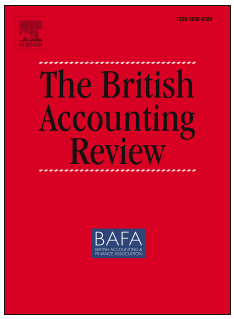


# The rise of common state ownership and corporate environmental performance

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# The rise of common state ownership and corporate environmental performance

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# Declarations

## Compliance with Ethical Standards

All authors contributed to the study's conception and design. Xutang Liu performed data collection and analysis. The first draft of the manuscript was written by Sabri Boubaker, Jing Liao, Xutang Liu, and Shouyu Yao. All authors commented on previous versions of the manuscript and have read and approved the final manuscript. No conflict of interest exists in the submission of this manuscript.

## Author Contributions

Conceptualization: Sabri Boubaker, Jing Liao, Xutang Liu, and Shouyu Yao; Methodology: Sabri Boubaker, Jing Liao, Xutang Liu, and Shouyu Yao. Formal analysis and investigation: Sabri Boubaker, Jing Liao, Xutang Liu, and Shouyu Yao; Writing - original draft preparation: Sabri Boubaker, Jing Liao, Xutang Liu, and Shouyu Yao; Writing - review and editing: Sabri Boubaker, Jing Liao, Xutang Liu, and Shouyu Yao; Supervision: Sabri Boubaker, Jing Liao, Xutang Liu, and Shouyu Yao;

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The authors have no competing interests to declare that are relevant to the content of this article.

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# The rise of common state ownership and corporate environmental performance

## Abstract

This study assesses the effect of common state ownership on corporate environmental performance. Using a large sample of Chinese listed firms, we find that state-owned common ownership leads to significantly enhanced corporate environmental performance. Our mechanism analysis indicates that state-owned common owners promote environmental-friendly practices through resource allocation mechanisms that alleviate corporate financial constraints. In addition, these owners play a leadership role in fostering corporate green innovation and enhancing the overall performance of the industry. Specifically, common state ownership leads to higher industry's green total factor productivity and profitability. Moreover, we observe that the positive relationship between common state ownership and corporate environmental performance is more pronounced in firms without politically connected CEOs/chairpersons and in privately owned firms.

**Keywords:** Common state ownership, Government social objective, Leadership role, Corporate environmental performance, China

**JEL Classification:** G32; G34

## 1. Introduction

The widespread prevalence of common ownership, such as institutional investors with block cross-holdings within an industry, has garnered significant interest in accounting and finance literature (Azar et al., 2018; Koch et al., 2021; Lewellen and Lowry, 2021; Yan, 2021). In the U.S. financial market, common ownership has led to a substantial increase in the density of ownership networks (Azar, 2018). Notably, by the end of 2015, approximately 81% of S&P 500 firms had at least one blockholder who owned shares in rival firms (Lewellen and Lowry, 2021). While the literature acknowledges that institutional cross-owners have strong incentives and power to influence corporate decisions, the debate on how they affect underlying corporations is still ongoing (Azar et al., 2018; Lewellen and Lewellen, 2022). This discussion gains further significance against the backdrop of the rise in state ownership worldwide (Megginson et al., 2021). Consequently, heightened attention has been directed toward understanding the influence of state-owned institutional ownership on corporations. In this context, this study endeavors to shed light on the effect of state-owned common ownership on corporate environmental performance (CEP), thereby contributing to the understanding of state-owned institutional investors and unraveling the intricate dynamics of common ownership.

Environmental issues are becoming increasingly urgent and critical, compelling governments to prioritize the improvement of environmental and social conditions to improve public welfare (Hsu et al., 2023). State-owned institutional investors under government control play a dual role: they foster stronger ties between portfolio firms and the government while being entrusted with achieving social and political objectives. The impact of social pressure and public scrutiny on state-owned institutional investors differs from their effects on other institutional investors, mainly due to the unique governance and sustainability mandates assigned to the former (Megginson et al., 2021). Given the growing importance of state

capitalism, there is a pressing need to examine the effects of state-owned institutional investors, particularly when they hold stakes in multiple firms operating in the same industry.

State ownership, driven by its commitment to the public interest, is more responsive to environmental issues (Besley and Ghatak, 2001; Hsu et al., 2023). For instance, Boubakri et al. (2019) find that privatized companies exhibit higher scores on environmental and social aspects prior to privatization. Similarly, Megginson et al. (2021) document that state-owned investors, such as sovereign wealth funds and public pension funds, are emerging as leaders in promoting environmental, social, and governance activities within their investee companies. Although the influence of common ownership on corporate social responsibility (CSR) has been recently studied by Dai and Qiu (2021), Cheng et al. (2022), Hirose and Matsumura (2022), and DesJardine et al. (2023), the results remain inconclusive. For example, DesJardine et al. (2023) find that common owners are more likely to encourage CSR activities in their portfolio firms, thereby leading to positive spillover effects, while Cheng et al. (2022) show a negative relation between common ownership and CSR performance. Given the significance of state-owned institutional ownership and the inconclusive evidence regarding the effect of common ownership on environmental performance, it is crucial to examine whether and how state-owned common owners, a particular category of the common owners, influence corporate engagement with environmental issues. This study bridges this research gap and sheds new light on the role of state-owned common ownership in shaping corporate environmental practices.

