State capital participation and corporate environmental engagement
Evidence from privately-controlled listed firms in China

Abstract:

Manuscript Type: Empirical

Research Question/Issue: This study investigates the impact of state capital participation (SCP) on the corporate environmental engagement (CEE) of privately controlled listed firms in China.

Research Findings/Insights: Using a sample of 20,133 firm-year observations from 2009 to 2021, we find that SCP significantly increases corporate expenditure on environmental protection, corporate environmental performance, and ESG ratings. Specifically, SCP increases environmental investment capacity and attracts more media coverage, online attention, and analysts' following, which leads to better environmental engagement. Further analyses show that after state shareholders exit privately controlled firms, CEE deteriorates, while private capital injection in state-owned firms have no significant impact on CEE. The positive effect of SCP is stronger in privately controlled firms with local government ownership, a larger number of state shareholders, longer state shareholder holding periods, those without politically connected managers, and firms operating in heavy pollution industries. Lastly, we show that minority government ownership reduces firm-level toxic emissions and enhances financial performance.

Theoretical/Academic Implications: We enrich the literature on the role of minority state ownership in corporate financial and environmental performance.

Practitioner/Policy Implications: In light of the escalating environmental concerns and the growing emphasis on corporate environmental responsibility, this study highlights the beneficial role of minority government ownership in driving environmental performance. By providing resources and attracting external scrutiny, government as a minority shareholder can significantly enhance environmental engagement of privately controlled firms.

Keywords: State Capital Participation, Minority Government Ownership, Environmental Engagement

1. Introduction

Amidst the looming ecological imbalance and the impending peril of global warming, environmental protection garners growing awareness. While existing literature has explored the influence of various corporate insiders and external stakeholders on corporate environmental engagement (e.g., Dixon-Fowler, Ellstrand, and Johnson, 2017; Wang, Wijen, and Heugens, 2018; Kong et al., 2023), the impact of heterogeneous shareholders remains largely underexplored. Economic theory posits that the private sector seeks profit maximization, while the public sector may address market failures, such as environmental pollution (Benabou and Tirole, 2009). While empirical studies confirm that state-owned enterprises (SOEs) are more responsive to environmental issues (Hsu, Liang, and Mato, 2021; Cheng, Li, Qiu, and Xiong, 2023), the increasing trend of state capital injection into private firms in various countries[1] raises a critical question: How does state capital participation (SCP) influence the environmental engagement of privately controlled firms?

Theoretically, the impact of SCP on corporate environmental engagement (CEE) is uncertain. In accordance with resource dependence theory, SCP can facilitate access to crucial resources, such as regulatory benefits, privileged information, government subsidies, and bank loans (e.g., Nguyen, Do, Le, 2021; Zhou, 2013). This expanded resource base empowers firms to invest more heavily in environmental initiatives. In addition, the broader stakeholder base and heightened external monitoring associated with SCP can motivate managers to prioritize environmental and social goals (Daily et al., 2003; David, et al., 1998). State capital is often expected to fulfill social and environmental responsibility, making them subject to greater public scrutiny, especially when they deviate from these expectations (Huang et al., 2020; Hsu, Liang, and Matos, 2021). This heightened scrutiny can indirectly pressure privately controlled firms to

[1] The phenomenon of state capital injection into private firms, where government-owned entities or funds invest in private enterprises, is common in various countries. For example, France has a long tradition of state intervention in the economy, particularly through Bpifrance, a public investment bank that holds stakes in private companies. The German government has used KfW, a state-owned development bank, to invest in private firms, particularly during times of economic distress or when strategic industries are involved. The Indian government has employed state-owned entities and sovereign wealth funds to inject capital into private firms, especially in sectors like telecommunications, infrastructure, and finance. In Brazil, BNDES (Brazilian Development Bank) is often involved in providing capital to private firms, particularly in strategic sectors like energy, agriculture, and infrastructure.

adopt more environmentally responsible practices. Based on these theoretical underpinnings, SCP is likely to promote CEE.

On the other hand, SCP might strengthen political ties between private firms and the government through state ownership, potentially leading to regulatory forbearance. Previous studies suggest that politically connected managers could shield firms from investigations and legal repercussions (Xiao and Shen, 2022; Correia, 2014). These political connections may reduce the perceived costs of non-compliance, reducing the incentive for firms to invest in costly green technologies and, consequently, their overall environmental engagement. As a result, the impact of SCP on CEE requires further empirical investigation.

China provides an interesting context to examine the relationship between SCP and CEE for the following reasons. First, China has undertaken extensive mixed-ownership reform initiatives. Its rapid economic growth has been fostered by mixed-ownership reforms encompassing both the privatization of state-owned enterprises (SOEs) and a distinctive "reverse mix" approach wherein state capital actively engages in privately controlled firms. Despite the extensive discussions on the privatization of Chinese SOEs, the reverse mixed reform, involving the injection of state capital in private enterprises, has not gained adequate attention. Second, China's remarkable economic expansion, as the world's largest developing nation, has come at a cost to its environment. Evidence shows that China's air pollution[2] and industrial wastewater which exceeds the World Health Organization's health standards, results in significant detrimental effects on residents' lives, including poorer health outcomes, rising medical costs, lower social well-being and quality of life perceptions, and higher crime (Wu et al., 2020; He, Wang, and Zhang, 2020). Consequently, investigating whether the state can enhance firms' environmental commitment is of great theoretical and practical significance.

Using a sample of 20,133 firm-year observations in Chinese A-share markets from 2009 to 2021, we find a positive effect of SCP on CEE, indicated by expenditures on

[2] Air pollution measured by inhalable fine particular matter ($PM_{2.5}$) ranks China fourth from the bottom of 180 countries (epi.yale.edu)

environmental protection, environmental performance index, and ESG ratings. Specifically, companies with SCP allocate 0.3% more of their budget to environmental expenditure compared to those without SCP, which equates to approximately 20% of the average environmental expenditure. To ensure the reliability of our results and mitigate potential endogeneity concerns, we employ a range of robustness tests, including predictive analysis, an instrumental variable (IV) approach, propensity score matching (PSM), double machine learning, different fixed effects, alternative measures and models, and additional controls for contemporaneous events including the *Environmental Protection Law* and the regional environmental inspections.

Furthermore, our analysis shows that SCP promotes corporate environmental engagement through enhanced environmental investment capacity and increased external monitoring. By alleviating financial constraints, SCP empowers firms to allocate greater resources towards environmental initiatives. This finding aligns with resource dependence theory, which underscores the resource-intensive nature of environmental activities. SCP also attracts more media coverage, online attention, and analyst scrutiny. This intensified external monitoring incentivizes firms to prioritize environmental considerations. Our heterogeneity analyses reveal that the positive impact of SCP on CEE is more pronounced in firms with local government ownership, a larger number of state owners, longer state ownership holding periods, firms without politically connected managers, and those in heavily polluting industries.

We further reveal that participation of non-state capital in SOEs does not yield a significant effect on CEE, suggesting that it is not the presence of diverse shareholders that drives the improvement in firms' environmental engagement. Instead, the results confirm that state capital demonstrates strong social responsibility and a great commitment to environmental activism (Hsu, Liang, and Matos, 2021). Furthermore, we assess the influence of SCP on pollution reduction and financial performance outcomes. Our analysis reveals that SCP reduces firm-level pollution emissions and has net positive effects on firm profitability of privately controlled firms, suggesting that the benefits of government minority ownership (i.e., access to finance, public monitoring) outweigh its costs (i.e., government entrenchment, lower efficiency).

This study adds to the existing literature in the following ways. First, we contribute to the literature on the role of state ownership in corporate performance (e..g., Megginson and Netter, 2001; Hsu et al., 2021). The classic literature focuses mainly on the effect of controlling state ownership and privatization (e.g., Eaton and Kostka, 2017; Huang et al., 2017; Pan et al., 2020). Recent studies have scrutinized the determinants of SCP and its economic implications (Dong and Liu, 2022; Kong and Wang, 2016; Huang et al., 2021; Jiang, Yuan, and Yang, 2023). Our study extends the findings of Hsu et al. (2021) and Jiang et al. (2023) by investigating the spillover effects of state-owned capital on the environmental engagement of privately controlled firms. Different from Hsu et al. (2021) who highlights the superior environmental performance of state-owned enterprises, our research explores the effect of minority state-owned ownership in affecting environmental engagement of privately controlled firms. While Jiang et al. (2023) focuses on direct pollutant emissions, our study delves into the broader impact of firm's commitment to green development and environmental engagement. By focusing on listed firms, we benefit from a richer database, including time-series data on controlling shareholders, enabling us to controlling for changes in ownership structure post-SCP. Additionally, listed firms are subject to greater public and external scrutiny from analysts, investors, and researchers. This study uses a sample of privately-controlled listed firms and finds that minority state ownership promotes both financial and environmental engagements due to better access to finance and improved external scrutiny.

Second, we contribute to the growing literature on corporate environmental activities. Existing studies have examined the effects of firm characteristics (Hsu, Liang, and Matos, 2021; Borghesi, Houston, and Naranjo, 2014; Drempetic, Klein, and Zwergel, 2019), board characteristics (Homroy and Slechten, 2019; Dixon-Fowler, Ellstrand, and Johnson, 2017), institutional investors (Dyck et al., 2019), employee shareholding (Kong et al., 2023; Jiang et al., 2021), and administrative hierarchy (Wang, Wijen, and Heugens, 2018; Zhang et al., 2019) on corporate environmental involvement. Hsu, Liang, and Matos (2021) document that SOEs have high environmental sensitivity. Our study enriches the role of state-owned capital as minority shareholders in corporate

environmental activities.

Third, we contribute to a broader understanding of the interplay between mixed-ownership reforms and environmental factors, thereby providing valuable guidance for sustainable decision-making in various contexts. As environmental concerns escalate and corporate environmental responsibility gains importance, this study explores how minority government ownership can encourage private firms to adopt more sustainable practices.

2. Background and hypothesis development

2.1. Institutional background

During their early development, SOEs underwent various phases of decentralization, profit concessions, profit-to-tax conversion, and contracting in China. Despite the Chinese central government's explicit proposal in 1993 to establish a modern enterprise system within SOEs, the implementation of SOE reforms faced obstacles due to prevailing theoretical and conceptual differences. By 1996, Huang et al. (2017) discovered that one-third of SOEs were experiencing financial losses. In 1997, China initiated a comprehensive privatization reform of SOEs with the aim of revitalizing underperforming entities. However, this extensive reform resulted in significant unemployment and the depletion of state assets, sparking extensive debates surrounding the advantages and disadvantages of the reform.

