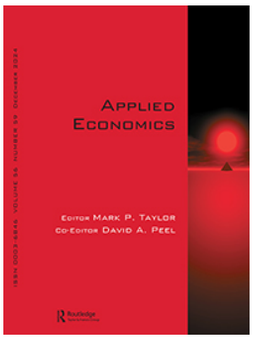

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Environmental regulation, ESG, and firm value: evidence from China

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ABSTRACT

Companies are facing increasing environmental regulatory risk, but the literature has rarely studied how firms respond to this type of risk. This paper uses China's Central Environmental Protection Inspection (CEPI) as an exogenous shock and explores the role of ESG engagement in mitigating the environmental regulatory risk. Our main findings are as follows. First, the CEPI reduces the market value of companies by 1.8%, or about $153,000 million. This implies that environmental regulation reduces firm value in the short run. Second, those with higher ESG scores suffer lower value degradation from the CEPI, implying that ESG plays the moderating role. Mechanism analyses suggest that ESG mitigates environmental regulatory risk by placating the government, but not by placating the public. This paper reveals a new role for ESG, i.e. buffering negative shocks from government environmental regulations. Meanwhile, our research provides helpful policy implications for governments and firms in developing countries to achieve sustainable development.

KEYWORDS

Government regulation; regulatory risk; ESG; central environmental protection inspection; China

JEL CLASSIFICATION

G14; M14; Q58

I. Introduction

Over the recent years, the issue of environmental protection has become a common concern worldwide. To address this challenge, strong regulatory actions are introduced in many countries, especially developing countries. For example, Brazil has implemented several environmental regulatory policies since 2004 to protect the Amazon region (Harding, Herzberg, and Kuralbayeva 2021). In 2014, the Chinese government declared the 'war on pollution' and implemented a series of strict environmental regulatory actions in the following years (Greenstone et al. 2021). As a result, companies are facing increasing environmental regulatory risk. The first question we focus on is whether environmental regulation decreases corporate value? The effect of environmental regulation on corporate value is controversial in the existing literature (Moosa and Ramiah 2014; H. N. A. Pham, Ramiah, and Moosa 2020; Ramiah, Martin, and Moosa 2013). On the one hand, Feldman, Soyka, and Ameer (1997) and Dowell, Hart, and Yeung (2000) show that when faced with environmental regulation, firms adopting stricter environmental standards will experience an increase in their stock prices.[1] On the other hand, environmental regulation triggers significant compliance costs that lead to deterioration of corporate financial indicators, thus reducing firm value (Guo, Kuai, and Liu 2020; H. Pham et al. 2019).

If environmental regulation reduces corporate value, then the second question is, how do companies deal with the environmental regulatory risk? Existing literature shows three main types of corporate responses to environmental regulations. Firstly, increased innovation and environmental expenditure (Jaffe and Palmer 1997; Porter and van der Linde 1995; Zhang et al. 2019). Secondly, strategic production reduction during the inspection, pollution transfer within enterprise groups, and closing plants (Cai, Chen, and Gong 2016; Chen et al. 2023; Cui and Moschini 2020; Karplus and Wu 2023). Thirdly, avoiding environmental regulations by seeking political connections (Correia 2014). However, the existing literature has paid little attention to the role of corporate

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[1]Khanna and Damon (1999) find that although environmental policies detract from corporate returns in the short run, positive effects are observed in the long run.

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ESG engagement in mitigating environmental regulatory risks. ESG, the concept that companies consider not only financial returns but also environmental, social, and corporate governance in their production and investment processes, is gradually being accepted by investors as a new investment concept around the world. According to the UN Principles for Responsible Investment (PRI), the assets under the management of institutional investors and service providers that have signed the PRI agreement have increased from $6.5 trillion in 2006 to $121 trillion in 2021 (Edmans 2023). Since ESG is the philosophy that companies proactively provide public goods such as environmental protection, an interesting question is, whether ESG serves as an effective tool for companies to deal with the environmental regulatory risk? Although there is some anecdotal evidence,[2] little research formally explores the role of ESG engagement in mitigating environmental regulatory risk. This paper tries to fill this gap.

This paper focuses on the Central Environmental Protection Inspection (CEPI) event in China and explores the effects of the ESG engagement in mitigating this environmental regulatory risk. The CEPI is a novel and nationwide environmental regulation campaign launched by the central government. Its purpose is to urge local governments to implement environmental protection goals and to reduce local protectionism in terms of pollution emissions. This campaign is the most extensive and influential environmental regulatory action in China in the last decade (Li et al. 2020). Meanwhile, the level of ESG engagement among Chinese firms is growing rapidly. By 2024, 2,110 Chinese A-share listed firms have voluntarily issued ESG/CSR reports, compared to only 371 firms in 2009. Based on the above two reasons, we regard the CEPI as an exogenous shock, providing us with a perfect 'quasi-natural experiment' to examine the impact of environmental regulation and ESG on firm value. It can better identify causality and mitigate endogeneity concerns. Furthermore, China is one of the world's largest carbon emitters, the ESG engagement of Chinese firms is of great importance for global climate change control.

This paper considers the first batch of CEPI as an exogenous shock and employs the event study methodology to explore the impact of CEPI on firm value, and investigate the moderating effect of ESG engagement. The analysis is based on the sample of Chinese A-share industrial listed firms. First, our baseline results show that the CEPI significantly reduces corporate value by 1.8%, or about $153,000 million. This implies that the environmental regulatory risk indeed negatively affects firms. Second, we find that ESG plays the moderating role of mitigating environmental regulatory risk. Specifically, for every 10% increase in the mean ESG score, the value loss due to the CEPI is mitigated by 47.5%. Our balance test indicates that the characteristics of firms in the treatment and control groups are balanced ex ante. Then, we show that our main results still hold if we use alternative ESG ratings, alternative estimation windows for calculating CARs, the PSM analysis, and conduct placebo tests using 'false' treatment group or 'false' treatment time. Moreover, mechanism analyses suggest that ESG mitigates environmental regulatory risk by placating the government, but not the public, as the moderating effect of ESG is more pronounced where government intervention is greater and public concern is lower. Finally, additional analyses reveal that after the inspection team leaves, the stock price rebounds, and such rebound is limited to companies with high ESG engagement. This reveals that ESG can also bring resilience to companies.