The presence of a common owner introduces firms to a wide range of dynamics and implications (Chen et al., 2021). Common owners, who are often industry specialists with superior information and extensive monitoring experience gained from block cross-holdings, can facilitate industry coordination by enhancing information sharing, reducing information uncertainties, and lowering monitoring costs (He and Huang, 2017; Kang et al., 2018; Edmans

et al., 2019; Chen et al., 2021). State-owned common owners, who combine the characteristics of both state-owned institutional investors and common owners, are expected to positively influence their portfolio firms' environmental performance. First, state-owned entities are responsible for promoting the government's social objectives. Unlike privately owned investors, who prioritize financial returns, state-owned institutional investors are more inclined to pursue social welfare and externalities (Hart and Zingales, 2017). Second, environmental and social engagement often entails significant implementation costs (Dimson et al., 2015), whereas the presence of common state ownership can improve portfolio firms' access to capital. Third, state-owned investors have emerged as leaders in addressing environmental concerns within investee companies (e.g., Hsu et al., 2023). State-owned common owners can play a coordinating role in their portfolio firms, benefiting both the portfolio firms and the entire industry. CSR activities not only enhance the industry's image but also help peers establish legitimacy (Burbano, 2016). Thus, collaborative efforts in environmental engagement can lead to economic efficiency and benefit the entire industry (Cheng et al., 2022). State-owned common owners, being more powerful than other institutional investors, possess the capacity to serve as leaders within portfolio firms to promote environmental protection and sustainability. By contrast, state-owned common ownership may negatively affect CEP because of reduced intra-industry competition (Cheng et al., 2022). Indeed, common owners can play an anti-competitive role in reducing managers' incentives to compete and internalizing the externalities of competitive behaviors (Azar et al., 2018; Park et al., 2019; Azar et al., 2022; Cheng et al., 2022; Lu et al., 2022; Antón et al., 2023). Given the huge costs of implementing environmental engagement (Dimson et al., 2015), common state ownership may decrease the environmental protection activities of portfolio firms. Moreover, common state ownership can naturally provide portfolio firms with government connections, which may reduce their incentive to leverage CSR activities in exchange for government ties and support (Borisova et

al., 2015; Lin et al., 2015; Haveman et al., 2017). Therefore, the anti-competitive effect of common state ownership may reduce CEP.

China exhibits a distinctive characteristic in which the government intervenes directly in the economic system and assumes a critical role in shaping the country's economy. The Chinese government holds the largest share of sovereign wealth funds globally (Megginson et al., 2021). Moreover, eight of the ten major security companies in China are government-owned, underscoring the government's significant presence in key sectors (Lin and Puchniak, 2021).[1] In 2014, the State-Owned Assets Supervision and Administration Commission (SASAC) introduced a pilot program to establish state-owned capital investment and operating companies, expanding the state's role beyond mere block ownership in state-owned enterprises (SOEs). This program signifies the increasing prominence of the state as a major force in Chinese capital markets (Chen and Rithmire, 2020). Environmental pollution has become a pressing issue in China despite its unique sustained GDP growth, raising concerns about the quality of the country's economic progress (Zhang et al., 2020). Zhou et al. (2021) reported that approximately 800 Chinese-listed firms were identified as heavily polluting by the end of 2018[2]. Consequently, environmental protection has gained widespread attention from researchers and the public in China.

Using a large sample of Chinese A-share firms listed on the Shanghai and Shenzhen Stock Exchanges from 2008 to 2019, our study reveals that common state ownership significantly enhances CEP. These results are robust when addressing potential endogeneity concerns. Our mechanism analysis indicates that firms with common state ownership experience lower

[1] According to Lin and Puchniak (2021), eight major Chinese securities companies are ultimately controlled by the government: Huatai Securities Co., Ltd., Guotai Junan Securities Co., Ltd., China Merchants Securities Co., Ltd., Shenwan Hongyuan Group Co., Ltd., Haitong Securities Co., Ltd., China Galaxy Securities Co., Ltd., CICC, and China Securities Co., Ltd.

[2] According to the Classified Management List of Environmental Protection Verification Industry of Listed Companies issued in June 2008, 15 industries—namely, thermal power, steel, cement, electrolytic aluminum, coal, metallurgy, chemical engineering, construction materials, papermaking, brewing, pharmacy, fermentation, textile, leather, and mining—are classified as heavily polluting industries in China (Zhou et al., 2021).

financial constraints and exhibit higher levels of green innovation, ultimately leading to better environmental performance. Furthermore, we observe that state cross-ownership improves industries' green total factor productivity and profitability, reflecting the positive impact of efficient resource allocation facilitated by common state ownership.

Given that political connections can influence a firm's motivation to fulfill its social and political objectives, we conduct further analysis to explore whether the relationship between common state owners and environmental performance varies based on executive political connections and state ownership. Our findings reveal that common state ownership positively impacts CEP only in firms without politically connected CEOs/chairpersons or non-SOEs. This result could be attributed to the social and political pressures that drive firms with politically connected CEOs/chairpersons and SOEs to prioritize CSR initiatives (See, 2009), thereby reducing the effect of state-owned cross-owners in these firms. This finding further supports our hypothesis that state-owned common owners play a leadership role in promoting CEP to fulfill the social goals set by the government.