The SCP includes both the governments' acquisition of previously privatized firms and their acquisition of minority shares in private firms. The primary objective of the former type is to maintain social stability and control over key industries. The second type aims to improve the financing environment, boost economic vitality, and forge strategic alliances in the private sector (Kong and Wang, 2016). Around the year 2000, there was a notable shift in China's privatization of state-owned enterprises (SOEs), commonly referred to as "the advance of the state and the retreat of the people." This reversal trend gained momentum. According to Huang et al. (2021), nearly one-quarter of previously privatized SOEs regained SCP between 1998 and 2007. In our sample of privately controlled listed firms during the period of 2009 and 2021, approximately

44.2% received SCP.

Following nearly two decades of industrialization, China's rapid economic growth has been accompanied by the pressing challenge of various environmental issues. Prior research (Huang et al., 2020; Hsu et al., 2021; Jiang et al., 2023) indicates that SOEs are more likely to comply with the local government's environmental regulations. Drawing from this observation, it can be inferred that private firms with and without SCP may exhibit significant differences in their levels of environmental commitment.

2.2. SCP and corporate environment participation

Prior studies have primarily focused on the role of the state as controlling shareholders in corporate environment performance. On the one hand, SOEs possess resource advantages, face less liquidity constraints, and exhibit greater capacity for environmental investments (Calza, Profumo, and Tutore, 2016; Li et al., 2018). Additionally, the stricter government regulations imposed on SOEs compel them to adhere to environmental governance systems, leading to an increased likelihood of environmental information disclosure and a greater willingness to bear pollution prevention costs compared to non-SOEs (Luo, Wang, and Zhang, 2017; Hsu, Liang, and Matos, 2021). On the other hand, SOEs that have multiple social objectives may be more likely to prioritize economic development over environmental protection (Wang, Wijen, and Heugens, 2018; Pan et al., 2020). Furthermore, SOEs hold greater environmental bargaining power and face lower penalties for violations. Combined with the pressure government officials face for economic growth, this may lead to the neglect of environmental issues, resulting in a lack of incentive for SOEs to engage in environmental initiatives and consequently reducing their overall environmental participation (Eaton and Kostka, 2017; Andersson, Opper, and Khalid, 2018).

Based on the aforementioned arguments, we posit that SCP in privately controlled firms might also exert positive and negative influences on their environmental engagement. On the positive side, SCP can enhance corporate environmental performance through two key mechanisms. First, by establishing political connections for private enterprises, SCP reduces the rent-seeking behavior of majority shareholders to build political ties. This, in turn, increases the financial resources available to firms

for investment in environmental initiatives (Xiao and Shen, 2022; Faccio, Masulis, and McConnell, 2006). At the same time, SCP provides privately controlled firms with government connections and credit support based on property rights, leading to a signaling effect that amplifies commercial credit financing and access to bank funds (Calza, Profumo, and Tutore, 2016; Li et al., 2018; Jiang et al., 2023). Furthermore, SCP builds a bridge between the private sector and the government, increasing the availability of tax incentives and government subsidies (Cheng et al., 2017; Xiao and Shen, 2022). By reducing the financial constraints of privately controlled firms, SCP might bolster firms' capacity for environmental investment, thereby advancing their engagement in environmental endeavors.

Second, SCP in privately controlled firms marks a crucial milestone in China's economic system reform and has garnered significant attention from both the government and the industry. The 20th Congress report of the Communist Party of China explicitly emphasizes the unwavering encouragement, support, and guidance for the development of the non-public sector economy, while emphasizing the decisive role of the market in resource allocation and the enhanced role of the government (CPCC, 20th Congress Report). Consequently, the mixed ownership reform, as a vital instrument for promoting the high-quality development of China's economy, holds a prominent position within the capital market and typically attracts substantial media coverage and the attention of numerous analysts. Moreover, state-owned capital, due to its distinctive nature, often garners stronger network attention and draws the focus of institutional investors (Luo et al., 2017). Hence, the SCP brings about increased monitoring pressure on participating companies. In the current global context, where pollution poses a threat to the balance of the world's ecosystem, there is widespread concern for the environment (Kong et al., 2023). This heightened environmental awareness, coupled with the increased monitoring pressure, might strengthen the motivation for participating enterprises to engage in environmental investment.

On the other hand, SCP might negatively affect corporate environmental engagement for the following reasons. First, firms with SCP might receive protection from investigation through their state shareholders. Research has shown that politically

connected companies have a lower likelihood of detection and enforcement of fraud, resulting in reduced penalties for misconduct (Correia, 2014; Kuang and Lee, 2017). SCP might facilitate companies in securing support from government officials and reduce the costs associated with polluting activities, owing to the inherent connections between the state-owned capital and the government. Local officials, driven by economic growth targets and employment pressures, may turn a blind eye to pollution from affiliated enterprises (Eaton and Kostka, 2017). Moreover, if the owner of the state-owned capital holds a higher political status, local officials may lack the incentive and capacity to regulate the implicated enterprises, thereby reducing firms' incentives to adopt environmental technologies (Eaton and Kostka, 2017; Andersson, Opper, and Khalid, 2018).

Based on the abovementioned arguments, we put forth the following two alternative hypotheses:

H1a: SCP increases the environmental engagement of privately controlled firms

H1b: SCP reduces the environmental engagement of privately contorlled firms

3. Research Design

3.1. Data and Sample

To mitigate the confounding effects of the 2008 financial crisis, we construct a sample of Chinese-listed companies from 2009 to 2021. We include firms whose controlling shareholders are private at the time of listing. To explore the impact of SCP on privately controlled firms, we exclude samples where controlling shareholders change after the SCP. In addition, we exclude firms from the financial and insurance industries and samples with missing observations. To mitigate the effect of extreme values, the continuous variables are winsorized at the 1st and 99th percentile. The final sample comprises 20,133 firm-year observations, covering 2,741 privately controlled companies listed on the Shenzhen and Shanghai stock exchanges.

Due to numerous gaps in the disclosure of equity ownership information for the top ten shareholders, we merge data from the *China Stock Market and Accounting Research* (CSMAR) and *RESET* databases. We also conduct manual searches on

websites such as *Tianyancha* to obtain information on shareholders and their corresponding control levels which cannot be determined solely based on the nature of the shareholders. This approach allows us to collate comprehensive data on the ownership percentage of the top ten shareholders. The financial data comes from the *CSMAR* database, and the data for calculating the corporate environmental performance are obtained from the *Wind* (Wind), *CSMAR*, and *Chinese Research Data Services* (CNRDS) databases. The ESG ratings are from *Huazheng*, a leading ESG data provider in China.

3.2. Variable construction

3.2.1. Corporate environmental engagement (CEE)

To assess corporate environmental engagement, we constructed the following three indicators. First, the environmental protection expenditure (*EXP)*, is defined as the ratio of a firm's environmental expenditures to its total assets at the beginning of the year. Following Zhang, Yu, and Kong (2019) and Kong et al. (2023), we aggregate corporate environment-related expenditures (including cleaning fees and sewage charges) from the income statement overhead to corporate environmental protection expenditures.

The second indicator is the environmental performance index (*INDEX*), which includes four specific aspects: environmental disclosure index (*DISCLOSURE*), environmental awareness index (*AWARENESS*), green emissions index (*EMISSION*), and environmental investment index (*INVEST*) (Yao et al., 2022). A detailed definition of these four indices is presented in Appendix A. Both *DISCLOSURE* and *AWARENESS* indicate the strategic intent, whereas *EMISSION* accesses the environmental performance from an output perspective.[3] *INVEST* focuses on the company's efforts and investments in promoting energy efficiency and sustainable energy use, providing insights into its environmental performance from an input perspective. *INDEX* is computed as the equal-weighted average of the four sub-indicators.

[3] Since the environmental performance index includes both the environmental inputs and outputs, we examine the impact of SCP on different aspects of the *INDEX* separately in Appendix B. The results show that SCP has positive effects on both sides.

The third measure is derived from the *Huazheng* ESG rating (*ESG)*. Environmental engagement is an influential domain in the assessment of corporate ESG. China's ESG rating system commenced its development later compared to others and is still in the process of establishing a unified standard. Presently, notable ESG rating agencies in China consist of *Huazheng*, *China Bond*, *WIND ESG*, and *SynTao Green Finance*. Among these agencies, *Huazheng* ESG rating emerged as the earliest in development, maintaining the highest coverage rate consistently through time and providing quarterly updates.[4] *Huazheng*'s ESG ratings are classified into nine levels, C, CC, CCC, B, BB, BBB, A, AA, and AAA.[5] Following Anderson, Mansi, and Reeb (2004), we use a conversion process to define *ESG*, where C has a value of 1 and AAA has a value of 9.

3.2.2. SCP in private enterprises

Following Bharath, Jayaraman, and Nagar (2013) and Chen et al. (2019), we construct the following two indicators to measure the SCP in privately controlled listed firms: (1) *STATE*, a dummy variable that takes the value of 1 if a company has state-owned capital among its top ten shareholders in that year, and 0 otherwise.[6] (2) *RATE*, a continuous variable that refers to the cumulative percentage of state-owned shares in a company's top ten shareholders.

3.2.3. Control Variables

Following prior literature (e.g., Kong et al., 2023; Xiao and Shen, 2022; Yao et al., 2022), we control for a set of firm-level characteristics, including firm size (*SIZE*), financial leverage (*LEV*), fixed assets (*PPE*), cash holdings (*CASH*), Tobin's Q (*TQ*), return on assets (*ROA*), operating income growth rate (*GROWTH*), company age (*AGE*), high-quality audit (*BIG4*), CEO dual (*DUAL*), institutional investors' shareholding

[4] *Huazheng* ESG rating system employs various criteria and indicators to evaluate companies' ESG performance. These criteria typically include environmental impact, such as resource usage, pollution control, and carbon emissions; social responsibility, including employee welfare, community engagement, and human rights practices; and governance practices, such as board structure, transparency, and risk management (as shown in Appendix C).

[5] Considering that the starting time of the ESG availability of the SynTao Green Finance is 2015, this paper mainly selects the *Huazheng* ESG data, and in the unreported results, we use the ESG data of the SynTao Green Finance to test the results, and the conclusions still hold true.

[6] To further ensure the robustness of our conclusions, we construct two dummy variables *DSOE5* and *DSOE10*, which take the value of 1 if there is a large state-owned shareholder with more than 5% and 10% of the company's top ten shareholders in the current year, and 0 otherwise. The results are presented in Section 4.3.3.

(*INST*), largest shareholding (*FIRST*), board size (*BSIZE*). Detailed definitions of all variables are contained in Appendix A.