This paper makes three main contributions to the literature. First, we provide novel evidence on the effects of environmental regulation on corporate value from a developing country. Previous literature does not yet reach a conclusive consensus on whether environmental regulation creates or destroys value (Moosa and Ramiah 2014). One branch of literature argues that environmental regulation brings extra risk and compliance costs to companies, which reduces corporate value (Guo, Kuai, and Liu 2020; H. Pham et al. 2019; Zhang, Yu, and Kong 2019). However, others emphasize that the impact of environmental regulation on corporate value is mixed and increases

[2]Anecdotal evidence suggests that investors are increasingly focusing on ESG performance in their portfolios to address regulatory risk. https://www.ft.com/content/6f9dc2cc-e512-11e7-97e2-916d4fbac0da.

the value of a few firms (Feldman, Soyka, and Ameer 1997; Khanna and Damon 1999; H. N. A. Pham, Ramiah, and Moosa 2020; Ramiah, Martin, and Moosa 2013). Specifically, the Porter hypothesis argues that environmental regulation increases firms' technological innovation and productivity (Jaffe and Palmer 1997; Porter and van der Linde 1995). Therefore, Dowell, Hart, and Yeung (2000) suggest that the relationship between environmental regulation and corporate value is an empirical question. Our study departs from the existing literature in two ways. Firstly, we explore the direct cost of environmental regulation to firms, i.e. reduced firm value, thus contributes to this debate with evidence from the world's largest developing country. Secondly, our study reveals an indirect benefit of environmental regulation to firms, i.e. environmental regulation has screened out socially responsible enterprises, which echo a virtuous circle – 'doing well by doing good'. To some extent, the top-down regulation indirectly pushes firms to engage more in ESG activities. Therefore, the evidence presented in this paper contributes to the comprehensive assessment of the benefits and costs of environmental regulation.[3]

Second, we provide new evidence to the literature on the role of ESG in risk management. Most of the ESG literature discusses the effects of ESG on firm value enhancement (e.g. Edmans 2011, 2023), while only few studies reveal the role of ESG in risk management, including the role of ESG in alleviating justice risk (Hong et al. 2019), product recall risk (Kong, Shi, and Yang 2019), consumer boycott risk (Kim and Park 2020), and the financial crisis (Lins, Servaes, and Tamayo 2017). Our paper focuses on a particular type of risk, i.e. the environmental regulatory risk lead by the CEPI, and studies the mitigating effects of corporate ESG engagement on the negative stock market responses. We feel it is important to explore how companies respond to this type of risk because the issue of climate change is becoming increasingly relevant and environmental regulatory risk appears to be the top risk for companies (Stroebel and Wurgler 2021). In addition, our mechanism analyses suggest that ESG is used to placate regulators rather than public opinion. Thus, our research provides novel evidence for the conjecture of Benabou and Tirole (2010).

Third, our study provides new evidence for the debate on whether investors/managers' ESG decisions are motivated by value or values (Starks 2023). On the one hand, they may consider social preferences rather than just profit maximization (Benabou and Tirole 2010). As a result, the stock returns of ESG portfolios are lower (Hwang, Titman, and Wang 2022). On the other hand, one branch of literature argues that ESG leads to either lower risk or higher returns, and is therefore consistent with profit maximization (Dimson, Karakaş, and Li 2015; Edmans 2011; Khan, Serafeim, and Yoon 2016; Krüger 2015). Since climate change is becoming a major concern worldwide, our study provides additional evidence on the value of ESG and implies that the motivations of investors and managers for ESG might be value.

The rest of this paper is organized as follows. Section II introduces the institutional background of China's Central Environmental Protection Inspection and develops the testable research hypotheses. Section III presents the research design of this paper. Section IV provides the main regression results, and Section V concludes the paper and proposes the policy implications.

II. Institutional background and hypotheses development

Institutional background

Since 2014, the Chinese government has attached great importance to the problem of environmental pollution (Greenstone et al. 2021). On 1 July 2015, the Chinese central government launched the Central Environmental Protection Inspection (CEPI) programme. The CEPI is directly led by the central government and is implemented by sending inspection teams to inspect each province.

[3]Recently, a few scholars examine the impact of the CEPI on corporate value, but the findings are mixed. For example, Wei and Zhao (2024), and Zeng et al. (2021) argue that the CEPI reduces corporate stock prices, whereas Wen (2023) finds that the CEPI reduces the stock price crash risk. Unlike them, this paper not only discovers the negative impact of the CEPI on corporate value, but also highlights the buffering role of ESG against environmental regulatory risks.

The inspection teams listen to reports and check documents from the local governments, visit and inquire, receive opinions from the public, and conduct temporary spot checks on site.

The CEPI was conducted during 2016 and 2017 years in all 31 provinces of mainland China. In January 2016, the pilot of CEPI was launched in Hebei province. Then, in July 2016, the central government sent the first batch of inspection teams to eight provinces. Then, the second to fourth batch of inspection was carried out in November 20 April 2016 17, and August 2017, respectively. Figure 1 shows the inspection order of CEPI.

As firms are the main producers of environmental pollution, the inspection teams will focus on the pollution behaviour of firms during the inspections, including setting up hotlines for local whistle-blowers and making spot checks at firms.[4] According to official statistics, during the CEPI a total number of 29,000 firms were punished, with fines of about 1.43 billion yuan.[5] Therefore, CEPI has greatly deterred local enterprises in terms of environmental compliance.