This study contributes to the growing interest in understanding the role of common state ownership in corporate decision-making. Existing literature has produced mixed results regarding the effect of common ownership on environmental and social performance. Some studies suggest that common ownership promotes CSR performance, leading to spillover effects that reduce systematic risk and enhance investment returns (DesJardine et al., 2023). For instance, Dai and Qiu (2021) show that common ownership enhances CSR performance by strengthening a firm's position in the production market. Conversely, Cheng et al. (2022) find that common ownership has an anti-competitive effect and diminishes the level of CSR. Hirose and Matsumura (2022) suggest that a low level of common ownership can increase CSR, whereas a high degree of common ownership may reduce CSR. In our study, we focus on the effects of common state ownership on CEP. Our findings show that state-owned common

ownership significantly promotes CEP, indicating the social and political objectives of state-owned institutional investors and the leadership role of state-controlled common owners in driving environmental protection. Consequently, we expand the understanding of institutional investor activism in terms of environmental commitment.

Our study also contributes to research on the global rise of state-owned institutional investors as influential stakeholders (e.g., Hsu et al., 2023). While many studies have examined the government's role as a block shareholder in listed firms, such as Megginson and Netter (2001), Megginson (2017), Xie et al. (2019), Boubakri et al. (2020), and Hsu et al. (2023), literature investigating the impact of state-owned institutional investors (an important investor category) on corporate decision-making is still burgeoning. As Megginson et al. (2021) point out, state-owned investors rank among the most significant private equity investors. While prior literature has documented the positive effects of institutional investors on CEP (Dyck et al., 2019), social pressures and public scrutiny may hold greater significance for state-owned investors than privately owned institutions. Our results indicate that state-owned cross-owners assume a leadership role in improving corporate environmental engagement to realize the government's social objectives. We find that state cross-owners improve portfolio firms' access to capital and stimulate green innovation, which, in turn, promotes corporate environmental engagement. Our study provides direct evidence that supports the perspectives of Megginson et al. (2021) and Hsu et al. (2023), who opine that state-owned investors are emerging leaders in promoting environmental initiatives.

Finally, this study contributes to the understanding of state capital and common ownership in emerging markets. State ownership is a prevalent phenomenon in emerging economies (Hsu et al., 2023). For instance, firms in which the state holds a majority share account for approximately two-thirds of China's domestic stock market value. The governments of Brazil and Russia also hold majority or substantial minority shares in publicly listed firms. As

common ownership becomes increasingly widespread and influential in emerging markets, the role of state-owned common ownership in firm decision-making becomes critical. The results of our study may also be applicable to other emerging markets. Recent research on emerging markets (Fu et al., 2022; Athira and Lukose, 2023; Xu et al., 2023; Yao et al., 2023a; Liu and He, 2024; Shi et al., 2024) confirms that common ownership, besides its coordinating and monitoring roles, can play an anti-competition role. Consequently, common state ownership may reduce portfolio firms' environmental engagement due to reduced competition. Nevertheless, our study shows that common state ownership motivates investee companies to engage in environmental protection through resource integration and leadership roles. Our findings indicate that state-owned common ownership can pursue social welfare to achieve the government's social goals, ultimately benefiting businesses and society. These results align with the arguments of Hart and Zingales (2017) and Gillan et al. (2021), asserting that the government is better equipped to address environmental and social issues. Overall, our study sheds light on the importance of common state ownership, and we anticipate that the documented results concerning China will likely be relevant to other emerging markets.

Our findings also have significant policy implications, highlighting the crucial role governments play in addressing environmental issues. It is widely argued that governments are better equipped than corporations to tackle market failures and negative externalities related to environmental or social problems (Hart and Zingales, 2017; Gillan et al., 2021). In emerging markets, where environmental regulations are weaker than in developed economies, governments (particularly in countries such as China) are expected to play a pivotal role in promoting environmental protection. Although the Chinese government has implemented several regulatory policies to encourage corporate environmental protection and green innovation (Jiang et al., 2020), there is further potential for collaboration between the government and its owned institutional investors to drive better environmental preservation

efforts. Our findings reveal the leadership role of common state ownership in promoting CEP. In addition, common state ownership can foster industry coordination and increase green total factor productivity and profitably across the industry. These findings support the view that "a rising tide lifts all boats," as suggested by DesJardine et al. (2023), showing that common ownership can improve portfolio firms' CSR practices and help them minimize negative externalities, ultimately benefiting both businesses and society. Therefore, policymakers should devise strategies to enhance the importance of state-owned common ownership in promoting environmental protection and benefiting both businesses and society.

The remainder of this paper is organized as follows. Section 2 provides a background on institutional investors in China, reviews the relevant literature, and develops the hypotheses. Section 3 describes the data and variable construction. Section 4 presents baseline results, addresses potential endogeneity concerns, and conducts mechanism checks. Section 5 discusses the results and presents conclusions.

## 2. Literature and hypothesis development

### *2.1. State-owned investors in China*

The Chinese government has consistently emphasized the pivotal role of state-owned investors in capital markets, acknowledging their significant influence and impact. According to Megginson et al. (2021), sovereign wealth funds and public pension funds are the two primary categories of state-owned investors globally, with the Chinese government being the largest owner of sovereign wealth funds. In 2014, the SASAC initiated a pilot program to establish state-owned capital investment and operating companies aimed at expanding the state's involvement beyond holding block ownership in SOEs. The introduction of this program marked the emergence of the state as a formidable force in Chinese capital markets, as highlighted by Chen and Rithmire (2020). These state-owned capital investment and operating companies, which do not engage in production or operational activities, were created to

strengthen the state's role in capital markets. The government has ultimate control over decision-making and management appointments in state-owned investment companies, which they can utilize to achieve various social and political goals (Lin and Puchniak, 2021).