3.3. Model specification

We estimate the impact of SCP on the environmental engagement of private firms using the following equation:

$$CEE_{it} = \beta_0 + \beta_1 STATE_{it}\ (RATE_{it}) + \gamma Z_{it} + INDUSTRY + YEAR + \varepsilon_{it} \quad (1)$$

where the dependent variable, CEE_{it} is proxied by environmental protection expenditures (EXP_{it}), environmental performance index ($INDEX_{it}$), and the *Huazheng* ESG ratings (ESG_{it}) [7]. Z_{it} is a set of firm-level variables, and ε_{it} is the error term. To mitigate time-invariant industry characteristics, as well as time-trend confounding effects, we control for industry fixed effects (*INDUSTRY*) and year effects (*YEAR*) in the model. Robust standard errors are clustered at the firm level to correct for firm-specific autocorrelation in the estimation errors.

3.4. Descriptive statistics

Table 1 reports the descriptive statistics. The statistics show that the mean value of the ratio of environmental expenditures to total assets (EXP_{it}) in our sample companies is 1.5%, which is consistent with Kong et al. (2023). The mean (median) value of *INDEX* is 0.172 (0.115), which is consistent with Yao et al. (2022). The average ESG rating per company in our sample is 3.968, with a median of 3. This indicates that the ESG scores in our sample are overall unbiased, aligning with Jiang et al. (2022). Regarding the control variables, the average debt to total assets (*LEV*) stands at 38.6%, while the average fixed asset ratio (*PPE*) is 18.8%. The average institutional investor shareholding (*INST*) is 36.2%, and the average shareholding of the largest shareholder (*FIRST)* is 31.7%. In addition, approximately 37.5% of the companies in our sample have the same chairman and CEO (*DUAL*). Overall, these variables demonstrate substantial consistency with the statistics reported by Jiang et al. (2021), Jiang et al.

[7] We also follow Jiang et al. (2023) and use the natural logarithm of the environmental responsibility score from the Huazheng ESG ratings as an alternative measure for CEE. The results are qualitatively the same and available from the authors upon request.

(2022), and Kong et al. (2023).

[Insert table 1 about here]

4. Empirical results

4.1 Baseline results

Table 2 presents the estimation results for Eq. (1). Panel A uses *STATE* as a proxy for SCP. The dependent variable in columns (1) and (2) is *EXP*. As shown in column (2), the estimated coefficient of *STATE* is 0.003 and significant at the 10% level when control variables are included. This indicates that environmental expenditure is 0.3% higher for companies with SCP than those without SCP, which is equivalent to approximately 20% (0.003 divided by *EXP* mean of 0.015) of the average value (91.8 million RMB in environmental expenditure). The dependent variable in columns (3) and (4) is *INDEX*. The coefficient of *STATE* is again positive and significant. In column (4), for example, the estimated coefficient of *STATE* is 0.022 and significant at the 1% level, indicating that the environmental performance of firms is on average 12.79% higher for private companies with state ownership. Column (5) and column (6) present the results when *ESG* is used as a proxy for *CEE*. In column (6), for example, the estimated coefficient of *STATE* is 0.064, and significant at the 1% level, suggesting that SCP leads to an average increase in a company's ESG rating of 0.064 compared to companies without state capital participation.

Panel B reports the results when using cumulative state ownership (*RATE*) as an alternative proxy for SCP. Column (2) shows that when including all control variables, the estimated coefficient of *RATE* is 0.048 and significant at the 1% level, indicating that for a one-standard-deviation increase in the shareholding of the state capital, the company's environmental protection expenditure (*EXP*) increases by 0.259% (0.048*0.054). Columns (3) and (4) use *INDEX* as the dependent variable and the coefficients of *RATE* remain significant and positive. The results are also economically significant. Column (4) shows that the estimated coefficient of *RATE* is 0.065, indicating that for every one-standard-deviation increase in the proportion of state ownership, the environmental performance of the firm increases by 0.351% (0.065*0.054). Similarly, column (6) shows that the estimated coefficient of *RATE* is

1.147 and significantly positive at the 5% level when *ESG* is used as the dependent variable. The results suggest that for a one-standard-deviation increase in the cumulative shareholding of the state capital, a company's ESG rating increases by 0.062 (1.147*0.054). Overall, the results suggest that SCP increases the environmental engagement of the participated companies. Therefore, H1a is supported.

[Insert table 2 about here]

4.2 Endogeneity concerns

We are aware that there might be endogeneity issues in this study. For example, state shareholders may select equity participation in companies with better environmental performance. To mitigate these concerns, we perform the predictive regressions and adopt a PSM and IV.

4.2.1 Predictive regressions

Given that state capital may rely on high levels of environmental engagement as a criterion to participate in private firms, this may reduce the accuracy of the main findings. Following Li, Li, and Yang (2022), we lag the CEE of private firms by one year and examine its effect on *STATE* and *RATE*.

Panel A of Table 3 reports the predictive regression results. In columns (1)-(3), *STATE* is used as the dependent variable,[8] and columns (4)-(6) use *RATE* as the dependent variable. *EXP*, *INDEX*, and *ESG* are used as explanatory variables, respectively. We find that none of their estimated coefficients are significant, suggesting that the CEE of private firms does not significantly affect whether state capital participates in private firms. Therefore, this may, to some extent, alleviate our concerns about reverse causality.

4.2.2 An IV approach

To further address endogeneity concerns, we perform two-stage least squares (2SLS) regression with an instrumental variable. As an instrument, we use the proportion of local state-owned firms to total listed companies within a province (*P_STATE*) . This instrument is plausible as a higher proportion of state-owned firms

[8] Considering that *STATE* is a dummy variable, columns (1)-(3) report estimates from Probit regressions.

in a region is likely to increase the likelihood of state-owned entities investing in private enterprises. However, it is unlikely to directly influence a private firm's environmental engagement, making *P_STATE* a relatively exogenous instrument.

Panel B of Table 3 reports the IV results. Columns (1) and (5) report the first stage results when *STATE* and *RATE* are used as the dependent variables, respectively. The negative and significant coefficients of *P_STATE* at the 1% level confirm that regions with higher proportion of state-owned firms are more likely to inject state capital in privately controlled firms. Columns (2)-(4) show that coefficients of the predicted value of *STATE* ($\widehat{STATE}$) are significantly positive at the 10% level or higher, suggesting that our main results are robust. Similarly, columns (6)-(8) use the $\widehat{RATE}$ as the key independent variable and find consistent results. Overall, the findings reinforce our argument that SCP can significantly enhance the CEE of privately controlled firms.

4.2.3 A PSM approach

It is possible that firms with and without SCP are significantly different in terms of their firm characteristics, and therefore exhibit different environment initiatives. To reduce bias in estimates of the treatment effect, we adopt a one-to-one nearest neighbor matching, where each treated subject is matched to an untreated subject with a similar propensity score without replacement based on the previous year's covariates.[9] Firms with SCP are treated as the treatment group, and companies that never had SCP as the control group. Following Li et al. (2023) and Zhang, Gu, and Wang (2023), we use the control variables in Eq. (1) as covariates to estimate the propensity scores. After matching, we obtained a total of 6,628 observations from the treatment and control groups. Panel C of Table 3 shows the regression results for the matched sample. The estimated coefficients of *STATE* and *RATE* are both positive and significant, suggesting that our results are robust to potential selection bias.

4.2.4 A double matching learning approach

[9] In Appendix D, we perform equilibrium tests by comparing the differences in covariates between the treatment and control groups. After matching, the covariates were found to be balanced, which suggests that the PSM approach was successful in balancing the firm characteristics between the treatment and control groups.

We further adopt a double machine learning approach to identify and correct for bias due to omitted variable bias or other forms of endogeneity in causal inference problems. Compared to traditional causal inference econometric models, double machine learning can achieve a higher precision in obtaining an effective set of control variables through various machine learning and regularization algorithms. This approach also avoids the 'curse of dimensionality' caused by redundant control variables, significantly alleviating estimation bias resulting from limited control variables (Bodory et al., 2022). Based on this, this paper employs a linear model using the random forest algorithm for predictive analysis. The results are presented in Panel D of Table 3. The positive and significant coefficients of *STATE* and *RATE* confirm that our baseline results are robust.

4.2.5 A first-difference model

We also adopt a first-difference model to address the issue of potential omitted variable bias and eliminate time-invariant unobserved heterogeneity. The results are presented in Panel E of Table 3. The coefficients of *ΔRATE* are positive and significant at the 10 percent level or higher, confirming that our baseline results are robust to potential omitted variable bias.

[Insert table 3 about here]

4.3 Other robustness tests

In this subsection, we provide additional robustness tests, including the removal of firms with voluntary CSR disclosure requirements, alternative measures for CEE and SCP, city fixed effects, and alternative models.

4.3.1 Excluding firms with voluntary CSR disclosure requirements

In the absence of disclosure requirements, companies are more likely to publish CSR reports when their ratings are high or mask poor CSR performance. This can bias our results upward, as there might be missing environmental rating data for companies with poor CSR scores. To eliminate this potential bias, we include only companies that are required to disclose their CSR reports for robustness. Since 2008, the Shanghai

Stock Exchange (SSE) and Shenzhen Stock Exchange (SZSE) have mandated some companies to disclose CSR reports annually. Specifically, the SSE requires the "corporate governance segment", overseas listed companies, and financial companies to disclose annual CSR reports. Meanwhile, the SZSE also requires companies of the SZSE 100 Index to disclosure their CSR reports annually.

Panel A of Table 4 reports the results of the subsample tests. The estimated coefficients of *STATE* and *RATE* remain significantly positive at the 10% level and above, which confirms that our results are robust.

4.3.2 Alternative measures

In this subsection, we adopt alternative measures for CEE and SCP. First, we follow Xiao and Shen (2022) and Kong et al. (2023) and use the corporate environmental protection score (*SCORE*), based on firms' environmental strength (*EP_STR*) and environmental concern (*EP_CON*),[10] as an alternative measure for *CEE*. The results are reported in columns (1) and (2) of Panel C, Table 7. We find that the estimated coefficients of *STATE* and *RATE* are significantly positive at the 1% level, suggesting that our results are robust to alternative CEE measures.

We next create two alternative variables for SCP, namely: (1) *DSOE5*, a dummy variable that takes the value of 1 if state capital comprises more than 5% shareholding of private enterprises, and 0 otherwise; (2) *DSOE10*, a dummy variable that takes the value of 1 if state capital consists of more than 10% shareholding of private enterprises, and 0 otherwise. Columns (3)-(8) of Panel C in Table 4 present the results. The coefficients of *DSOE5* and *DSOE10* are all positive and significant at the 1% level, with the coefficients of *DSOE5* larger than those of *STATE* in our baseline results presented in Table 2, and *DSOE10* is larger than *DSOE5*. As such, our results are robust to different measures of SCP and imply that a larger shareholding of state capital has a greater impact on *CEE*.