Hypotheses development

Environmental regulation and firm value

The stakeholder theory argues that the value of a company is created by all categories of stakeholders (Freeman 1984). The typical stakeholders include consumers, suppliers, government, communities, employees, and stockholders (Carroll 1996). Among the various types of stakeholders, the role of government is unique. Specifically, government environmental regulatory policies can affect firms' production, sales, and environmental performance, and can even lead to the closure of heavily polluting firms. For a transitional economy like China, the government is even considered as the most influential stakeholder due to its deep interference in business activities (Quan et al. 2018). Hence, government environmental regulation will affect the value of firms. In addition, as more investors focus on CSR or ESG, they will express their concerns for environmental performance by 'voting with their feet' in the capital market. Therefore, two types of stakeholders, the government and investors who

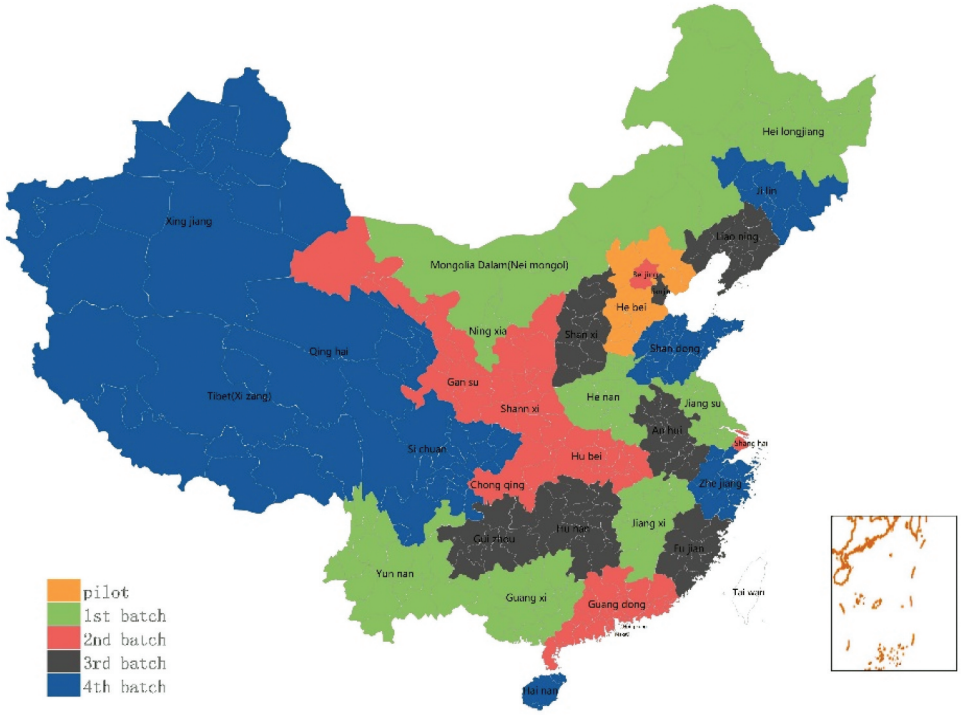


Figure 1. The order of the central environmental protection. This map shows the geographical distributions of the different batches of CEPI. In this paper, we focus on the first batch of CEPI (the green areas on the map).

[4]https://www.scmp.com/news/china/politics/article/3141401/chinese-provinces-failed- tackle-pollution-named-g overnment.
[5]Xinhua News Agency, China, http://www.xinhuanet.com/politics/2018-01/04/c_11222 06360.htm.

prefer socially responsible investment, will force companies to highly focus on environmental performance. In fact, there is evidence that in the capital market, negative environmental events can lead to a decline in the stock price of a company (Deak and Karali 2014). For example, Muoghalu, Robison, and Glascock (1990) finds that, companies suffer significant losses when they face hazardous waste lawsuits. Moreover, the decline in stock value is positively correlated with the amount of the fine (Karpoff, Lott, and Wehrly 2005).

The institutional background implies that the CEPI initiated by the central government is a top-down environmental regulation campaign that imposes stricter environmental requirements on firms. Therefore, the CEPI is an exogenous negative shock to firms. Based on the above analyses, we propose the following hypothesis:

Hypothesis 1: Environmental regulation is negatively associated with firm value.

The moderating effects of ESG

Although government environmental regulation can cause negative shocks to the value of all firms, there should be some cross-sectional heterogeneity in the negative shocks across firms. We argue that the level of corporate ESG engagement affects the magnitude of negative shocks. Firstly, ESG/CSR activities provide an 'insurance-like' protection for companies (Godfrey 2005), which can remove some negative impacts of the environmental regulation. When firms engage in ESG/CSR activities, they actually provide public goods that should have been borne by the government. Thereby firms send a signal to stakeholders that they are not completely self-interested (Godfrey, Merrill, and Hansen 2009). This will enable firms to gain moral capital or goodwill. When a negative event (e.g. environmental regulation) occurs, the moral capital or goodwill can gain stakeholders' sympathy and support. The government, as one of the most important stakeholders, will mitigate penalties for companies with high ESG engagement, thus increases the resilience of firms during the crisis (Benabou and Tirole 2010) and ultimately increases their economic value. Secondly, companies with higher ESG levels are more likely to be supported by responsible investors in the capital market. On the one hand, socially responsible investment uses disinvestment to punish bad companies which are revealed to have poor environmental performance during the environmental regulation. On the other hand, it rewards companies that perform well in ESG through additional investments and buying their stocks (Broccardo, Oliver, and Zingales 2022). Based on the above analyses, we derive the following hypothesis.

Hypothesis 2: In the context of the negative impact of environmental regulation, the decline in the corporate value is lower for companies that engage more in ESG activities than for companies that are less involved.

III. Research design

Sample construction

We use the A-share industrial listed firms as our sample. We focus on industrial companies because they are the producers of most pollution and are therefore the focus of the CEPI.

During the 2016–2017 period, the CEPI, arranged directly by the central government, was conducted in four batches in all 31 provinces in mainland China. We regard it as an exogenous shock, however, given that firms located in the provinces inspected in the last three batches may generate expectations, which could lead to endogenous concerns. Therefore, we focus on the impact of the first batch of inspection, as it is the most shocking and exogenous among all batches.[6] Our sample contains two periods. First, we define the period during which the inspection team is stationed as the onsite period. Specifically, the onsite period is from July 12 to 19 August 2016.[7] Second, as a baseline for comparison, we take the month prior to the onsite period as the pre-check period, which is from June 8 to 11 July 2016.

[6]It is worth noting that a pilot was carried out in Hebei Province before the first batch of inspection. However, the impact and intensity of this pilot was much lower than that of the other inspections. Thus, we exclude the sample from Hebei province.
[7]Inspector teams were stationed in each province for one month, with slight variations in the date of the initial stationing in each province.