### *2.2. Common state ownership and corporate environmental performance*

Environmental, social, and governance (ESG) considerations have gained increasing attention, and many studies have explored topics related to ESG (Khan, 2019; Drempetic et al., 2020; Clementino and Perkins, 2021; Gillan et al., 2021). Among these, CEP and environmental protection have received considerable attention. Industrialization-induced air and water pollution, along with other environmental issues, pose significant challenges to both the living environment and human health (Ebenstein, 2012; Tanaka, 2015). The generation and release of pollutants by firms can directly cause irreversible harm to the local environment and the health and well-being of residents (Chen et al., 2020).

In response to worsening environmental pollution, improving environmental quality and societal well-being has become a distinct social objective of the Chinese government (Hsu et al., 2023). The Chinese government plays a key role in promoting CSR by implementing regulatory policies that foster environmental protection and green innovation (Jiang and Kim, 2020; Jiang et al., 2020). Importantly, the Chinese government leverages state ownership to drive CSR accomplishments (See, 2009). For instance, SOEs are entrusted with fulfilling the government's mandates, particularly regarding environmental protection (Jiang et al., 2020; Wang and Jiang, 2021). Li and Zhang (2010) reveal that SOEs with greater government ownership exhibit higher social responsibility rankings. Hsu et al. (2023) find that state ownership positively affects corporate environmental engagement. Thus, state-owned institutional investors are more likely to align themselves with the government's social objectives regarding environmental protection.

Additionally, because state-owned investors have emerged as significant players in global

financial markets and are renowned for promoting environmental and social policies among investee firms (Megginson et al., 2021), such investors are poised to assume the leadership roles that drive environmental engagement. This is particularly notable when state-owned investors possess substantial cross-holdings, as their government's social objectives and leadership role can exert a more pronounced influence on corporate environmental engagement due to the coordinating effect of common ownership.

### *2.2.1. The competing views on common ownership*

The existing literature finds that common ownership has a significant impact on portfolio firm outcomes. McCahery et al. (2016) provide evidence that institutional investors either engage with executives to influence firm management through direct intervention or choose to exit the firm by selling their shares (voting with their feet), thereby indirectly influencing top executives. Both the "voice" mechanism and the threat of "exit" can incentivize managers to align with the preferences of institutional cross-owners (Edmans et al., 2019).

The anti-competition view argues that common ownership reduces managers' incentives to compete, as the gains of one portfolio firm come at the expense of others, ultimately reducing the overall value of the common owner's portfolio (Hansen and Lott, 1996; Gilo et al., 2006; He and Huang, 2017; Azar et al., 2018). In this vein, Azar et al. (2018) find that common ownership reduces product market competition and leads to higher product prices in the U.S. airline industry by promoting less performance-sensitive contracts. Azar et al. (2022) document that the anti-competitive effects of common ownership result in lower interest rates on deposit accounts and higher maintenance fee thresholds in the U.S. banking industry. Park et al. (2019) find that firms with institutional cross-owners are more likely to disclose information voluntarily because they are less concerned about revealing proprietary information. Antón et al. (2023) suggest that common ownership tends to weaken managerial incentives to compete, resulting in less competitive behavior in product markets. Yao et al. (2023a) document that

blockholder common ownership reduces corporate risk-taking by increasing market concentration and reducing market competition, which support the anti-competition effect of common ownership. These findings challenge corporations' value-maximization objectives when institutional cross-owners possessing monopoly power are not price-takers (Azar et al., 2018).

According to Lewellen and Lewellen (2022), active involvement in corporate governance requires substantial resources from institutional investors to monitor the underlying corporations and engage with the management. In cases where competing investors cross-own firms, it is possible that the engagement from one institution benefits competing institutions, exacerbating the free-riding problem in corporate governance. Additionally, common owners may have incentives to collude with competitors, especially in concentrated industries (Lewellen and Lewellen, 2022).

Another stream of literature suggests that the presence of institutional cross-owners can benefit portfolio firms. First, common ownership facilitates industry coordination, such as strategic alliances, which ultimately enhance firm performance. In intensely competitive industries, rivals within the same sector may create negative externalities such as interfirm lawsuits, advertising wars, and R&D races, adversely impacting the portfolio returns of common owners (He and Huang, 2017). He and Huang (2017) propose that institutional cross-owners provide strategic benefits to portfolio firms by fostering explicit coordination, thereby enhancing their product market performance as measured by profit margins, market share growth, and innovation efficiency. Liu and He (2024) document that common institutional investors can act as an information bridge between two firms in the same industry, which allows the sharing of knowledge and information from one firm to another, thereby leading to similar investment behavior. Consequently, common ownership increases investment efficiency and firm value. These findings align with Hansen and Lott's (1996) notion that cross-

holders aim to reduce rivalry between portfolio firms and play a vital bridge-building role in common ownership.