4.3.3 Controlling for city fixed effects

To ensure that our findings are not biased by economic development in different

[10] Details on what *EP_STR* and *EP_CON* represent are presented in Appendix E.

regions, we control for city-fixed effects in Eq. (1). Panel C of Table 4 shows that our findings are still significant after controlling for city-fixed effects. This means that the increase in environmental participation of firms with SCP is not due to regional economic development.

4.3.4 Alternative models

One potential concern with our OLS regression is that it assumes that the dependent variables are normally distributed, which is not the case as there are numerous zeros in our main measures of CEE (*EXP, INDEX*, and *ESG*). Therefore, the OLS regression may not be able to correctly estimate the marginal effects of *STATE* and *RATE*. To mitigate this concern, we use Tobit and Poisson regressions as alternative estimation models (Belloc et al., 2016) and report the results in Panel D of Table 4. The positive and significant coefficients of *STATE* and *RATE* reinforce our main argument that SCP improves the environmental engagement of privately controlled firms.

4.3.5 Controlling for contemporaneous events

The positive effect of SCP on CEE might be a result of the 2015 *Environmental Protection Law* and the environmental inspections conducted by the Ministry of Ecology and Environment of the People's Republic of China since 2016. The Environmental Protection Law has increased the cost of polluting for enterprises and held local governments accountable for implementing environmental policies. Meanwhile, the environmental inspections have intensified the central government's monitoring and supervision of firms' pollution levels and compliance with environmental laws. Both are likely to boost firms' environmental initiatives. To rule out the potential effects of these two events on CEE, we first create the following two dummy variables: (1) *ELAW* which equals 1 for the years after 2015, and 0 otherwise, (2) *INSPECTION*, which equals 1 for the cities that were inspected during the first round of inspections which occurred between 2016 and 2017, and 0 otherwise. Then we include these two variables in Eq. (1) and rerun the regressions.

The results are presented in Panel E of Table 4. The coefficients of *ELAW* and *INSPECTION* are positive and significant at 5% or higher, suggesting that both events positively affect CEE. However, the coefficients of *STATE* and *RATE* remain

significantly positive suggesting our results are robust after controlling for the two contemporaneous events.

[Insert table 4 about here]

4.4 Potential channels

In this subsection, we explore two plausible channels through which the SCP increases private firms' environmental initiatives, including improved environment investment capacity (*EIC*) and increasing external monitoring pressure after the SCP.

4.4.1. Improved EIC

Environmental governance entails significant costs, including energy, labor, contracted services, and raw materials, permeating all aspects of corporate decision-making. Consequently, corporate environmental participation can be constrained by the capacity for environmental investment (Cheng et al., 2017). In China, private firms face pronounced financing constraints and struggle to obtain sufficient resources through market financing alone. On the one hand, SCP not only directly boosts private enterprises' cash flow through equity financing, but also enhances external financing by signaling and providing implicit guarantees, thereby improving the overall financing environment for private enterprises (Stiglitz and Weiss, 1981; Kong and Wang, 2016). On the other hand, SCP facilitates the establishment of political connections, thereby increasing government benefits received by private firms (Xiao and Shen, 2022). This, in turn, increases the resources available for improving environmental performance. Therefore, we posit that SCP enhances *CEE* by improving the *EIC* of private firms.

To test whether SCP increases a firm's *EIC*, we construct the following variables, including (1) trade credit (*CREDIT*), measured as the ratio of accounts payable to net assets of a company; (2) bank credit (*DEBT*), measured as the ratio of the sum of short-term and long-term borrowings to total assets of a company; (3) tax benefits (*TAXB*), measured as the ratio of tax refunds received to the sum of taxes paid by the enterprise; (4) government subsidies (*SUB*), measured as the ratio of government subsidies received by a company to total assets; (5) financing constraints as measured by the size and age-based index (*SA*) proposed by Hadlock and Pierce (2010).

Table 5 presents the results. The significant coefficients of *STATE* and *RATE* in

columns (1)-(5) of Panels A and B show that state capital injection increases trade credit financing, bank credit, tax benefits, and government subsidies, and eases financial constraints of private firms. Overall, the results confirm our arguments that state capital increases the environmental investment capacity of private firms, which in turn positively affects CEE.

[Insert table 5 about here]

4.4.2. Intensified monitoring

Recent studies have shown that influential entities such as media, analysts, and other stakeholders possess the ability to exert pressure, which affects corporate environmental engagement (Ang et al., 2020; Dong et al., 2021; Jia et al., 2016). The injection of state capital in private enterprises is a significant event in the capital market, often drawing media attention, increased analyst coverage, and investor interest. This heightened scrutiny places additional monitoring pressure on relevant firms, which might affect their environmental engagement (Kong and Wang, 2016). The increased external monitoring might lead to a greater willingness of private firms to engage in environmental initiatives, thereby resulting in better corporate environmental performance.

To test the abovementioned prediction, we first construct the following indicators: (1) the natural logarithm of the number of institutional site visits (*VISIT*); (2) Media attention (*MEDIA*), measured as the natural logarithm of the number of company-related posts in the stock bar (Ang et al., 2021); (3) Investor attention (*INTERNET*), proxied by the Baidu search index (Gao, Ren, and Zhang, 2020); (4) Analyst attention (*ANA*), measured as natural logarithm of the number of analysts following a company; and (5) Research reports (*REPORT*), natural logarithm of the number of research reports related to a company.

Table 6 presents the estimation results. Panels A and B show that state ownership injection increases the number of site visits by institutional shareholders, attracts more media and investor attention, has more analysts following, and more research reports. The results suggest that state ownership in private firms intensifies external monitoring,

thereby increasing their willingness to engage in environmental initiatives.[11]

[Insert table 6 about here]

5 Further analyses

In this section, we further examine the effect of characteristics of SCP (central vs. local government ownership, number of state shareholders, and stock holding period), heavy pollution industries, exits of state shareholders in privately controlled firms, and private capital injection in SOEs on corporate environmental initiatives. We also examine whether SCP affects environmental outcomes and financial performance of privately controlled firms.

5.1 Characteristics of SCP on CEE

This subsection uses a subsample of privately controlled firms with SCP to investigate the role of different state capital types, number of state shareholders among the top ten shareholders, and length of holding period in the environmental engagement of privately controlled firms.

While Hsu, Liang, and Matos (2021) show that central SOEs are more concerned with environmental issues, Eaton and Kostka (2017) find that central SOEs are responsible for a significant number of serious pollution incidents in China, and these SOEs often flout environmental regulations. In addition, local governments are often complicit in this behavior as they are eager to attract investment from SOEs, which can boost economic growth. To empirically examine whether local and central government ownership has different impacts on CEE, we create a dummy variable, *LOCAL*, that equals 1 if the state shareholders are all local government-controlled and 0 for firms that have at least one shareholder controlled by the central government. Then we replace *STATE* with *LOCAL* in Eq. (1). The results are presented in Panel A, Table 9. The positive and significant coefficients of *LOCAL* suggest that compared with private firms with central SCP, local SCP is associated with better CEE.

[11] Following the capital injection, state shareholders might also actively engage in the corporate governance of private enterprises through its position as an "other major shareholder". This involvement includes utilizing state-owned asset management companies to hold shares, appointing state-owned directors, and exercising veto power, consequently amplifying its role in environmental participation (Hao and Gong, 2017). Ideally, we would want test whether state shareholders also amplify internal monitoring and positively affect corporate environmental engagement, but unfortunately, we do not have the data.

In addition, the larger the number of state shareholders among the top ten shareholders of privately controlled firms, the greater influence these shareholders might have on corporate environmental initiatives. To test this argument, we create a variable *NUMBER* which measures the number of state shareholders among the top ten shareholders of privately controlled firms. Then we replace *STATE* with *NUMBER* in Eq. (1). The results are presented in Panel B, Table 9. The positive and significant coefficients of *NUMBER* suggest that the greater the number of state shareholders, the SCP is associated with better CEE.

Lastly, we test whether the holding period of state shareholders affects CEE. We first create a variable called *LENGTH* to measure the number of years between when state shareholders inject capital into privately controlled firms and when they exit from those firms (or the fiscal year if there is still state capital). Then we replace *STATE* with *LENGTH* in Eq. (1). The results are presented in Panel A, Table 7. The positive and significant coefficients of *LENGTH* suggest that the longer state shareholders hold their shares, the greater the impact the SCP has on the environmental initiatives of privately controlled firms.

[Insert table 7 about here]

5.2. The role of politically connected managers

The role of politically connected managers in influencing corporate environmental engagement is complex. On the one hand, research suggests that these managers can mitigate regulatory risks, potentially leading to decreased environmental investment (Correia, 2014; Xiao and Chen, 2022). On the other hand, they may also drive environmental disclosure and performance to enhance their career prospects and secure government support (Cheng et al., 2017; Lin et al., 2015). To empirically investigate how politically connected managers influence the relationship between SCP and CEE, we introduce a binary variable, PC, to identify CEOs or board chairmen with past or present government affiliations. We incorporate PC and its interaction with SCP proxies into our baseline model to re-run the analysis.

Table 8 reports the results. We find that the coefficient of *STATE*PC* and *RATE*PC* are negative and statistically significant in all columns except column (1),

suggesting that the positive impact of SCP on CEE is moderated by the presence of political connections. This confirms our hypothesis that political connections weaken the positive impact of SCP on CEE.

[Insert table 8 about here]

5.3 Impact of heavy pollution industries

We have shown that private firms with SCP have better access to financing and experience greater external monitoring and public scrutiny. Such conditions could enable (i.e. access to financing) and/or encourage (i.e. monitoring) more investment in corporate environmental engagement amongst heavy polluting industries which may provide greater incremental benefits from pollution reduction measures. Therefore, we posit that the positive impact of SCP on CEE is more pronounced in heavy pollution industries. Following Zhang et al. (2019) and Kong et al. (2023), we create a dummy variable, *HEAVY*, which equals 1 if a firm belongs to the polluting industries included in the "Listed Companies' Environmental Protection Industry Classification Management Directory" issued by the Chinese Ministry of Environmental Protection, and 0 otherwise. We include the interaction terms of *STATE* (*RATE*) and *HEAVY* in Eq. (1) and re-run the regression.

Table 9 reports the estimation results. The coefficients of *STATE*HEAVY* and *RATE*HEAVY* are positive and significant at 5% or above, consistent with our expectation that the positive effect of SCP is more prominent in heavy pollution industries.

[Insert table 9 about here]

5.4 Impact of private capital injection on the CEE of SOEs

The mixed ownership reform includes both the SCP in private enterprises and non-state-owned capital participation in SOEs. Prior studies have shown that the privatization of SOEs, where companies go from government-controlled to privately controlled, can improve their efficiency and competitiveness, leading to better financial performance (Guan et al., 2021; Tan and Tan, 2017; Genin, Tan, and Song, 2021). However, it is not clear whether private capital injection in SOEs affects CEE. To

answer this question, we follow Guan et al. (2021) and construct two indicators to measure non-state capital participation in SOEs: (1) the presence of non-state shareholders among the top ten shareholders of SOEs (*MIX*); and (2) the cumulative shareholding of non-state shareholders among the top ten shareholders of SOEs (*MIXRATE*). We retain a subsample of SOEs from 2009 to 2021 and obtain 12,233 firm-year observations.

Table 10 reports the impact of non-state capital participation on the *CEE* of SOEs. The estimated coefficients of *MIX* and *MIXRATE* are negative but insignificant in all columns (1), (2), (4), and (6), while positive and insignificant in columns (3) and (5). The results suggest that non-state capital participation does not have a significant impact on the environmental engagement of SOEs.

[Insert table 10 about here]

5.5 Impact of the SCP on environmental outcomes

Increased corporate environmental engagement does not necessarily mean that firms' environmental outcomes improve. For instance, a firm's investments in the environment (*EXP*) might not deliver expected gains, while the environmental performance index (*INDEX*) could be greenwashed, especially for the environmental disclosure and awareness components. In addition, ESG ratings can be improved by simply focusing on one or both of the social and governance aspects of the ratings. To rule out such possibilities, we examine whether environmental outcomes, as measured by corporate pollution emissions, improve following the SCP. Corporate pollutant emissions mainly include chemical oxygen demand and ammonia nitrogen emissions from industrial wastewater, as well as sulfur dioxide (SO_2), and nitrogen oxide (NO_x) emissions from industrial waste gas (e.g., Jiang et al., 2023; Chen et al., 2023). Based on China's "Administrative Measures on Emission Fee Collection Standards", we determine the equivalent values of enterprise pollution emissions and convert these values into enterprise pollution. The following three indicators of corporate pollutant emissions are constructed: emission intensity of water pollution (*WATER*), air pollution (*AIR*), and total pollution (*TOTAL*). Specifically, *WATER* is measured as water pollutants (including chemical oxygen demand, ammonia nitrogen emissions, total

nitrogen, and total phosphorus) per unit of output value.[12] *AIR* is measured as the toxic air pollutants (including SO_2, NO_X, and particulate matter pollution) per unit of output value, while *TOTAL* is the sum of water and air pollutants per unit of output value.

The results are presented in columns (1)-(6) of Panel A, Table 11. *STATE* and *RATE* are all negative and significant at 1%, suggesting that SCP reduces corporate toxic emissions. Overall, our results suggest that investment of state capital in private firms not only improves firm-level environmental engagement, but it also improves the environmental outcomes of privately controlled firms (i.e., reduced firm-level pollution). [13]

5.6 Impact of the SCP on financial performance

We have so far shown that the SCP has a positive impact on the CEE and environmental outcomes of privately controlled firms. However, it is not clear how SCP affects the financial performance of these firms. Dong and Liu (2022) show that state capital injection reduces technological improvement and management efficiency of private industrial firms, and therefore has a detrimental effect on firm profitability. Jiang et al. (2023) find that the reduction of corporate pollutant emissions associated with SCP is at the expense of economic output for unlisted firms. However, SCP might reduce local government expropriation risks, increase the level of property rights, and facilitates access to resources, and therefore positively affect the firm performance of private firms (Kong and Wang, 2016). To empirically examine the net effects of SCP on financial performance, we use the ratio of net profit to net assets (*ROA*) and Tobin's Q (*TQ*) as dependent variables, and rerun Eq. (1).

The results are reported in Panels B and C of Table 11. Columns (1) and (2) present the effect of SCP on current performance, and columns (3)-(8) report the results on firms' one-, two-, and three-year performance, respectively. However, government ownership has a significantly positive impact on the one-, two- and three-year *ROA* and *TQ* of private firms. Further, the increasingly larger coefficients on *STATE* and *RATE*

[12] Output value is the total monetary worth of industrial products that have been sold or are available for sale by an industrial enterprise during a specific time period.

[13] We also investigate the impact of SCP on corporate pollution levels one, two, and three years later, and find similar results. The results are available on request.

over time, suggest that the effect of SCP on the financial performance of privately controlled firms becomes more obvious.

Our results are consistent with Kong and Wang (2016) that minority government ownership benefits private firms. Since the average government ownership in our listed samples (2.3%) is smaller than that of unlisted industrial firms (23.2% as documented in Kong and Wang (2016)) and we exclude firms where controlling shareholders change after SCP, we do not find evidence that the costs of SCP outweigh its benefits.

[Insert table 11 about here]

6. Conclusion

This study examines the impact of state capital participation on the environmental engagement of private firms in China. Using a sample of privately listed companies in Shanghai and Shenzhen A-shares in China from 2009 to 2021, we find a significant positive relationship between SCP and corporate environmental engagement. On the one hand, SCP increases the environmental investment capacity of private firms by increasing supply chain financing, bank credit facilities, tax incentives, and government subsidies. These measures help alleviate the financing constraints faced by private firms, making it easier for them to invest in environmental protection. On the other hand, SCP attracts more media coverage, online attention, and analysts' tracking. This increased external monitoring pressure leads to an increased willingness on the part of private firms to participate in environmental protection. The positive impact of SCP on CEE is magnified in firms with local government ownership, a larger number of state shareholders among the top ten largest shareholders, and longer holding period of state shares, and in heavily polluted industries. Altogether, the results suggest that compared to private capital, state-owned capital has stronger social attributes, and they have more resources and stronger incentives to promote environmental participation in firms. Finally, we find that government minority ownership improves environmental outcomes, by lowering pollution emissions, while also improving the financial performance of privately listed firms.

Overall, our study enriches the economic consequences of mixed ownership reform from an environmental perspective. While environmentally responsible

activities can be costly, and privately controlled firms often face severe financing constraints, minority government ownership could be a viable solution to enhance these firms' environmental commitments. To maximize the positive influence of state capital, could strategically allocate funds to privately controlled firms with weaker environmental performance, thereby incentivizing more sustainable practices. Additionally, the government could foster green innovation by directing state capital toward research and development of eco-friendly technologies and sustainable business models. This approach can spur innovation and contribute to a more sustainable economy. Lastly, regulators should champion transparency in ESG performance, empowering stakeholders to monitor and hold companies accountable for their actions.

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Table 1. Descriptive statistics

This table reports the descriptive statistics of our sample, which consists of 20,133 firm-year observations for 2,741 unique firms during the period from 2009 and 2021. All variable definitions are presented in Appendix A. All continuous variables are winsorized at the 1st and 99th percentiles.

Variable	*N*	*Mean*	*SD*	*p1*	*p25*	*p50*	*p75*	*p99*
EXP	20,133	0.015	0.070	0	0	0	0	0.519
INDEX	20,133	0.172	0.192	0	0.083	0.115	0.167	0.823
ESG	20,133	3.968	2.040	1	2	3	6	8
STATE	20,133	0.442	0.497	0	0	0	1	1
RATE	20,133	0.023	0.054	0	0	0	0.020	0.269
SIZE	20,133	21.865	1.090	19.781	21.083	21.745	22.510	25.144
LEV	20,133	0.386	0.196	0.048	0.226	0.374	0.526	0.861
PPE	20,133	0.188	0.133	0.002	0.083	0.165	0.268	0.570
CASH	20,133	0.005	0.098	-0.276	-0.038	0.001	0.042	0.335
TQ	20,133	4.111	3.610	1.292	2.309	3.172	4.576	20.509
ROA	20,133	0.040	0.071	-0.312	0.017	0.042	0.073	0.207
GROWTH	20,133	0.210	0.491	-0.562	-0.009	0.133	0.309	2.602
AGE	20,133	2.774	0.392	1.386	2.565	2.833	3.045	3.466
BIG4	20,133	0.035	0.185	0	0	0	0	1
DUAL	20,133	0.375	0.484	0	0	0	1	1
INST	20,133	0.362	0.246	0.002	0.138	0.342	0.561	0.876
FIRST	20,133	0.317	0.139	0.080	0.210	0.298	0.405	0.708
BSIZE	20,133	2.088	0.192	1.609	1.946	2.197	2.197	2.485

Table 2. Baseline results

This table examines the effect of SCP on corporate environmental engagement (*CEE*), proxied by *EXP* (environmental protection expenditure scaled by total assets), *INDEX* (environmental performance index based on corporate environmental disclosure, environmental awareness, green emission, and environmental investment), and *ESG* (ratings provided by Huazheng). Detailed variable definitions are provided in Appendix A. All continuous variables are winsorized at the 1st and 99th percentiles. Industry and year-fixed effects are included in all regressions. The t-statistics are presented in parentheses. Standard errors are clustered at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, using a two-tailed test.

Panel A: Impact of state ownership dummy (STATE) on CEE

	(1)	(2)	(3)	(4)	(5)	(6)
	EXP	*EXP*	*INDEX*	*INDEX*	*ESG*	*ESG*
STATE	0.004***	0.003*	0.043***	0.022***	0.042***	0.064***
	(2.582)	(1.801)	(7.984)	(4.692)	(2.717)	(2.756)
SIZE		0.001		0.075***		-0.174***
		(0.946)		(8.647)		(-7.092)
LEV		-0.004		0.172***		0.833***
		(-0.630)		(9.815)		(5.812)
PPE		0.087***		0.091***		-0.114
		(7.581)		(3.385)		(-0.627)
CASH		0.011**		0.021**		-0.135
		(2.427)		(2.129)		(-1.108)
TQ		-0.000		-0.004***		0.035***
		(-1.220)		(-6.256)		(6.595)
ROA		-0.011		0.360***		-3.614***
		(-0.900)		(11.535)		(-13.659)
GROWTH		-0.001		-0.012***		0.163***
		(-1.555)		(-4.155)		(5.231)
AGE		-0.006*		0.015		0.311***
		(-1.674)		(1.610)		(5.043)
BIG4		-0.005		0.126***		0.047
		(-1.182)		(4.977)		(0.451)
DUAL		0.001		-0.004		-0.025
		(0.290)		(-0.761)		(-0.667)
INST		0.001		0.014		0.260***
		(0.242)		(1.115)		(2.787)
FIRST		0.001		-0.052**		-0.422***
		(0.099)		(-2.392)		(-2.616)
BSIZE		-0.001		0.056***		0.014
		(-0.305)		(3.732)		(0.131)
CONSTANT	0.014***	-0.004	0.153***	-0.080*	3.950***	6.557***
	(11.482)	(-0.165)	(46.132)	(-1.816)	(367.295)	(11.674)
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes
N	20,133	20,133	20,133	20,133	20,133	20,133
R^2_a	0.056	0.077	0.071	0.148	0.107	0.153

Panel B: *Impact of state ownership proportion (RATE) on CEE*

	(1)	(2)	(3)	(4)	(5)	(6)
	EXP	*EXP*	*INDEX*	*INDEX*	*ESG*	*ESG*
RATE	0.055*	0.048***	0.331***	0.065**	1.025**	1.147**
	(1.799)	(5.995)	(4.820)	(2.425)	(2.381)	(2.581)
SIZE		0.001**		0.075***		-0.336***
		(3.047)		(17.883)		(-6.844)
LEV		-0.005		-0.068***		1.057***
		(-1.439)		(-6.533)		(6.385)
PPE		0.086***		0.112***		0.060
		(15.471)		(10.162)		(0.256)
CASH		0.011*		0.001		0.038
		(1.788)		(0.053)		(0.523)
TQ		-0.000**		0.004***		0.004
		(-2.625)		(13.346)		(0.600)
ROA		-0.010		0.189***		-0.995***
		(-0.843)		(7.601)		(-3.328)
GROWTH		-0.001		-0.013**		0.125***
		(-1.578)		(-2.976)		(4.559)
AGE		-0.006***		0.015***		0.446***
		(-5.202)		(3.816)		(4.153)
BIG4		-0.006***		0.067***		-0.139
		(-3.807)		(6.166)		(-0.968)
DUAL		0.001		-0.001		0.047
		(0.494)		(-0.302)		(1.035)
INST		-0.000		0.011		-0.629***
		(-0.143)		(1.324)		(-3.616)
FIRST		0.003		-0.048***		-0.421
		(1.000)		(-5.303)		(-1.226)
BSIZE		-0.002		0.019***		0.319***
		(-1.698)		(4.843)		(3.181)
CONSTANT	0.014***	-0.006	0.164***	-1.566***	3.964***	9.321***
	(11.348)	(-0.634)	(46.856)	(-17.330)	(407.535)	(8.429)
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes
N	20,133	20,133	20,133	20,133	20,133	20,133
R^2_a	0.057	0.077	0.068	0.237	0.110	0.120

Table 3. Endogeneity concerns

This table address endogeneity concerns. Panel A reports the predictive analysis results. We use $STATE_{it+1}$ and $RATE_{it+1}$ as explanatory variables to investigate whether corporate environmental engagement affect state capital injection in the relevant firms. Panel B reports the 2SLS regression results. Columns (1) and (5) present the first-stage results. Columns (2)-(4) report the second-stage results when the predicted value of *STATE* ($\widehat{STATE}$) is included as the key explanatory variable, and columns (6)-(8) report the second-stage results when the predicted value of *RATE* ($\widehat{RATE}$) is used as the key explanatory variable. *P_STATE* is the proportion of local state-owned firms to total listed companies within a province. Panel C exhibits the results produced by a 1:1 nearest neighbor matching technique. Panel D presents the results using a double machine learning approach. Panel E adopts a first-difference model, analyzing the changes in state ownership on change in CEE. Controls are the same as those in Table 2, with detailed variable definitions in Appendix A. All continuous variables are winsorized at the 1st and 99th percentiles. Industry and year-fixed effects are included in all regressions. T-statistics are presented in parentheses. Standard errors are clustered at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, using a two-tailed test.

Panel A: Predictive analysis

	(1)	(2)	(3)	(4)	(5)	(6)
	$STATE_{it+1}$	$STATE_{it+1}$	$STATE_{it+1}$	$RATE_{it+1}$	$RATE_{it+1}$	$RATE_{it+1}$
EXP	0.275			0.024		
	(1.279)			(1.329)		
INDEX		0.057			0.007	
		(0.541)			(1.200)	
ESG			0.003			-0.000
			(0.474)			(-1.518)
CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes
N	16,464	16,464	16,464	16,464	16,464	16,464
R^2_a/Pseudo R^2	0.080	0.080	0.080	0.105	0.104	0.104

Panel B: An IV approach

	(1) *STATE*	(2) *EXP*	(3) *INDEX*	(4) *ESG*	(5) *RATE*	(6) *EXP*	(7) *INDEX*	(8) *ESG*
P_STATE	1.984***				0.245***			
	(8.414)				(5.634)			
$\widehat{STATE}$		0.032*	0.202**	1.640**				
		(1.670)	(2.201)	(2.567)				
$\widehat{RATE}$						0.258*	0.639**	13.295**
						(1.667)	(2.193)	(2.435)
CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F	38.322				49.505			
N	20,133	20,133	20,133	20,133	20,133	20,133	20,133	20,133
Adj_R²	0.115	0.039	0.062	0.096	0.107	0.031	0.137	0.079

Panel C: A PSM approach

	(1) *EXP*	(2) *EXP*	(3) *INDEX*	(4) *INDEX*	(5) *ESG*	(6) *ESG*
STATE	0.003**		0.011***		0.122***	
	(2.451)		(4.321)		(4.405)	
RATE		0.069***		0.112***		0.468**
		(4.617)		(3.411)		(2.306)
CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes
N	6,628	6,628	6,628	6,628	6,628	6,628
R^2_a	0.096	0.100	0.157	0.248	0.137	0.137

Panel D: A double machine learning approach

	(1) *EXP*	(2) *EXP*	(3) *INDEX*	(4) *INDEX*	(5) *ESG*	(6) *ESG*
STATE	0.003**		0.016***		0.014**	
	(2.58)		(6.05)		(2.49)	
RATE		0.042***		0.072***		0.540**
		(4.51)		(2.88)		(1.99)
CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes
N	20,133	20,133	20,133	20,133	20,133	20,133

Panel E: A first-difference model

	(1) *ΔEXP*	(2) *ΔINDEX*	(3) *ΔESG*
ΔRATE	0.011*	0.035**	2.245***
	(1.735)	(2.148)	(2.582)
CONTROLS	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes
YEAR	Yes	Yes	Yes
N	16,464	16,464	16,464
Adj_R^2	0.053	0.236	0.157

Table 4: Further robustness tests

This table presents additional robustness results. Panel A presents the results for the sample with mandatory CSR disclosure. Panel B presents the results using alternative measures for SCP and CEE. Panel C further includes city-fixed effects. Panel D presents the Tobit and Poisson regression results. Panel E further controls the impact of environmental law and the environmental inspections conducted by the Ministry of Ecology and Environment of the People's Republic of China. Controls are the same as those in Table 2, with detailed variable definitions in Appendix A. All continuous variables are winsorized at the 1st and 99th percentiles. Industry and year-fixed effects are included in all regressions. T-statistics are presented in parentheses. Standard errors are clustered at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, using a two-tailed test.

Panel A: Excluding firms with voluntary disclosure

	(1)	(2)	(3)	(4)	(5)	(6)
	EXP	*EXP*	*INDEX*	*INDEX*	*ESG*	*ESG*
STATE	0.008*		0.005**		0.094**	
	(1.955)		(2.317)		(2.056)	
RATE		0.042***		0.162***		0.854***
		(2.971)		(3.122)		(2.692)
CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes
N	1,219	1,219	1,219	1,219	1,219	1,219
R^2_a	0.189	0.187	0.316	0.318	0.164	0.257

Panel B: Alternative measures for CEE and SCP

	(1) *SCORE*	(2) *SCORE*	(3) *EP*	(4) *EP*	(5) *INDEX*	(6) *INDEX*	(7) *ESG*	(8) *ESG*
STATE	0.146***							
	(4.418)							
RATE		0.632**						
		(2.269)						
DSOE5			0.006***		0.037***		0.109***	
			(3.526)		(6.427)		(4.294)	
DSOE10				0.007***		0.043***		0.221***
				(4.887)		(6.838)		(3.422)
CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	20,133	20,133	20,133	20,133	20,133	20,133	20,133	20,133
R^2_a	0.099	0.097	0.106	0.106	0.164	0.163	0.207	0.207

Panel C: Controlling for city effects

	(1) *EXP*	(2) *EXP*	(3) *INDEX*	(4) *INDEX*	(5) *ESG*	(6) *ESG*
STATE	0.003*		0.023***		0.070**	
	(1.845)		(5.215)		(1.969)	
RATE		0.035***		0.061***		0.228***
		(5.795)		(2.792)		(2.945)
CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes
CITY	Yes	Yes	Yes	Yes	Yes	Yes
N	20,114	20,114	20,114	20,114	20,114	20,114
R2_a	0.215	0.215	0.241	0.320	0.271	0.271

Panel D: Tobit and Poisson models

	Tobit model						Poisson model					
	EXP	*EXP*	*INDEX*	*INDEX*	*ESG*	*ESG*	*EXP*	*EXP*	*INDEX*	*INDEX*	*ESG*	*ESG*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
STATE	0.003***		0.022***		0.059**		0.192*		0.120***		0.016*	
	(2.898)		(8.219)		(2.087)		(1.827)		(4.616)		(1.698)	
RATE		0.048***		0.109***		0.244***		0.679**		0.381**		0.079*
		(5.167)		(4.418)		(2.936)		(2.270)		(2.573)		(1.798)
CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	20,133	20,133	20,133	20,133	20,133	20,133	20,133	20,133	20,133	20,133	20,133	20,133
Pseudo R^2	0.033	0.033	0.035	0.035	0.039	0.037	0.031	0.036	0.038	0.037	0.039	0.039

Panel E: Controlling for contemporaneous events

	Controlling the impact of environmental laws						Controlling the impact of the Central Environmental Protection Inspectorate					
	EXP	*EXP*	*INDEX*	*INDEX*	*ESG*	*ESG*	*EXP*	*EXP*	*INDEX*	*INDEX*	*ESG*	*ESG*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
STATE	0.003*		0.021***		0.058***		0.003*		0.022***		0.059**	
	(1.707)		(4.625)		(2.602)		(1.787)		(4.703)		(2.623)	
RATE		0.046***		0.104***		0.324**		0.048*		0.109*		0.315**
		(4.967)		(2.734)		(2.246)		(1.745)		(1.812)		(2.209)
ELAW	0.018***	0.018***	0.042***	0.042***	0.089	0.092*						
	(3.708)	(9.386)	(4.482)	(4.512)	(1.284)	(1.695)						
INSPECTION							0.004***	0.004***	0.013**	0.013***	0.003**	0.003**
							(2.609)	(2.636)	(2.568)	(2.594)	(2.056)	(2.078)
CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	20,133	20,133	20,133	20,133	20,133	20,133	20,133	20,133	20,133	20,133	20,133	20,133
R^2	0.081	0.081	0.150	0.148	0.152	0.152	0.077	0.078	0.148	0.146	0.152	0.152

Table 5. Improved environmental investment capacity

This table reports the results of the alleviating effect of SCP on corporate EIC. The estimation model is shown as follows:

$$EIC_{it} = \beta_0 + \beta_1 STATE_{it}\ (RATE_{it}) + \gamma Z_{it} + INDUSTRY + YEAR + \varepsilon_{it}$$

Where EIC is proxied by the ratio of trade credit financing to total assets (*CREDIT*) in column (1), the ratio of bank credit facilities to total assets (*DEBT*) in column (2), tax incentives (*TAXP*), and government grants (*SUB*) in columns (3) and (4), and the *SA* index in column (5). Controls are the same as those in Table 2, with detailed variable definitions in Appendix A. All continuous variables are winsorized at the 1st and 99th percentiles. Industry and year-fixed effects are included in all columns. T-statistics are presented in parentheses. Standard errors are clustered at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, using a two-tailed test.

Panel A: Impact of state ownership dummy on EIC

	(1) *CREDIT*	(2) *DEBT*	(3) *TAXP*	(4) *SUB*	(5) *SA*
STATE	0.004***	0.006**	0.008***	0.001**	-0.009***
	(4.063)	(2.714)	(3.449)	(2.012)	(-4.051)
CONTROLS	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes
N	13,606	16,917	13,423	18,659	20,133
R^2_a	0.436	0.757	0.546	0.471	0.814

Panel B: *Impact of state ownership proportion on EIC*

	(1) *CREDIT*	(2) *DEBT*	(3) *TAXP*	(4) *SUB*	(5) *SA*
RATE	0.034***	0.086***	0.035***	0.003***	-0.056**
	(3.147)	(5.069)	(3.950)	(4.150)	(-3.011)
CONTROLS	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes
N	13,606	16,917	13,423	18,659	20,133
R^2_a	0.436	0.174	0.545	0.117	0.814

Table 6. Increased external monitoring

This table examines whether SCP increases external monitoring from investors and analysts. The estimation model is shown as follows:

$$MONITOR_{it} = \beta_0 + \beta_1 STATE_{it}\ (RATE_{it}) + \gamma Z_{it} + INDUSTRY + YEAR + \varepsilon_{it}$$

Where *MONITOR* is proxied by (1) the number of site visits conducted by institutional investors (*VISIT*), the number of company-related posts in the stock bar (*MEDIA*) in column (2), the Baidu search index (*INTERNET*) in column (3), number of analysts following (*ANA*) and research reports (*REPORT*) in columns (4) and (5) respectively. Controls are the same as those in Table 2, with detailed variable definitions in Appendix A. All continuous variables are winsorized at the 1st and 99th percentiles. Industry and year-fixed effects are included in all regressions. T-statistics are presented in parentheses. Standard errors are clustered at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, using a two-tailed test.

Panel A: State ownership dummy on corporates' willingness to participate in the environment

	(1)	(2)	(3)	(4)	(5)
	VISIT	*MEDIA*	*INTERNET*	*ANA*	*REPORT*
STATE	0.165***	0.123***	0.017***	0.128***	0.161***
	(4.117)	(5.780)	(4.722)	(6.032)	(6.147)
CONTROLS	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes
N	20,133	20,133	19,291	20,133	20,133
R^2_a	0.138	0.688	0.906	0.420	0.420

Panel B: State ownership proportion on corporates' willingness to participate in the environment

	(1)	(2)	(3)	(4)	(5)
	VISIT	*MEDIA*	*INTERNET*	*ANA*	*REPORT*
RATE	0.675**	0.550***	0.043*	0.632**	0.693*
	(2.378)	(3.326)	(1.827)	(2.084)	(1.848)
CONTROLS	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes
N	20,133	20,133	19,291	20,133	20,133
R^2_a	0.117	0.687	0.906	0.239	0.242

Table 7. SCP characteristics on CEE

This table examines the impact of various SCP characteristics, including the type of state shareholder, number of state shareholders, and holding period, on CEE. *LOCAL* is a dummy variable that equals 1 if all state shareholders are controlled by local governments, and 0 otherwise. *NUMBER* denotes the number of state shareholders among the top ten shareholders. *LENGTH* is the average holding period of state shareholders. Controls are the same as those in Table 2, with detailed variable definitions in Appendix A. All continuous variables are winsorized at the 1st and 99th percentiles. Industry and year-fixed effects are included in all regressions. T-statistics are presented in parentheses. Standard errors are clustered at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, using a two-tailed test.

Panel A: Central vs local government capital participation on CEE

	(1)	(2)	(3)
	EXP	*INDEX*	*ESG*
LOCAL	0.019***	0.061***	0.762**
	(3.066)	(2.895)	(2.093)
CONTROLS	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes
YEAR	Yes	Yes	Yes
N	8,900	8,900	8,900
R^2_a	0.078	0.260	0.157

Panel B: Number of state shareholders on CEE

	(1)	(2)	(3)
	EXP	*INDEX*	*ESG*
NUMBER	0.003*	0.009**	0.002**
	(1.918)	(2.228)	(2.073)
CONTROLS	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes
YEAR	Yes	Yes	Yes
N	8,900	8,900	8,900
R^2_a	0.080	0.261	0.157

Panel C: Holding period of state shareholders on CEE

	(1)	(2)	(3)
	EXP	*INDEX*	*ESG*
LENGTH	0.002**	0.004**	0.066***
	(2.140)	(2.339)	(5.679)
CONTROLS	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes
YEAR	Yes	Yes	Yes
N	8,900	8,900	8,900
R^2_a	0.078	0.261	0.163

Table 8: The role of politically connected managers

This table examines the impact of politically connected managers on the relationship between SCP and CEE. *PC* is a dummy variable that equals 1 if the CEO or board chairman had or currently has a role in a government agency (including central government, local government, military, or other government agencies), and 0 otherwise. Controls are the same as those in Table 2, with detailed variable definitions in Appendix A. All continuous variables are winsorized at the 1st and 99th percentiles. Industry and year-fixed effects are included in all regressions. T-statistics are presented in parentheses. Standard errors are clustered at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, using a two-tailed test.

	(1) *EXP*	(2) *EXP*	(3) *INDEX*	(4) *INDEX*	(5) *ESG*	(6) *ESG*
*STATE*PC*	-0.004		-0.044***		-0.320***	
	(-1.462)		(-2.828)		(-2.729)	
*RATE*PC*		-0.127*		-0.253***		-2.005***
		(-1.888)		(-2.708)		(-2.746)
STATE	0.003*		0.020***		0.028	
	(1.856)		(4.183)		(1.317)	
RATE		0.047		0.109*		0.380
		(1.499)		(1.795)		(1.593)
PC	0.003	0.002	0.025	0.044*	0.099	-0.023
	(0.399)	(0.361)	(1.232)	(1.92)	(0.922)	(-0.347)
CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes
N	20,133	20,133	20,133	20,133	20,133	20,133
Adj R^2	0.077	0.078	0.150	0.148	0.149	0.149

Table 9. Heavy-polluting industries

This table reports how heavily polluting industries affect the relationship between SCP and CEE. Controls are the same as those in Table 2, with detailed variable definitions in Appendix B. All continuous variables are winsorized at the 1st and 99th percentiles. Industry and year-fixed effects are included in all regulations. t-statistics are presented in parentheses. Standard errors are clustered at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, using a two-tailed test.

	(1)	(2)	(3)	(4)	(5)	(6)
	EXP	*EXP*	*INDEX*	*INDEX*	*ESG*	*ESG*
*STATE*HEAVY*	0.020***		0.031***		0.097**	
	(3.692)		(2.603)		(2.290)	
*RATE*HEAVY*		0.029**		0.048**		0.172**
		(2.202)		(2.189)		(2.186)
STATE	0.002		0.013**		0.090**	
	(1.616)		(2.502)		(2.197)	
RATE		0.039***		0.064***		0.357***
		(7.556)		(2.888)		(2.884)
CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes
N	20,133	20,133	20,133	20,133	20,133	20,133
R^2_a	0.081	0.078	0.249	0.246	0.153	0.153

Table 10. Private capital injection

This table investigates the effect of private capital injection on the CEE of SOEs. Controls are the same as those in Table 2, with detailed variable definitions in Appendix A. All continuous variables are winsorized at the 1st and 99th percentiles. Industry and year-fixed effects are included in all regressions. T-statistics are presented in parentheses. Standard errors are clustered at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, using a two-tailed test.

	(1)	(2)	(3)	(4)	(5)	(6)
	EXP	*EXP*	*INDEX*	*INDEX*	*ESG*	*ESG*
MIX	-0.000		0.022		0.355	
	(-1.008)		(0.851)		(1.497)	
MIXRATE		-0.000		-0.007		-0.500
		(-0.006)		(-0.175)		(-1.082)
CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes
N	12,233	12,233	12,233	12,233	12,233	12,233
R^2_a	0.057	0.056	0.341	0.341	0.176	0.177

Table 11. The impact of SCP on pollution reduction and financial performance

This table reports the results of the effect of SCP on pollution reduction and financial performance. Panel A presents the results of the effect of SCP on emission outcomes, proxied by *WATER* (water pollutants including chemical oxygen demand, ammonia nitrogen emissions, total nitrogen, and total phosphorus per unit of output value), *AIR* (toxic air pollutants including SO_2, NOX, and particulate matter pollution) per unit of output value), and *TOTAL* (sum of water and air pollutants per unit of output value). Panels B and C report the effect of SCP on *ROA* and *TQ*, respectively. Columns (1) and (2) use current year firm performance as the explanatory variable, and columns (3) to (8) use one-, two-, and three-year ROA as the explanatory variables, respectively. Controls are the same as those in Table 2, with detailed variable definitions in Appendix A. All continuous variables are winsorized at the 1st and 99th percentiles. Industry and year-fixed effects are included in all regressions. T-statistics are presented in parentheses. Standard errors are clustered at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, using a two-tailed test.

Panel A: The effect of SCP on emission outcome

	(1)	(2)	(3)	(4)	(5)	(6)
	WATER	*WATER*	*AIR*	*AIR*	*TOTAL*	*TOTAL*
STATE	-0.001***		-0.001***		-0.001***	
	(-6.971)		(-6.832)		(-6.841)	
RATE		-0.004***		-0.004***		-0.004***
		(-3.321)		(-3.672)		(-3.582)
CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes
N	19,669	19,669	19,669	19,669	19,669	19,669
R2_a	0.278	0.276	0.311	0.309	0.319	0.317

Panel B: The effect of SCP on ROA

	(1) ROA_{it}	(2) ROA_{it}	(3) ROA_{it+1}	(4) ROA_{it+1}	(5) ROA_{it+2}	(6) ROA_{it+2}	(7) ROA_{it+3}	(8) ROA_{it+3}
STATE	0.001		0.002**		0.003**		0.004**	
	(1.437)		(2.054)		(2.394)		(2.159)	
RATE		0.009		0.019**		0.041***		0.056***
		(0.787)		(2.215)		(3.504)		(3.959)
CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	20,133	20,133	16,464	16,464	13,928	13,928	11,628	11,628
R^2_a	0.253	0.253	0.278	0.278	0.181	0.181	0.141	0.142

Panel C: The effect of SCP on Tobin's Q

	(1) TQ_{it}	(2) TQ_{it}	(3) TQ_{it+1}	(4) TQ_{it+1}	(5) TQ_{it+2}	(6) TQ_{it+2}	(7) TQ_{it+3}	(8) TQ_{it+3}
STATE	0.109		0.158**		0.338***		0.428***	
	(0.823)		(2.162)		(5.054)		(6.710)	
RATE		-0.237		0.554***		0.619***		0.647***
		(-0.293)		(2.719)		(2.679)		(2.783)
CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	20,133	20,133	16,464	16,464	13,928	13,928	11,628	11,628
R^2_a	0.343	0.340	0.261	0.259	0.206	0.206	0.170	0.170

Appendix A. Description and definition of key variables

Variable	Definition
EXP	A company's environmental protection expenditure scaled by its total assets.
INDEX	Corporate environmental performance index, which is average value of its four sub-measurements, including environmental disclosure, environmental awareness, green emission, and environmental investment.
DISCLOSURE	Ranging from 0 to 1 and calculated based on three binary indicators: (i) whether the company includes environment-related information in its annual report, (ii) whether the company includes environment-related information in its CSR report, and (iii) whether the company discloses environment-related information separately. These indicators are combined to form the environmental disclosure scores for listed companies. *DISCLOSURE* is calculated using the formula: (listed company disclosure score - minimum annual disclosure score) / (maximum annual disclosure score - minimum annual disclosure score).
AWARENESS	Ranging from 0 to 1 and calculated based on eight binary indicators: (i) inclusion of environmental protection philosophy, environmental protection policy, environmental management organization structure, circular economy development model, green development, etc., in the annual report; (ii) mention of achieved and future environmental protection objectives; (iii) establishment of relevant environmental management systems, regulations, and obligations; (iv) provision of environmental education and training; (v) participation in environmental public welfare activities; (vi) establishment of emergency response mechanisms for major environmental emergencies; (vii) receipt of environmental protection honors or awards; and (viii) implementation of the "three simultaneous" system. The values for these eight indicators are consolidated into an environmental awareness score. *AWARENESS* is calculated using the formula: (listed company's awareness score - lowest awareness score of the year) / (highest awareness score of the year - lowest awareness score of the year).
EMISSION	A dummy variable that takes a value of 1 if a company adopts a policy, measure or technology that results in a reduction in wastewater, gas, sludge or greenhouse gas emissions, and 0 otherwise.
INVEST	Ranging from 0 to 1 and calculated based on three binary indicators, including: (i) whether the company has developed or adopted innovative products, equipment or technologies that are beneficial to the environment; (ii) whether the company has adopted renewable energy policies and circular economy measures; and (iii) whether the company has adopted policies, measures or technologies that conserve energy and resources. The environmental investment score is calculated as the sum of these indicators. *INVEST* is calculated using the formula: (investment score of the listed firm - lowest investment score of the year) / (highest investment score of the year - lowest investment score of the year).
ESG	The numerical score of ESG ratings provided by *Huazheng*.
STATE	A dummy variable that takes the value of 1 if a private enterprise has state-owned capital among its top ten shareholders in the year, and 0 otherwise.
RATE	Cumulative shareholding of state-owned capital among the top ten shareholders of private enterprises in the year.
SIZE	The natural logarithm of total assets.
LEV	Ratio of total liabilities to total assets.
PPE	Ratio of tangible assets to total assets.
CASH	Ratio of cash and cash equivalents to total assets.
TQ	Ratio of the market value to the book value of assets.
ROA	Net income divided by net assets.
GROWTH	Ratio of increase in operating income to operating income at the beginning of the year.
AGE	The natural logarithm of the number of years since a firm's establishment.
BIG4	A dummy variable that takes the value of 1 if the firm hires the Big 4 auditor, and 0 otherwise.
DUAL	A dummy variable that takes the value of 1 if the chairman and CEO are the same person, and 0 otherwise.
INST	Percentage of shares held by institutional investors.
FIRST	Percentage of shares held by the largest shareholder.
BSIZE	The natural logarithm of the number of board members.
CREDIT	Ratio of accounts payable and prepayments to total assets.
DEBT	Ratio of short-term and long-term debt to total assets.
TAXB	Ratio of tax refunds received to the sum of taxes paid and tax refunds received.
SUB	Government grants as a percentage of total assets.
SA	Calculated as $-0.737 \times \text{Size} + 0.043 \times \text{Size}^2 - 0.040 \times \text{Age}$.
VISIT	Number of institutional field research is taken as the natural logarithm.
MEDIA	Number of company-related posts in the stock bar is taken as the natural logarithm.
INTERNET	Baidu search index to measure a company's online attention.
ANA	Number of analysts at the tracking company is taken as the natural logarithm.
REPORT	Number of company-related research reports is taken as the natural logarithm.

MIX	A dummy takes the value of 1 if there are non-state shareholders among the top ten shareholders of SOEs, and 0 otherwise.
MIXRATE	Cumulative shareholdings of non-state shareholders among the top ten shareholders of state-owned enterprises.
DIS	The latitude and longitude distance between the company's city and Beijing divided by 1000.
SCORE	Following Xiao and Shen (2022), we calculate the company's environmental advantage and concern scores. We then subtract the environmental advantage score from the environmental concern score to obtain the Environmental Performance Score.
DSOE5	A dummy variable that takes the value of 1 if at least one of the top ten shareholders of private firms hold more than 5% of the shares and is a state shareholder, and 0 otherwise.
DSOE10	A dummy variable that takes the value of 1 if at least one of the top ten shareholders of private firms hold more than 10% of shareholding and is a state shareholder, and 0 otherwise.
LOCAL	State capital participating in private enterprises is local state capital takes the value of 1, otherwise it is 0.
NUMBER	Number of Chinese equity shareholders in the top 10 shareholders of private companies
LENGTH	Length of state capital participation in private enterprises
HEAVY	Takes the value of 1 if the enterprise belongs to a heavy polluting industry, otherwise 0
PC	A dummy variable that equals 1 if the chairman or CEO of a private firm has political background, and 0 otherwise.
AIR	Toxic air pollutants (including SO_2, NO_X, and particulate matter pollution) per unit of output value.
WATER	Water pollutants (including chemical oxygen demand, ammonia nitrogen emissions, total nitrogen, and total phosphorus) per unit of output value.
TOTAL	The sum of water and air pollutants per unit of output value.

Appendix B. Impact of SCP on different dimensions of the environmental performance index

This table examines the impact of SCP on the four different dimensions of the *INDEX*, namely *DISCLOSURE, AWARENESS, EMISSION,* and *INVEST* as detailed in Appendix A. All continuous variables are winsorized at the 1st and 99th percentiles. Industry and year-fixed effects are included in all regulations. t-statistics are presented in parentheses. Standard errors are clustered at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, using a two-tailed test.

	(1) *DISCLOSURE*	(2) *DISCLOSURE*	(3) *AWARENESS*	(4) *AWARENESS*	(5) *EMISSION*	(6) *EMISSION*	(7) *INVEST*	(8) *INVEST*
STATE	0.002**		0.004***		0.002**		0.001**	
	(2.535)		(2.837)		(2.235)		(2.201)	
RATE		0.005**		0.058**		0.120**		0.076**
		(2.092)		(2.190)		(2.235)		(2.065)
CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	20,133	20,133	20,133	20,133	20,133	20,133	20,133	20,133
R^2_a	0.191	0.191	0.260	0.260	0.135	0.136	0.178	0.178

Appendix C: *Huazheng* ESG rating system

Level 1	Level 2
Environmental	Internal management system
	Business objectives
	Green products
	External authentication
	Business objectives
	Violation incidents
Social	Institutional system
	Business activities
	Social contributions
	External authentication
Governance	System building
	Governance structure
	Business activities
	Operational risks
	External risks

Appendix D. Univariate analysis between matched and unmatched sample

This table reports the univariate analysis between the treatment and control groups before and after propensity score matching

Control variables		Mean		Standard	Error	T-test	
		Treat	Control	(%)	(%)	t	p
SIZE	U	22.216	21.381	79.8		33.01	0.000
	M	22.201	22.142	3.7	92.9	1.51	0.132
LEV	U	0.413	0.342	37.6		15.45	0.000
	M	0.411	0.400	4.1	83.7	1.55	0.117
PPE	U	0.201	0.169	24.1		9.92	0.000
	M	0.201	0.195	4.2	82.4	1.56	0.118
CASH	U	0.014	0.004	10.3		4.21	0.000
	M	0.014	0.018	-3.7	64.4	-1.51	0.132
TQ	U	4.332	3.495	26.9		11.1	0.000
	M	4.267	4.696	-3.8	78.8	-1.52	0.131
ROA	U	0.049	0.046	4.5		1.87	0.062
	M	0.049	0.054	-2.7	-	-1.12	0.274
GROWTH	U	0.211	0.205	1.2		0.48	0.628
	M	0.211	0.262	-1.3	-	-0.50	0.617
AGE	U	2.835	2.725	29.6		12.11	0.000
	M	2.833	2.821	3.2	89.1	1.36	0.174
BIG4	U	0.073	0.026	22.1		9.15	0.000
	M	0.072	0.058	3.6	70.2	1.53	0.137
DUAL	U	0.330	0.432	-21.1		-8.62	0.000
	M	0.329	0.345	-3.3	84.2	-1.35	0.176
INST	U	44.381	30.331	57.4		23.48	0.000
	M	44.234	44.362	-0.5	99.1	-0.21	0.837
FIRST	U	30.599	33.372	-19.7		-8.09	0.000
	M	30.642	30.549	0.7	96.7	0.26	0.794
BSIZE	U	2.135	2.064	36.9		15.11	0.000
	M	2.134	2.119	7.8	78.9	3.06	0.002

Appendix E. Environment scores

Level 1	Level 2	Level 3
SCORE	*EP_STR(+)*	develops or utilizes environmentally friendly products, equipment,
		adopts policies or technologies to reduce emissions (*EP_str_b*)
		uses renewable energy (*EP_str_c*)
		has policies or technologies for energy conservation (*EP_str_d*)
		adopts green office policies (*EP_str_e*)
		passes ISO 14001 certification (*EP_str_f*)
		wins environmental protection awards (*EP_str_g*)
		has any other environmental advantages that are not covered above
	EP_CON(-)	penalized for damaging the environment (*EP_con_a*)
		discharges pollutants (*EP_con_b*)