We gather information on firms' stock prices and other financial indicators from the China Stock Market & Accounting Research (CSMAR) database. Our ESG data comes from the HuaZheng database. We match the listed firms' stock prices and financial indicators with their ESG ratings. We exclude firms with Special Treatment (ST), and winsorize all numerical variables at the 1% level. Finally, our sample contains 2226 observations for 1113 listed industrial companies in China.

Variables

Stock market returns

Following Lins, Servaes, and Tamayo (2017), we adopt two measures of stock market returns. First, the raw return ($Return_{i,t}$), which equals to the stock returns for firm i during period t (the onsite period or pre-check period).

Second, the cumulative abnormal returns ($CAR_{i,t}$). We define event date (T_0) as July 12, which is the date of the first inspection team's stationing, and we select the estimation window as [T_0 −30, T_0 −120]. We use [T_0 −22, T_0 +28] as the event window, that is, the period in which we study the market's reaction to the CEPI (from June 8 to August 19). We further divide the event window into two parts: Pre-check ([T_0 −22, T_0 −1]) and Onsite ([T_0, T_0 +28]). We use the market model to calculate abnormal returns over the event window, and compute the CARs by summing up the abnormal returns within the specific time windows of Pre-check and Onsite.

ESG engagement

We use Environmental, Social and Governance (ESG) ratings for listed companies from the HuaZheng database, which is widely used in the ESG literature (e.g. Jiang et al. 2022; Lin, Fu, and Fu 2021). The HuaZheng ESG rating system is one of the earliest comprehensive ESG evaluation systems in China, which covers almost all listed companies. The ESG engagement of each company is categorized into nine grades, C, CC, CCC, B, BB, BBB, A, AA, AAA. Referring to Lin, Fu, and Fu (2021), we assign 1 to 9 to each grade, with higher values leading to higher ESG ratings. We use the corresponding ratings in 2015 (one year before the CEPI) to measure corporate ESG engagement. The detailed composition of the indicators is reported in Table A1.

To mitigate potential concerns caused by ESG rating divergences (Berg, Koelbel, and Rigobon 2022), we include two alternative ESG database as robustness checks. First, the Bloomberg database. The internationally covered Bloomberg ESG rating is broadly used in the literature (e.g. Avramov et al. 2022; Huang et al. 2022), but only firms that publish ESG/CSR reports receive corresponding ESG scores. Second, the HeXun database, which is also a commonly used source of ESG/CSR data, and covers all A-share listed companies (Cheng et al. 2022; Zhao, Fang, and Zhang 2022).

Control variables

Referring to the existing literature (Bae et al. 2021; Lins, Servaes, and Tamayo 2017), our control variables consist of the following firm-level characteristics: (1) Firm size (*Lnmv*), which is the logarithm of market value. (2) Long-term debt (*Longdebt*), which is equal to long-term debt over total assets. (3) Short-term debt (*Shortdebt*), which is equal to short-term debt over total assets. (4) Cash holdings (*Cash*), which is equal to cash holdings over total asset. (5) *Profitability*, equals to operating income over total assets. (6) *BM*, equals to the book value of equity over market value. (7) *Momentum*, which is the annual stock return. (8) Idiosyncratic risk (*Idiosyncratic*), calculated as the variance of market return. It is worth noting that all control variables are measured using data in 2015 and are therefore not affected by the CEPI.

Econometric model

We consider the first batch of CEPI as an exogenous event and estimate the impact of the environmental inspection on stock returns of industrial-listed firms using the event study methodology. The event study examines the short-term stock price reaction around the announcement of an event, and this methodology is commonly used in economics and finance research (Deng, Kang, and Low 2013; S. Fan et al. 2023; Fisher-Vanden and Thorburn 2011; Flammer 2021). We estimate the following specification:

$$R_{i,t}=\alpha+\beta_1 \text{Onsite}_{i,t}+\sum \beta_k \text{Control variables} + \sum \beta_m Factor \text{ loadings} + \sum \beta_n \text{Industry FE}+\varepsilon_{i,t} \quad (1)$$

where i indicates firms, and t denotes the two time period (pre-check or onsite).[8] The dependent variable $R_{i,t}$ is stock market returns (raw returns or cumulative abnormal returns) for firm i during period t. The treatment group includes firms located in the first batch of CEPI (232 firms), and the control group consists of firms located in the last three batches of CEPI (881 firms). Thus, $Onsite_{i,t}$ is a dummy variable which equals one if firm i is in the treatment group, and t equals to the onsite period.[9] Following Lins, Servaes, and Tamayo (2017), we control for Fama – French three factors and the momentum factor (*Factor loadings*), and two-digit industry fixed effects (*Industry FE*). It is notable that the event study literature commonly does not control for individual fixed effects because of the lack of time-level variation.[10] $\varepsilon i, t$ denotes the residual term. Considering the heteroskedasticity and serial correlation of the residual term, we use robust standard errors clustered at the province level.

Further, we adopt the following model to explore the moderating role of ESG engagement:

$$R_{i,t}=\alpha+\beta_1 \text{Onsite}_{i,t}+\beta_2 \text{ESG}_i+\beta_3 \text{ESG}_i \times \text{Onsite}_{i,t}+\sum \beta_k \text{Control variables} + \sum \beta_m Factor \text{ loadings} + \sum \beta_n \text{Industry FE}+\varepsilon_{i,t} \quad (2)$$

where ESG_i denotes the ESG engagement for firm i in 2015, the definition of other variables is the same as Eq. (1).

Descriptive statistics

Table 1 presents the descriptive statistics. The average raw returns in our sample are 4.1%, while the average cumulative abnormal returns are slightly negative (less than −1%). The average ESG rating in our sample in 2015 is about 4 (B rating). In terms of ESG sub-components, firms generally perform poorly on E (environmental) but well on G (governance), which shows the necessity of environmental inspections. The definitions of these variables can be seen in Table A2.

IV. Empirical analyses

The effects of the CEPI on stock market returns

We first examine the stock market reaction on environmental inspection. In Figure 2, we depict the changes in the CARs of the treatment group

Table 1. Descriptive statistics.