Furthermore, institutional cross-owners possess an information advantage and can coordinate their invested firms, enabling them to monitor managers more effectively (Edmans et al., 2019). He et al. (2019) observe that institutional cross-owners actively monitor firms and are more likely to vote against management in shareholder-sponsored governance proposals. Kang et al. (2018) propose that institutional cross-owners leverage their information advantages and governance expertise to enhance monitoring, resulting in improved governance outcomes. Ramalingegowda et al. (2020) find that common ownership reduces earnings management by enhancing monitoring effectiveness. Improved monitoring effectiveness also fosters corporate innovation (Gao et al., 2019) and promotes philanthropic giving (Fu and Qin, 2021). Brooks et al. (2018) show that cross-owners have better monitoring and negotiating power to decrease information asymmetry between acquirers and target shareholders. Chen et al. (2021) find that U.S. firms with common owners have better access to financing because they mitigate creditors' concerns about adverse selection. In addition, the positive monitoring effects of common institutional ownership also apply to emerging markets such as China and India. For example, institutional cross-owners can actively play a monitoring and governance role in driving managers to actively engage in CSR (Fu et al., 2022), increasing executive pay-for-performance sensitivity (Xu et al., 2023), mitigating corporate tax avoidance (Athira and Lukose, 2023), and enhancing firm value and lowering loan spreads (Shi et al., 2024). Overall, the enhanced monitoring of common ownership improves corporate governance and leads to improved firm outcomes.

#### *2.2.2. Common state ownership and corporate environmental performance*

The anti-competition view proposes that common ownership reduces managers' incentives to compete because the gains of one portfolio firm come at the expense of other

portfolio firms' gains, leading to an overall reduction in the total portfolio value of the common owner (Azar et al., 2018). Empirical evidence shows that common ownership can lead to anti-competitive behaviors that reduce intra-industry competition (Hansen and Lott, 1996; Gilo et al., 2006; He and Huang, 2017; Azar et al., 2018; Hemphill and Kahan, 2020; Azar et al., 2022). For example, Azar et al. (2018) analyze data from the U.S. airline industry and show that common ownership is associated with higher airline prices and lower firm output. Regarding the U.S. banking industry, Azar et al. (2022) find that common ownership leads to higher banking fees. Moreover, institutional cross-owners decrease managers' competitive drive, thereby leading to weaker performance sensitivity of the top management team (Antón et al., 2023) and lower corporate advertising expenditure (Lu et al., 2022). These results support the anti-competition effect of common ownership.

Dimson et al. (2015) indicate that implementing environmental and social engagements incurs significant costs. Using a large sample of U.S. firms from 1991 to 2015, Cheng et al. (2022) find a negative relation between common ownership and CSR performance; this association is more pronounced in highly competitive industries, which is consistent with an anti-competitive view. Cheng et al. (2022) further argue that the reduced competition resulting from common ownership may diminish portfolio firms' incentives to engage in CSR. Similarly, Hirose and Matsumura (2022) have documented that a high degree of common ownership hinders corporate emission abatement activities. This is because common owners tend to soften competition and increase prices. Therefore, state-owned cross-owners, who play an anti-competition role through common ownership, may have strong incentives to reduce investees' pursuit of CSR activities.

A key distinction between state-owned institutional cross-owners and other types of cross-owners is that common state owners naturally possess government backgrounds and connections. As significant governance intervention actors, governments influence firms

through taxation, subsidies, law enforcement, market regulations, and environmental policies (Pastor and Veronesi, 2012). Consequently, common state owners are more likely to benefit from such government connections than other types of common owners. For instance, firms with government ties enjoy better access to state-controlled resources (Borisova et al., 2015). In China, CSR activities serve as a means for firms to establish bonds with governments (Lin et al., 2015). These government connections help firms better navigate the uncertainty during economic transitions more effectively (Haveman et al., 2017). Given that common state owners naturally possess government connections and better resource access, firms with common state ownership may be less concerned about policy uncertainty than firms without such ownership. Therefore, state-owned common owners may have fewer incentives to engage in CSR activities. State-owned cross-owners may prioritize short-term gains, thereby influencing investee firms to reduce their environmental engagement. Based on this discussion, we propose the following hypothesis:

**Hypothesis 1**: Common state ownership reduces CEP.

By contrast, evidence suggests that common ownership promotes CSR activities (Dai and Qiu, 2021; Yan, 2021; Fu et al., 2022; DesJardine et al., 2023). For instance, Yan (2021) argues that firms invested by common owners are concerned about their potential exit, which could lead to a significant decline in the firm's stock price. Consequently, co-owned firms tend to increase their CSR investments (measured by corporate donations) to enhance their corporate image and foster trust with common owners. Similarly, Dai and Qiu (2021) measure common ownership as the average weight a firm assigns to its industry rivals' profits and find that common ownership is positively associated with corporate CSR performance. They suggest that CSR can serve as a strategic tool for expanding market share in the product market. Likewise, DesJardine et al. (2023) propose a “rising tide lifts all boats” theory, suggesting that a firm's CSR activities can generate positive spillovers for peer firms, while a firm's

irresponsible activities can harm its peers. Therefore, firms with common ownership are more likely to engage in CSR activities to produce spillovers that reduce systemic risk and enhance investment returns (DesJardine et al., 2023). Fu et al. (2022) find that common ownership plays an effective monitoring role in promoting CSR. Based on the signaling theory, they argue that CSR spending can act as a signal that differentiates firms from their peers, particularly in an environment with information asymmetry. Consequently, stakeholders consider firms with strong CSR performance to be valuable.

Common state owners naturally have government backgrounds and connections. In particular, state-owned common owners need to implement the government's social objectives. While the private sector aims to maximize profits, the public sector seeks to address market failures, such as environmental pollution, through the state (Bénabou and Tirole, 2010). For instance, in China, SOEs have the dual objectives of generating profits and implementing state policies, with profit-making being the primary objective for private firms (Jiang and Kim, 2020). Accordingly, the anti-competitive role of common ownership may not apply to state-owned common owners, particularly in China, where the government sets rules. Instead, state-owned common owners can enhance the environmental performance of portfolio firms. First, state-owned common owners are more likely to enhance portfolio firms' access to capital and valuable resources. Politically connected firms have been found to enjoy better access to debt financing (Khwaja and Mian, 2005), receive more bailouts (Faccio et al., 2006), and obtain greater government investment (Duchin and Sosyura, 2012). Moreover, common owners, including state-owned ones, have been shown to enhance portfolio firms' access to financing and alleviate their financial constraints (Yan, 2021). Common state ownership can enhance portfolio firms' environmental performance by improving access to government-controlled resources and easing financial constraints.

Second, state-owned common owners are more likely to play a positive coordinating role among portfolio firms, benefiting individual firms and the entire industry. DesJardine et al. (2023) find that common owners are more likely to promote CSR among portfolio firms to generate positive spillovers for peer firms, reduce systemic risk, and increase returns on investment. Institutional cross-owners can also address free-riding concerns by coordinating with portfolio firms, leading to greater gains from socially responsible engagement (Cheng et al., 2022). Here, CSR activities can enhance an industry's reputation, aid peers in building legitimacy, and attract top talent to the field (Burbano, 2016). Interestingly, state-owned investors are recognized as emerging leaders in terms of responding to investee companies' environmental concerns (Hsu et al., 2023). As powerful investors, common state owners can effectively lead and guide portfolio firms in improving their environmental practices.

Overall, considering the social and political objectives of common state owners, their ability to enhance portfolio firms' access to capital, and their leadership role in environmental engagement, state-owned common owners are expected to enhance their environmental performance. Based on these arguments, we propose the following hypothesis:

**Hypothesis 2**: Common state ownership increases CEP.

## *3.* Research design

### *3.1. Data and sample*

Our initial sample includes all Chinese companies listed on the A-share market in the Shanghai and Shenzhen Stock Exchanges from 2008 to 2019[3]. We selected our sample from 2008 because the data on CEP are available from 2008. The data used to construct corporate environmental engagement measurements is retrieved from WIND, the Chinese Research Data Services Platform (CNRDS), and the Chinese Stock Market and Accounting Research

[3] Our sample period ends in 2019 due to the significant and dramatic negative impact of COVID-19 on the environmental protection activities of listed firms in China.

(CSMAR) databases. Common state ownership measurements are manually collected quarterly from the Institutional Investor database of the CSMAR. Following the prior literature, we exclude (1) financial firms, (2) special treatment (ST) firms, and (3) firm-year observations with missing information for variable construction. To avoid the impact of outlier observations, all continuous variables are winsorized at the 1% and 99% levels. Our final sample includes 3,208 listed firms, consisting of 24,706 firm-year observations.

### *3.2. Common state ownership*

Following He and Huang (2017), Chen et al. (2018), and Chen et al. (2021), we construct three variables to measure common state ownership. **(**1) State cross-ownership ($Cross5Dum\_State$) is a dummy variable that equals one if the firm has at least one common state institutional owner in any of the four quarters of a fiscal year and zero otherwise. A common state owner refers to an institutional investor who is ultimately controlled by the government and holds at least 5% of the outstanding shares in at least two firms in the same industry. (2) Number of state cross-owners ($Cross5Num\_State$): The natural logarithm of one plus the average number of state institutional cross-owners in the focal firm across the four quarters of the fiscal year. (3) Proportion of common state ownership ($Cross5Prop\_State$): the proportion of shares held by all state institutional cross-owners in the focal firm averaged over the four quarters of the year.

### *3.3. Corporate environmental performance*

Prior research has proposed several measures of CEP (Xie and Hayase, 2007; Escrig-Olmedo et al., 2017). Following Yao et al. (2023b), among others, we construct a more comprehensive CEP index. This index is meticulously constructed and centered on three key dimensions of environmental performance: corporate environmental awareness, emissions control, and environmental investment. The three CEP sub-measurements are constructed as follows:

The environmental awareness index ($Awareness$) is measured based on eight indicators that take the value of either one or zero, including whether (i) the firm releases environmental protection concept, environmental guidelines, environmental management organizational structure, recycling economy development model, and green development in the annual report; (ii) the firm releases the achievement of environmental targets in the past year and the future environmental targets; (iii) the firm formulates relevant environmental management systems, regulations, and obligations; (iv) the firm implements environmental education and training programs; (v) the firm engages in environmental protection public welfare activities; (vi) the firm implements emergency response mechanisms for major environment-related emergencies; (vii) the firm receives awards for environmental protection; and (viii) the firm implements the "Three Simultaneity" system[4]. We aggregate the values of the above eight indicators as the environmental awareness score, and $Awareness$ is calculated as follows: (the awareness score of a firm – the minimum awareness score of the year)/(the maximum awareness score of the year – the minimum awareness score of the year). Accordingly, the values of *Awareness* range from zero to one.

The emission control index ($Emission$) is measured by a dummy variable that takes the value of one if the firm adopts policies, measures, or techniques that lead to a reduction of either wastewater, gas, sludge, or greenhouse gas discharge, and zero otherwise. *Emission* evaluates a firm's environmental performance from an output perspective.

The environmental investment index ($Investment$) is constructed based on three indicators that take a value of either one or zero, including whether: (i) the firm exploits or adopts innovations that are beneficial to the environment; (ii) the firm adopts renewable energy policies and measures of the circular economy; and (iii) the firm adopts policies, measures, or

[4] The "Three Simultaneity" system refers to the designing, building, and operating of facilities for the prevention and containment of pollution and other environmental protection facilities in the productive process. This system was proposed by the Chinese government in *the Provisions Concerning the Protection and Improvement of the Environment* in 1973.

techniques to save energy and resources. Similarly, the environmental investment score is an aggregation of the three indicators and $Investment$ is calculated as (the investment score of a firm − the minimum investment score of the year)/(the maximum investment score of the year − the minimum investment score of the year). $Investment$ focuses on whether the firm has made investments and efforts to promote energy conservation and sustainable energy utilization, with values ranging from zero to one. Finally, the CEP index ($CEP\ index$) is an equally weighted average index of $Awareness$, $Emission$, and $Investment$. The $CEP\ index$ is used as the primary dependent variable.

### *3.4. Control variables*

Following Earnhart and Lizal (2006), Flammer (2015), Dixon-Fowler et al. (2017), and Du et al. (2018), we control for many variables that may explain CEP. The controls include ($Firm\ size$), leverage ratio ($Leverage$), return on assets ($ROA$), annual growth rate of sales revenue ($Sales\ growth$), ratio of net cash flows from operating activities to total assets ($OCF$), institutional investor ownership ($IO$), auditing quality ($Big4/10$), board size ($Board\ size$), board independence ($Independence$), CEO ($Duality$), state control ($SOE$), ownership of the largest shareholder ($Top1$), firm age ($Firm\ age$), and proportion of tangible assets ($Tangible$). We also include macroeconomic variables such as the regional GDP growth rate ($GDPG$) and regional population growth rate ($POPG$). The variable definitions are presented in Appendix A.

### *3.5. Model specification*

To examine the relationship between common state ownership and CEP, we use the following regression model:

$$CEP_{i,t} = \beta_0 + \beta_1 Common\_State_{i,t} + \sum_k \beta_k Controls_{k,i,t} + \epsilon_{i,t} \quad (1)$$

where $CEP_{i,t}$ is the CEP measure ($CEP\ index$) of the listed firm $i$ in year $t$. $Common\_State_{i,t}$ represents the three measures of common state ownership in year $t$. $Controls_{k,i,t}$ refers to a set of control variables, including $Firm\ size$, $Leverage$, $ROA$, $Sales\ growth$, $OCF$, $IO$,

$Big4/10$, $Board\ size$, $Independence$, $Duality$, $SOE$, $Top1$, $Firm\ age$, $Tangible$, $GDPG$, and $POPG$. Firm-fixed effects are included in all regressions to control for time-invariant unobserved firm characteristics that could otherwise distort our results. Year-fixed effects are included in all regressions to account for variations and trends across different years, helping to mitigate the influence of time-related factors on CEP. All continuous variables are winsorized at the 1% level in each tail.

## 4. Empirical results

### *4.1. Descriptive statistics and correlation matrix*

Table 1 presents descriptive statistics of the key variables. The mean value of $Cross5Dum\_State$ is 0.074, suggesting that 7.4% of our sample firm-years have at least one state-owned institutional cross-owner. The maximum value of $Cross5Prop\_State$ is 0.521, indicating that state cross-ownership plays a significant role in Chinese-listed firms. The mean value of the $CEP\ index$ is 0.145, ranging from 0 to 1, indicating that the CEP varies widely across firms. Almost one-quarter of the CEOs (24.3%) also hold the position of chair of the board and 42.3% of the sampled firms are classified as SOEs.

***[Insert Table 1 about here]***

Table 2 provides the correlation matrix for the main variables used in our analysis. Common state ownership measures ( $Cross5Dum\_State$ , $Cross5Num\_State$ , and $Cross5Prop\_State$ ) are positively correlated with corporate environment performance measures ( $CEP\ \ index$ , $Awareness$ , $Emission$ , and $Investment$ ). The correlation coefficients between the independent variables are relatively small, suggesting that multicollinearity is not a serious issue in this study.

***[Insert Table 2 about here]***

### *4.2. Common state ownership and corporate environmental performance*

#### *4.2.1. Baseline results*

Table 3 reports the baseline results of the impact of common state ownership on CEP based on Equation (1). The coefficients on three common state ownership measures ( $Cross5Dum\_State$ , $Cross5Num\_State$ , $Cross5Prop\_State$ ) are all positive and statistically significant at the 1% threshold level[5]. In terms of economic significance, for example, in Column (1) of Table 3, the coefficient on $Cross5Dum\_State$ is 0.022, indicating that a firm's environmental performance is 15.17% higher when it is held by a common state owner compared with those that are not[6]. These results indicate that common state ownership promotes the building of eco-friendly corporations. In other words, they suggest that common state owners pursue the government's social objectives and assume a leadership role in enhancing CEP, thereby supporting hypothesis H1. The results are in line with the literature about the positive effect of common ownership on CSR performance (see, e.g., Dai and Qiu, 2021; Yan, 2021; Fu et al., 2022; DesJardine et al., 2023). The results concerning the other variables closely align with the findings of prior relevant studies (see, e.g., Dixon-Fowler et al., 2017; Du et al., 2018). For instance, firms with greater size and lower debt ratio tend to exhibit heightened environmental engagement.

***[Insert Table 3 about here]***

#### *4.2.2. Robustness checks*

*4.2.2.1. Alternative measures of corporate environmental performance*

We further examine the impact of common state ownership on the three sub-measures of CEP: environmental awareness ( $Awareness$ ), emissions control ( $Emission$ ), and

[5] For the robustness check, we use the one-year lagged value of common state ownership and all controls. The results of the baseline model remain qualitatively the same.

[6] We follow Fauver et al. (2017) to calculate the economic significance. 15.17% = 0.022 (coefficient on $Cross5Dum\_State$) / 0.145 (mean value of $CEP$).

environmental investment ($Investment$). The regression results are presented in Table 4. As shown in columns (1) to (3), the coefficients of $Cross5Dum\_State$ are all positive and significant at the conventional level, suggesting that common state ownership can improve a firm's environmental performance[7]. The results remain economically significant. For example, Column (1) shows that, on average, a firm's environmental performance increases by 18.1%[8] if it is cross-held by common state owners compared to firms without common ownership. Therefore, common state ownership enhances CEP. These results support the positive effects of state-controlled cross-owners on environmental engagement.

***[Insert Table 4 about here]***

*4.2.2.2. Alternative measures of common state ownership*

We employ alternative measures of common state ownership to examine the robustness of the baseline results. Table 5 reports the regression results using the alternative common state ownership variables. Following Gao et al. (2019) and Fu and Qin (2021), we gauge common state ownership if a state institutional investor holds at least 3% of the outstanding shares in at least two rival firms in the same industry. Thus, we construct $Cross3Dum\_State$, $Cross3Num\_State$, and $Cross3Prop\_State$ to measure common state ownership. $Cross3Dum\_State$ is a dummy variable that equals one if the firm has at least one state institutional cross-owner (with at least 3% of the outstanding shares) in any of the four quarters of the fiscal year and zero otherwise. $Cross3Num\_State$ is calculated as the natural logarithm of one plus the average number of state institutional cross-owners (with at least 3% of the outstanding shares) in a firm across the four quarters of the fiscal year. $Cross3Prop\_State$ is calculated as the proportion of shares held by all state institutional cross-owners (with at least

[7] Many firm-year observations were omitted when we used the xtlogit command for the regression model in Column (2).

[8] The 18.1% = 0.023/0.127, where 0.023 is $\beta 1$ in Column (1) of Table 4, and 0.127 is the mean value of $Awareness$ in Table 1.

3% of the outstanding shares) in the focal firm averaged over the four quarters of a year. All the control variables from Equation (1) are included in the regression analysis. For simplicity, the results of the control variables are not shown. As shown in Columns (1) to (3), the coefficients of $Cross3Dum\_State$, $Cross3Num\_State$, and $Cross3Prop\_State$ are all positive and statistically significant at conventional threshold levels. Overall, our results still hold after using alternative measures of common state ownership.

***[Insert Table 5 about here]***

*4.2.2.3. Dedicated common state ownership*

Implementing environmental and social engagement comes at significant costs (Dimson et al., 2015) and is frequently accompanied by numerous uncertainties over long investment horizons. Dedicated institutional investors have longer investment horizons and a stronger preference for firms' sustainable growth (Eccles et al., 2014; Kim et al., 2019). In this vein, Chen et al. (2021) find that dedicated institutional cross-owners facilitate the financing of investment opportunities to a greater degree than transient ones. However, Fan and Fu (2020) argue that in the A-share market, institutional investors are more likely to divest firm stocks from their portfolio (referred to as "exit") when dissatisfied with its performance rather than actively monitoring firm operations (referred to as "voice") because of their tendency to excessively focus on short-term gains. This might be true for privately owned institutional investors; however, state-owned common owners need to promote the government's social objectives. Unlike private investors, who place greater emphasis on financial returns, state-owned institutional investors are more inclined to prioritize social welfare and externalities (Hart and Zingales, 2017). Thus, we examine the effects of dedicated common state ownership on CEP. We expect that dedicated state-owned common owners with long-term investment horizons and the need to implement government social objectives will significantly improve CEP.

We construct three variables to measure the effects of dedicated state cross-ownership: $State-Cross5Ded\_Dum$[9], $State-Cross5Ded\_Num$, and $State-Cross5Ded\_MaxPeriod$. $State-Cross5Ded\_Dum$ is a dummy variable that equals one if the firm has at least one state-dedicated institutional cross-owner (with at least 5% of the outstanding shares) in any of the four quarters of a fiscal year, and zero otherwise. $State-Cross5Ded\_Num$ is calculated as the average value of the natural logarithm of one plus the number of state-dedicated cross-owners (with at least 5% of the outstanding shares) in a firm across the four quarters of the fiscal year. $State-Cross5Ded\_MaxPeriod$ is calculated as the natural logarithm of one plus the number of maximum holding periods (measured by quarters) of state-dedicated cross-owners in a year. