$
$$EP_{it} = \alpha + \beta_1 ESG_{it} + \beta_2 SOE_{it} + \beta_3 Asset_{it} + \beta_4 Age_{it} + \beta_5 ROA_{it} + \lambda_t + u_{it} \quad (8)$$

Equation (5) to (7) measures the relationship between ESG scores and firm performance, while equation (8) measures the relationship between ESG scores and environmental performance.

4.4 Lag Regression Models

To delve into the relationship between environmental policy and both firm and environmental performance, we construct a lag regression model:

$$FP_{it} = \alpha + \beta_1 Policy_{i,t-1} + \beta_2 C_t + \lambda_t + u_{it} \quad (9)$$
$$EP_{it} = \alpha + \beta_1 Policy_{i,t-1} + \beta_2 C_t + \lambda_t + u_{it} \quad (10)$$

Equations (9) and (10) express the lag regression model used in the research, where $Policy_{i,t-1}$ is the resource tax amount that is lagged for one year. C_t are the control variables. Hence, grounded in variable measurement, the elaborated model designed to quantify the correlation between environmental policy and both firm performance and environmental performance is as follows:

$$Net\ profit_{it} = \alpha + \beta_1 Policy_{i,t-1} + \beta_2 SOE_{it} + \beta_3 Asset_{it} + \beta_4 Age_{it} + \beta_5 ROA_{it} + \lambda_t + u_{it} \quad (11)$$
$$Tobin's\ Q_{it} = \alpha + \beta_1 Policy_{i,t-1} + \beta_2 SOE_{it} + \beta_3 Asset_{it} + \beta_4 Age_{it} + \beta_5 ROA_{it} + \lambda_t + u_{it} \quad (12)$$
$$Market\ capital_{it} = \alpha + \beta_1 Policy_{i,t-1} + \beta_2 SOE_{it} + \beta_3 Asset_{it} + \beta_4 Age_{it} + \beta_5 ROA_{it} + \lambda_t + u_{it} \quad (13)$$
$$EP_{it} = \alpha + \beta_1 Policy_{i,t-1} + \beta_2 SOE_{it} + \beta_3 Asset_{it} + \beta_4 Age_{it} + \beta_5 ROA_{it} + \lambda_t + u_{it} \quad (14)$$

Equations (11) to (13) assess the linkage between environmental policy and firm performance, whereas equation (14) gauges the connection between environmental policy and environmental performance.

For this study, we consider policy, SOE, assets, list age, and ROA as factors that vary over time. The traditional view only takes into account the impact of environmental protection policies on corporate performance in the current period, ignoring their effect on the lag period, which relates to the innovation ability of enterprises. Consequently, they tend to underestimate the future business performance of enterprises (Ye, 2022). This is why we introduce the lagged model into the study to account for policy and error terms that vary over time, as these are the two factors affected by the lagged effect.

4.5 Oaxaca-Blinder decomposition

The Oaxaca-Blinder decomposition is a commonly used method to analyze differences between two different groups and to explain the sources of these differences. In this case, we use it to shed light on the difference between state-owned enterprises and non-state-owned enterprises.

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5. EMPIRICAL RESULTS

5.1 ESG scores and firm financial performance

Table 6 displays the results of fixed-effect regression on financial performance. The model shows a positive and significant relationship between ESG scores and all aspects of firm performance, revealing that companies with higher ESG scores tend to have better financial performance. The regression model indicates a coefficient of 0.014 between net profit and ESG score, a coefficient of 0.002 between market capitalization and ESG score, both of which are significant, showing their relationship, and a coefficient of 0.004 between ESG score and Tobin's Q, which is less significant.

Other variables are also important in this research. The coefficients for state-owned enterprises, total assets, listed age, and ROA all show a significant relationship with net profit. It's worth mentioning that the correlation between state-owned enterprises and net profit is negative, while the other relationships are positive. The coefficients reveal a negative and prominent relationship between Tobin's Q and total assets, state-owned enterprises, listed age, and ROA. There are noticeable relationships between total assets, listed age, and market capitalization. Among these correlations, total assets are positively related to market capitalization, while listed age is negatively related to it. Both state-owned enterprises and ROA are negatively related to market capitalization.

5.2 ESG scores and firm environmental action

Table 7 displays the results of the model testing the relationship between ESG scores and firm environmental actions. ESG scores are also positively and significantly related to the company's environmental performance, with a coefficient of 0.001.

Regarding other factors, both total assets and listed age are positively and significantly related to environmental actions, and the model also reveals positive correlations between SOE, ROA, and alpha actions.

These two tables successfully validate our hypothesis (1).

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Table 6. Time-fixed effects regression on firm performance

	Net profit		Tobin's Q		Market capitalization	
ESG	0.014***	(0.001)	0.004*	(0.002)	0.002***	(0.000)
SOE	-0.425***	(0.120)	-0.249	(0.167)	-0.046	(0.042)
Asset	0.773***	(0.036)	-0.756***	(0.052)	0.757***	(0.013)
Age	0.073***	(0.007)	-0.019	(0.010)	-0.024***	(0.002)
ROA	2.061***	(0.103)	-0.045	(0.166)	-0.031	(0.042)
Constant	0.549	(0.760)	19.146***	(1.101)	-2.966***	(0.276)
Observations	5198		5682		5682	
R^2	0.301		0.070		0.464	

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

Table 7. Time-fixed effects regression on environmental action

	Environmental Action	
ESG	0.001***	(0.000)
SOE	0.004	(0.022)
Asset	0.033***	(0.007)
Age	0.026***	(0.001)
ROA	0.011	(0.016)
Constant	-0.778***	(0.140)
Observations	5918	
R^2	0.133	

* p < 0.05, ** p < 0.01, *** p < 0.001

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5.3 Environmental policy and firm financial performance

Tables 8 and 9 indicate the results of lagged regression models testing the impacts of environmental policy on financial performance and environmental actions, respectively. Environmental policy, particularly lagged environmental policy in this paper, is positively related to company financial performance. The policy has a positive and significant effect on net profit with a coefficient of 0.069, a coefficient of 0.038 with Tobin's Q, and a coefficient of 0.014 with market capitalization.

Regarding other factors, it is interesting to find that the influence of assets and listed age, although significant, varies across the three outcomes of financial performance. Assets and listed age both have positive effects on net profit but negative effects on Tobin's Q.

To our surprise, being a state-owned company or not does not appear to affect the company's financial performance according to our model. Further exploration of the role of ownership type will be tested in the next section.

5.4 Environmental policy and firm environmental action

The company's ESG score is also found to have a positive association with environmental actions, as indicated in Table 9. Notably, the relationship between environmental actions and ESG is positive, with a coefficient of 0.01.

Moreover, the model shows a positive and significant correlation between both assets and ROA and environmental performance. Surprisingly, the regression model reveals a negative relationship between SOE and environmental action. This may indicate that environmental policies in China are not specifically targeting state-owned enterprises, or it could suggest that SOEs are not inclined to take on the responsibility of preserving the environment and regulating pollution.

These two tables successfully validate our hypothesis (2).

Table 8. Lagged regression on firm performance

	Net profit		Tobin's Q		Market capitalization	
L.Policy	0.069*	(0.030)	0.038*	(0.018)	0.014*	(0.007)
SOE	-0.083	(0.499)	-0.628	(0.327)	-0.040	(0.128)
Asset	0.598***	(0.160)	-0.511***	(0.091)	0.741***	(0.035)
Age	0.152***	(0.023)	-0.043***	(0.013)	-0.030***	(0.005)
ROA	1.081***	(0.140)	0.068	(0.200)	-0.054	(0.078)
Constant	2.210	(3.611)	13.988***	(2.064)	-2.527**	(0.806)
Observations	836		955		955	
R^2	0.260		0.092		0.436	

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

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Table 9. Lagged regression in environmental performance

	Environmental Action	
L.Policy	0.010	(0.006)
SOE	-0.051	(0.114)
Asset	0.058*	(0.029)
Age	0.008	(0.004)
ROA	0.084**	(0.029)
Constant	-1.164	(0.655)
Observations	977	
R^2	0.039	

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

5.5 Oaxaca-Blinder decomposition Analysis

Table 10 describes the results of our decomposition model. From the table, it is clear that the variation between state-owned enterprises (SOEs) and non-SOEs can be primarily attributed to the varying sizes of these companies. SOEs, particularly manufacturing companies, have a greater volume. This large volume implies a high level of capacity, which in turn suggests a higher market capitalization. Furthermore, SOEs account for a significant proportion of large-scale firms in heavily polluting industries, such as steel mills and energy plants.

Table 10. Results for Oaxaca-Blinder decomposition

	Model with Policy		Model with ESG	
Market performance	Coefficient	%	Coefficient	%
Overall				
Difference	-0.92		-1.10	
Explained	-1.00	109	-1.05	95.50
Unexplained	0.08	-9	-0.05	4.50
Explained				
Policy	0.03	-2.51		
ESG			0.00	-0.17
ROA	-0.01	1.16	0.00	0.29
Asset	-1.06	106.07	-1.06	101.30
Age	0.05	-4.71	0.01	-1.41

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6. ROBUSTNESS CHECK

6.1 Implication of ESG scores after balancing

To test the robustness of our model, we conducted balanced regressions on financial performance and environmental action. Table 10 shows the correlation between ESG scores and firm financial performance, which remains positive after balancing, with a coefficient of 0.001. With a notable improvement in R2, increasing from 0.301 to 0.559 for net profit, from 0.070 to 0.206 for Tobin's Q, and from 0.464 to 0.539 in market capitalization, it indicates that our model has a strong ability to explain the variance in firm performance and is robust.

Table 11 indicates the results of time fixed-effects regression. The relationship between ESG scores and firm environmental performance remains as positive as before balancing, with a coefficient of 0.001. With a substantial improvement in R2, increasing from 0.039 to 0.068 for environmental action, it indicates that our model possesses a strong capacity to explain the variability in firm performance and is robust in its explanatory power.

Table 11. Time-fixed effects regression on firm performance after balancing

	Net profit		Tobin's Q		Market capitalization	
ESG	0.001	(0.003)	0.003*	(0.001)	0.001*	(0.001)
Constant	0.259	(3.305)	13.102***	(1.729)	-3.195***	(0.805)
Observations	468		545		545	
R^2	0.559		0.206		0.539	

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

Table 12. Lagged regression on environmental performance after balancing

	Environmental Action	
ESG	0.001	(0.001)
Constant	0.083	(0.867)
Observations	552	
R^2	0.068	

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

6.2 Implication of environmental policy after balancing

The relationship between environmental policy and firm finances is even more prominent than before balancing. The coefficient between policy and net profit is approximately 0.012, while the coefficient between policy and Tobin's Q is about 0.070, which is the most remarkable one. The coefficient between environmental policy and market capitalization is approximately 0.032.

The increase in R2 also demonstrates the enhanced capability of the regression model to explain the relationship between policy and firm performance. The R2 between net profit and policy increases from 0.260 to 0.581, while the one between Tobin's Q and policy rises from 0.092 to 0.238, and the one between market capitalization and policy increases from 0.436 to 0.475.

Table 13 displays the results of the model testing the relationship between environmental policy and firm environmental performance after balancing, with a coefficient of 0.002. There is an increase in the value of R2, which rises from 0.039 to 0.042 after balancing, indicating an improvement in the model's ability to account for the relationship.

Table 13. Lagged regression on firm performance after balancing

	Net profit		Tobin's Q		Market capitalization	
L.Policy	0.012	(0.040)	0.070***	(0.021)	0.032**	(0.010)
Constant	3.054	(3.736)	14.453***	(2.060)	-2.288*	(0.961)
Observations	397		468		468	
R^2	0.581		0.238		0.475	

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

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Table 14. Lagged regression on environmental performance after balancing

	Environmental Action	
L.Policy	0.002	(0.011)
Constant	-0.292	(1.013)
Observations	473	
R^2	0.042	

7. CONCLUSION AND DISCUSSION

7.1 Main conclusions

Over the past few years, China has prioritized the promotion of environmental preservation and sustainable growth. As a socialist country, the Chinese government holds considerable sway in policymaking, making it an intriguing setting for this study. However, whether those policies are effective or not remains unclear. At the same time, ESG ratings, representing capital investments, appear to have a greater impact on Chinese listed enterprises. This phenomenon provides an interesting backdrop for our research. Thus, we selected a sample of 1,117 listed firms in heavily polluted industries and collected data on their financial performance and environmental actions between 2012 and 2020. Using this sample, we employed the lagged-effects model and time fixed-effects model to investigate the correlation between ESG scores and firms' environmental and financial performance, as well as the relationship between environmental policies and both a company's environmental and financial performance. Our first two hypotheses have been successfully verified.

The empirical findings reveal a statistically significant positive association between ESG scores and a company's environmental and financial performance. Having higher ESG scores doesn't just imply a good reputation for the companies but can truly benefit them. According to our findings, when firms achieve higher ESG scores during their development, their financial performance improves as well. These improvements are reflected not only in their net profit but also in Tobin's Q and market value. Simultaneously, an increase in ESG scores is also linked to advancements in a company's environmental actions. When firms are rated with higher ESG scores, they are taking action to protect the environment. This suggests that the ESG score is a well-established tool for evaluating a firm’s environmentally related actions and an efficient means of regulating and guiding firms to protect the environment.

Furthermore, the study identifies a robust and positive relationship between environmental policies and a company's financial performance, albeit with a positive but less significant connection to its environmental performance. According to our lagged effects model, as the intensity of environmental policy increases, financial performance, as represented by net profit, Tobin’s Q, and market capitalization, is expected to increase significantly as well. This indicates a lagged effect of environmental policy on corporate performance. Simultaneously, increasing the intensity

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of environmental policy is likely to result in improved firm environmental performance. This suggests the effectiveness of Chinese environmental policy.

However, our third hypothesis is contradicted by the empirical results. It is interesting to find that the implications of environmental policies and ESG are not consistent. The research also reveals that the impact of ESG factors on a company's environmental and financial performance is notably stronger and more positive than the influence of environmental policies. This finding is surprising, considering the robust regulatory framework in place in China. It suggests that the direct effect of environmental policies on companies is somewhat limited. In contrast, the ESG ratings, representing the scores rated by capital, appear to have a more substantial and beneficial impact on firms' overall performance in these areas.

The difference in the effects of environmental policies and ESG may be due to two reasons. One reason is that the duration required to develop policies can be relatively long. Since the Reform and Opening in 1978, China has focused on economic growth but neglected the formulation of various policies concerning environmental issues. It is in more recent decades that environmental issues have become one of the key aspects of government policies. However, these policies require time and ongoing evaluation to improve their effectiveness. Therefore, current policies might lack efficiency. Another reason may be the inherent complexity of environmental policies. Environmental policy instruments mainly include command and control instruments, market-based policy instruments, voluntary instruments, and public participation instruments. As a result, their impact on companies may take time to materialize and can be subject to delays. However, ESG factors are being integrated into investment decisions by both institutional and individual investors, offering an immediate incentive for companies to prioritize ESG considerations.

7.2 Policy recommendations

According to the conclusions above, this paper makes the following policy recommendations:

The Chinese government should formulate policies with a market focus. By comparing the difference in the effects of ESG ratings and environmental policy, it is evident that pressure from investors and capital is more likely to influence firms' both financial and environmental performance. The government should leverage its market power to stimulate the energy of enterprises. For instance, the Chinese government should strengthen and improve the ESG disclosure system of enterprises to provide comprehensive information for stakeholders and investors to make informed decisions and investments.

The government ought to focus on economic growth as well as regulate environmental pollution. Pursuing economic growth while ignoring environmental problems may not have a significant impact in the short term, but in the long term, pollution will become a constraint on economic growth. To solve this problem, the Chinese government should formulate policies with an ESG focus. For instance, the government can provide subsidies for firms that fulfill their ESG responsibilities. In this way, enterprises are likely to shift from mandatory to voluntary disclosure of ESG information, thereby boosting corporate enthusiasm and protecting the environment.

7.3 Limitation

This paper has two limitations.

(1) This paper selected a sample of 1,117 firms operating in the heavily polluting industry between 2012 and 2020. Some firms became publicly listed during this period, which negatively affected the integrity of the data sample.

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(2) The use of Cronbach's alpha method to integrate environmental performance may have resulted in certain biases, and its persuasiveness is not completely compelling. In the future, we hope other scholars to develop a comprehensive system for integrating firm environmental performance.

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APPENDIX

Market performance	Coefficient	Std. errs.	P-value
Overall			
Non-state-owned	13.82	0.10	0.00
State-owned	14.73	0.12	0.00
Difference	-0.92	0.16	0.00
Explained	-1.00	0.16	0.00
Unexplained	0.08	0.07	0.23
Explained			
Policy	0.03	0.03	0.32
ROA	-0.01	0.01	0.22
Asset	-1.06	0.16	0.00
Age	0.05	0.03	0.17
Unexplained			
Policy	0.66	0.29	0.02
ROA	0.05	0.02	0.03
Asset	-4.26	1.04	0.00
Age	0.24	0.10	0.02
_cons	3.40	0.93	0.00

Market performance	Coefficient	Std. errs.	P-value
Overall			
Non-state-owned	13.24	0.04	0.00
State-owned	14.34	0.08	0.00

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Difference	-1.10	0.09	0.00
Explained	-1.05	0.09	0.00
Unexplained	-0.05	0.05	0.29
Explained			
ESG	0.00	0.01	0.86
ROA	0.00	0.00	0.55
Asset	-1.06	0.08	0.00
Age	0.01	0.03	0.66
Unexplained			
ESG	-0.22	0.07	0.00
ROA	0.00	0.00	0.58
Asset	-0.84	0.46	0.07
Age	0.17	0.04	0.00
_cons	0.84	0.46	0.07