Variable	Obs.	Mean	SD	P25	Median	P75	Min	Max
Return	2226	0.041	0.088	−0.014	0.034	0.088	−0.152	0.309
CAR	2226	−0.009	0.100	−0.069	−0.003	0.050	−0.263	0.284
HZ_ESG	2226	4.075	0.946	4	4	5	1	7
HZ_E	2226	1.868	1.049	1	2	2	1	6
HZ_S	2226	3.880	1.428	3	4	5	1	8
HZ_G	2226	5.526	1.213	5	6	6	1	8
Lnmv	2226	16.258	0.767	15.678	16.114	16.690	15.098	18.827
Longdebt	2226	0.065	0.094	0	0.022	0.102	0	0.670
Shortdebt	2226	0.358	0.162	0.230	0.344	0.467	0.034	0.842
Cash	2226	0.145	0.108	0.069	0.119	0.187	0.002	0.720
Profitability	2226	0.614	0.410	0.379	0.546	0.740	0.046	7.155
BM	2226	0.484	0.217	0.320	0.457	0.617	0.095	1.018
Momentum	2226	0.579	0.615	0.118	0.461	0.876	−0.278	3.157
Idiosyncratic	2226	0.002	0.001	0.002	0.002	0.003	0.001	0.006

This table reports the descriptive statistics, include the number of observations (Obs.), the average value (Mean), standard deviation (SD), the 25th quartile (P25), the median, the 75th quartile (P75), the minimum (Min) and maximum (Max) values. Variable definitions can be seen in Table A2.

[8]The pre-check period is the month before the CEPI, and the onsite period is the time during which the inspection is ongoing (one month in duration).
[9]We use the stock returns during pre-check period as a benchmark for comparison.
[10]This implies that the inclusion of individual fixed effects will lead to the multicollinearity problem.

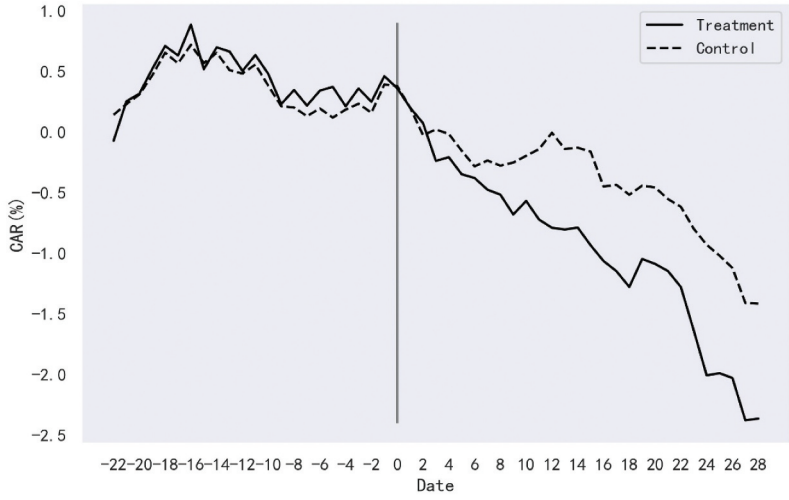


Figure 2. The changes of CAR for treatment group and control group. The solid line represents the changes in CARs of the Treatment group, and the dotted line represents the changes in CARs of the Control group. X-axis represents time relative to the event day. The vertical line indicates the event day (date = 0).

and the control group over the window [$T_0 - 22$, $T_0 + 28$].[11] Before the event date T_0, the CARs of the two groups are parallel and almost undifferentiated. However, after T_0, the CARs of the Treatment group decline rapidly, while the CARs of the control group only show a modest decline during the onsite period.[12] This implies that the CEPI has caused a large negative impact on the value of those inspected firms.

Next, to formally explore the effects of the CEPI on the value of inspected firms, we run the regression defined in Equation (1). Table 2 reports the results. In column (1), we perform a univariate regression, and use raw stock return as the dependent variable. In column (2), we replace the dependent variable with cumulative abnormal return (*CAR*). The coefficients of *Onsite* are significantly negative at the 1% level in both columns, indicating that the CEPI significantly reduces the stock returns of the inspected firms. In terms of economic significance, the CARs of firms located in the inspected provinces are significantly lower by 1.8% during the onsite period. Since the CEPI ultimately covers all provinces in mainland China, this equates to a $153000 million ($53000000 \times 1.8\%/6.23$)[13] value loss for A-share listed companies. In columns (3) and (4), we include all control variables, the coefficients and significance levels remained consistent. Considering that the central government has great power in China and is one of the most important stakeholders (Quan et al. 2018), the CEPI, as a top-down environmental regulation campaign initiated by the central government, is bound to have a huge negative impact on corporate value. Therefore, we believe that hypothesis 1 is supported.

The moderating effects of ESG engagement

Next, we ask whether corporate ESG engagement can mitigate the regulatory risk caused by the CEPI? To answer this question and examine hypothesis 2, we divide the sample into two subgroups for comparison: those with higher ESG ratings (above the sample mean: 4/B) are categorized into the high ESG group; while others are classified into the low ESG group. Figure 3 compares the change in the CARs between the two groups over window [$T_0 - 22$, $T_0 + 28$]. Before T_0, the two groups with high and low ESG ratings show parallel trends in CARs. However, after T_0, the CARs of the high ESG group decrease less than the low ESG

[11] T_0 is the day of the inspection team's stationing.
[12] The decline in stock returns for the control group implies that expectation effects may exist.
[13] The market value of A-share listed companies in 2015 was approximately RMB 53,000,000 million, and the average exchange rate of RMB to USD in 2015 was approximately 6.23.

Table 2. The effects of the CEPI on stock market returns.

Variables	(1) Return	(2) CAR	(3) Return	(4) CAR
Onsite	−0.013***	−0.018***	−0.013***	−0.017***
	(0.004)	(0.006)	(0.005)	(0.006)
Lnmv			−0.002	0.014***
			(0.002)	(0.002)
Longdebt			0.001	0.039
			(0.022)	(0.034)
Shortdebt			0.000	0.028*
			(0.011)	(0.016)
Cash			−0.018	−0.006
			(0.017)	(0.024)
Profitability			−0.000	−0.004
			(0.003)	(0.006)
BM			0.020*	0.032***
			(0.011)	(0.012)
Momentum			−0.006	−0.000
			(0.004)	(0.005)
Idiosyncratic			−5.139**	−9.419***
			(2.278)	(2.323)
Factor Loadings	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Obs.	2226	2226	2226	2226
R^2	0.109	0.075	0.118	0.112

This table reports the results of the effects of the CEPI on stock market returns. The dependent variables are firm-level stock returns (raw returns *Return* and cumulative abnormal returns *CAR*). *Onsite* is a dummy variable for firms in the treatment group, and during the onsite period (July 12 to August 19, 2016). All specifications control for Fama – French three factors and the momentum factor, as well as two-digit industry fixed effects. Standard errors clustered at the province level are in brackets. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively. All variables are defined in Table A2.

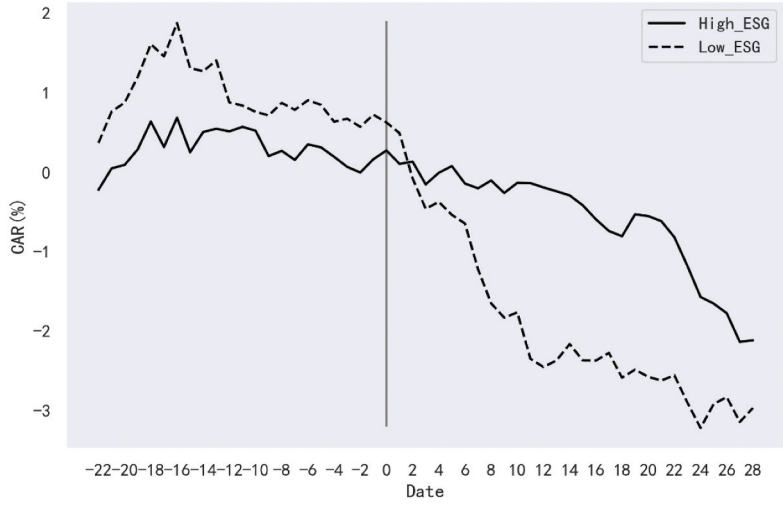


Figure 3. The changes of CAR for the high ESG performance group and the low ESG performance group. The solid line represents the changes in CARs of the high ESG performance group, and the dotted line represents the changes in CARs of the low ESG performance group. X-axis represents time relative to the event day. The vertical line indicates the event day (date = 0).

group, which implies that corporate ESG engagement indeed plays the mitigation role.

To formally verify the moderating role of corporate ESG engagement, we perform the specification defined Equation (2). The results are reported in Table 3. We use HuaZheng's ESG rating in 2015 (*HZ_ESG*) as a proxy for corporate ESG engagement. It's clear that the interaction term *HZ_ESG*×*Onsite* is significantly positive at the 1% level, regardless of whether our dependent variable is the raw stock return or CARs, and with or without the inclusion of control variables. Specifically, for every 10% increase in the mean ESG score, the value loss due to the CEPI declines by 47.5% (= 4.075×10%×0.021/0.018). This suggests that corporate ESG engagement does buffer negative shock from government

Table 3. The moderating effects of ESG performance.

Variables	(1) Return	(2) CAR	(3) Return	(4) CAR
Onsite	−0.065***	−0.103***	−0.064***	−0.105***
	(0.018)	(0.017)	(0.017)	(0.017)
HZ_ESG	0.001	0.003	0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.002)
HZ_ESG×Onsite	0.013***	0.021***	0.013***	0.022***
	(0.005)	(0.005)	(0.004)	(0.004)
Lnmv			−0.002	0.014***
			(0.002)	(0.002)
Longdebt			0.000	0.038
			(0.021)	(0.032)
Shortdebt			0.001	0.029*
			(0.012)	(0.016)
Cash			−0.020	−0.009
			(0.017)	(0.024)
Profitability			−0.001	−0.005
			(0.003)	(0.006)
BM			0.020*	0.033***
			(0.011)	(0.012)
Momentum			−0.006	0.001
			(0.004)	(0.005)
Idiosyncratic			−4.979**	−9.132***
			(2.276)	(2.340)
Industry FE	Yes	Yes	Yes	Yes
Factor Loadings	Yes	Yes	Yes	Yes
Obs.	2226	2226	2226	2226
R^2	0.112	0.081	0.119	0.116

This table reports the results of the moderating effects of ESG performance. The dependent variables are firm-level stock returns (raw returns *Return* and cumulative abnormal returns *CAR*). *Onsite* is a dummy variable for firms in the treatment group, and during the onsite period (July 12 to August 19, 2016). HuaZheng's ESG rating in 2015 (*HZ_ESG*) is used to measure corporate ESG performance. All specifications control for Fama – French three factors and the momentum factor, as well as two-digit industry fixed effects. Standard errors clustered at the province level are in brackets. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively. All variables are defined in Table A2.

environmental regulations, i.e. Hypothesis 2 is verified. This could be due to the fact that ESG provides an 'insurance-like' protection or moral capital for firms, thus gaining sympathy and support from the government (Benabou and Tirole 2010; Godfrey 2005). We will verify this further in the mechanism analyses.

Robustness tests

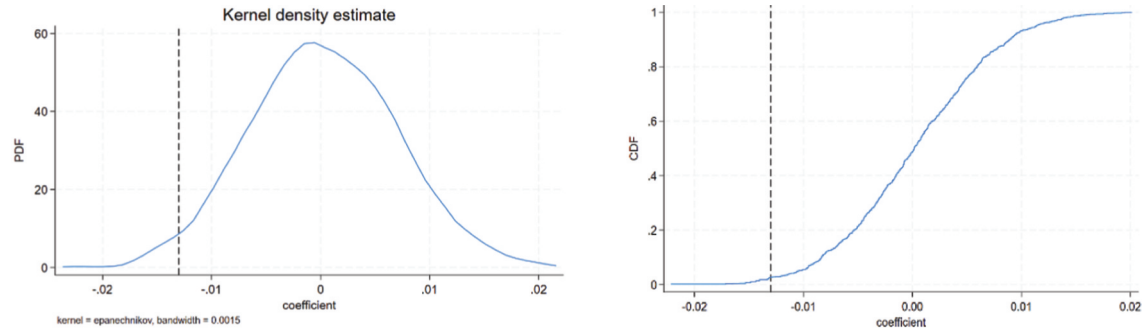
We further conduct several robustness tests. First, we perform a balance test to examine whether the characteristics of firms in the treatment and control groups are balanced ex ante (see Table B1). Second, we adopt two alternative ESG ratings (see Table B2) and two alternative estimation windows to compute new CARs (see Table B3). Third, the propensity score matching (PSM) analysis (see appendix B4).

Finally, we perform two sets of placebo tests, using false treatment firms and false treatment time, respectively. First, we randomly select 232 firms out of the total 1113 firms as the 'false' treatment group, and use this 'false' treatment group to perform the OLS regression defined in Eq. (1) and repeat this process 1000 times. The PDF and CDF for the 'false' coefficients of *Onsite* are depicted in Figure 4. Figure 4(a) shows results using raw returns (*Return*) as the dependent variable, and Figure 4(b) presents results using *CAR* as the dependent variable. The PDF figures are close to a normal distribution with zero mean, and the actual estimates are in the tail of CDF figures. Thus, we believe that our results are robust.

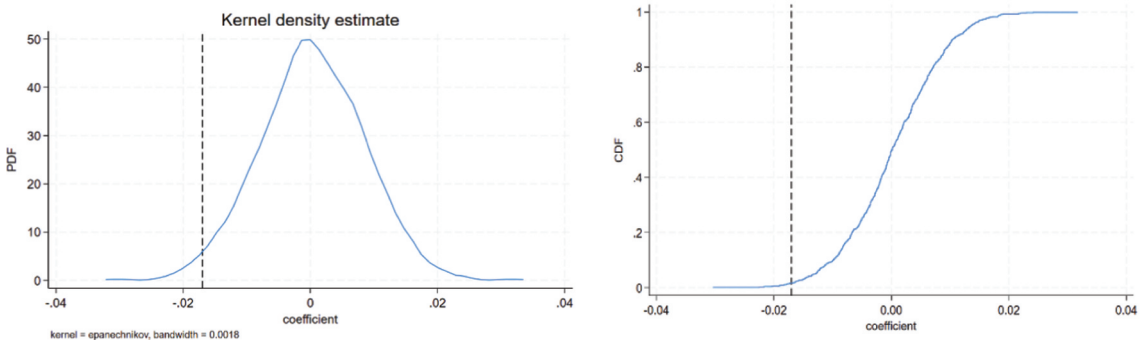
Second, we use one year prior to the actual onsite date as the 'false' treatment time. We recalculate the raw stock returns (*Return_False*) and CARs (*CAR_False*) based on the 'false' treatment time, then repeat the benchmark regressions. Table 4 report the results. All the coefficients we interested in are insignificant, which is in line with our expectations.

Mechanism analyses

Although the existing literature (e.g. Godfrey 2005; Godfrey, Merrill, and Hansen 2009) highlights the



(a): The PDF and CDF using raw returns as the dependent variable



(b): The PDF and CDF using CARs as the dependent variable

Figure 4. Placebo tests. This figure depicts the PDF and CDF of 1000 falsification estimates. The figures on the left show the CDF, and figures on the right present the PDF. The vertical line represents the actual estimates.

Table 4. Placebo test: 'false' treatment time.

Variables	(1) Return_False	(2) CAR_False	(3) Return_False	(4) CAR_False
Onsite	0.002	−0.011	0.100	0.036
	(0.016)	(0.014)	(0.097)	(0.070)
HZ_ESG			0.014***	0.011
			(0.004)	(0.007)
HZ_ESG×Onsite			−0.025	−0.008
			(0.021)	(0.016)
Controls	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Factor Loadings	Yes	Yes	Yes	Yes
Obs.	2032	1983	2032	1983
R^2	0.658	0.329	0.653	0.036

This table reports the results of placebo test, using 'false' treatment time (one year prior to the actual date). The dependent variables are firm-level stock returns (raw returns *Return* and cumulative abnormal returns *CAR*). *Onsite* is a dummy variable for firms in the treatment group, and during the 'false' onsite period (July 12 to August 19, 2015). HuaZheng's ESG rating in 2015 (HZ_ESG) is used to measure corporate ESG performance. All specifications include firm-level control variables, Fama – French three factors and the momentum factor, as well as two-digit industry fixed effects. Standard errors are in brackets. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively. All variables are defined in Table A2.

'insurance-like' nature of ESG/CSR, the mechanisms behind it have not been thoroughly explored. Benabou and Tirole (2010) conjecture that ESG/CSR could be a means of placating regulators and public opinion to avoid strict supervision. However, there is little literature to examine their conjecture. In this section, we explore the mechanism by which ESG buffers environmental regulatory risk from the perspective of placating the government and placating the public, respectively.

First, we hypothesize that if ESG placates regulators, then the moderating effect of ESG should be more pronounced where government intervention is greater. We divide our sample into two groups based on the government intervention index

calculated by G. Fan, Wang, and Zhu (2011). The results are presented in the first two columns of Table 5, where the ESG engagement only plays the moderating role in the high government intervention group, which implies that ESG placates regulators, thus mitigate the negative effects of environmental regulation.

Second, we focus on the role of public opinion (i.e. public environmental attention). We conjecture that if ESG placates public opinion, then the moderating effect of ESG will be more pronounced where public concern is stronger. We identify public environmental attention through the Baidu search index, which is commonly used in the literature (e.g. Campante, Chor, and Li 2023; Zheng et al. 2023). We obtain the Baidu search index for the keyword 'environmental pollution' in each city in 2015, and divide the sample into two groups based on the mean value of the search index. The results are reported in the last two columns of Table 5, where the ESG engagement only plays the moderating role in the low environmental attention group. The above results show that in China, ESG only placate regulators rather than public opinion.

Additional analyses

In this section, we try to explore what happens when the inspection teams leave? To do this, we add a new time period for analyses, which is the month after the inspection teams leave (August 20 to 19 September 2016). The dummy variable $Post_{it}$ equals one if firm i is in the treatment group and the time period is after the inspection teams leave. Table 6 presents the results. We find that when inspection teams leave, the stock price rallies. This suggests that when the first batch of CEPI takes place, the capital market regards it as a campaign style inspection.

Next, we consider the heterogeneity of ESG engagement. Just the same as before, we categorize firms with ESG ratings greater than or equal to B/4 in 2015 into the high ESG group, and the rests are in the low ESG group. Table 7 report the results. We find that the rally in stock prices after the inspection teams leave only occurs in the high ESG group, while the CARs of the low ESG group remain almost unchanged. This suggests that ESG engagement can not only provide moderating effects while the inspection teams are onsite, but can still perform similar effects after the inspection teams leave, and ESG increases the resilience for companies.

V. Conclusion

This paper examines the role of ESG engagement in mitigating corporate stock price volatility due to environmental regulation risk, using the sample of Chinese industrial listed companies. How to achieve sustainable development has become a common concern around the world, especially for developing countries that generate substantial pollution. Therefore, our study, based on empirical

Table 5. Mechanism analyses.

	(1)	(2)	(3)	(4)
Sample	High Government Intervention	Low Government Intervention	High Environmental Attention	Low Environmental Attention
Variables	Return	Return	Return	Return
Onsite	−0.071***	−0.005	−0.046	−0.072***
	(0.015)	(0.075)	(0.048)	(0.018)
HZ_ESG	0.001	−0.002	0.000	0.001
	(0.002)	(0.003)	(0.002)	(0.002)
HZ_ESG×Onsite	0.014***	−0.002	0.006	0.016***
	(0.004)	(0.018)	(0.012)	(0.005)
Controls	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Factor Loadings	Yes	Yes	Yes	Yes
Obs.	674	1552	970	1256
R^2	0.173	0.128	0.126	0.151

This table reports the results of mechanism analyses. We measure government intervention through the government intervention index calculated by G. Fan, Wang, and Zhu (2011). Column (1) consists firms located in high government intervention cities, while column (2) includes the rest. We measure public environmental attention through the Baidu search index (keyword is 'environmental pollution') in each city in 2015. Column (3) includes firms located in high environmental attention cities, while column (4) contains the rest. The dependent variables are raw returns (*Return*). *Onsite* is a dummy variable for firms in the treatment group, and during the onsite period (July 12 to August 19, 2016). HuaZheng's ESG rating in 2015 (HZ_ESG) is used to measure corporate ESG performance. All specifications include firm-level control variables, Fama – French three factors and the momentum factor, as well as two-digit industry fixed effects. Standard errors are in brackets. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively. All variables are defined in Table A2.

Table 6. Stock market reactions after the inspection teams leave.

Variables	(1) Return	(2) CAR
Onsite	−0.014***	−0.018***
	(0.005)	(0.006)
Post	0.015***	0.013**
	(0.004)	(0.005)
Controls	Yes	Yes
Industry FE	Yes	Yes
Factor Loadings	Yes	Yes
Obs.	3331	3331
R^2	0.140	0.079

This table reports the stock market reactions after the inspection teams leave. The dependent variables are firm-level stock returns (raw returns *Return* and cumulative abnormal returns *CAR*). *Onsite* is a dummy variable for firms in the treatment group, and during the onsite period (July 12 to August 19, 2016). *Post* is a dummy variable for firms in the treatment group, and during the post period (August 20 to September 19, 2016). All specifications include firm-level control variables, Fama – French three factors and the momentum factor, as well as two-digit industry fixed effects. Standard errors are in brackets. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively. All variables are defined in Table A2.

Table 7. The heterogeneity effects of the CEPI on stock returns after the inspection teams leave.

Sample Variables	(1) High ESG CAR	(2) Low ESG CAR
Onsite	−0.007	−0.042***
	(0.010)	(0.015)
Post	0.017***	0.007
	(0.005)	(0.011)
Controls	Yes	Yes
Industry FE	Yes	Yes
Factor Loadings	Yes	Yes
Obs.	2542	789
R^2	0.090	0.135

This table reports the heterogeneity effects of the CEPI on stock returns after the inspection teams leave. The dependent variables are firm-level stock returns (raw returns *Return* and cumulative abnormal returns *CAR*). *Onsite* is a dummy variable for firms in the treatment group, and during the onsite period (July 12 to August 19, 2016). *Post* is a dummy variable for firms in the treatment group, and during the post period (August 20 to September 19, 2016). High ESG sample consists firms with ESG ratings greater than or equal to B/4 in 2015, and the low ESG groups includes the rest. Heavy-polluting sectors are defined based on the *Classified Management Directory of Environmental Protection Verification Industry of Listed Companies*. All specifications include firm-level control variables, Fama – French three factors and the momentum factor, as well as two-digit industry fixed effects. Standard errors are in brackets. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively. All variables are defined in Table A2.

research from China, the largest developing country, has important policy implications for sustainable development in other developing countries.

First, the government can reduce environmental pollution by forcing companies to increase ESG engagement through environmental regulations. In the last decade, ESG/CSR has become a mainstream business activity. However, for an emerging economy like China, the introduction of the ESG concept is relatively late, and many firms may not fully understand and engage in ESG activities. Our research shows that top-down environmental regulation screens out socially responsible firms, which indirectly push firms to engage more in ESG activities.

Second, from the perspective of firms, our study provides a solution for firms to enhance their resilience against regulatory risks. Since the vast majority of developing countries are usually characterized by weak laws and inadequate protection of property rights, companies are exposed to various governmental regulations, including environmental regulations. In such cases, companies could improve resilience through ESG engagement by acquiring more ethical capital or reputation to reduce negative shocks from various government regulations.

Third, from the perspective of the investors, our research proves the value role of investing in ESG portfolios. In the context of heightened uncertainty, particularly when confronted with the potential for frequent government regulations, ESG portfolios demonstrate greater resilience. Consequently, both investors with social preferences and those who are purely seeking to maximize returns should consider incorporating ESG factors into their portfolios.

Disclosure statement

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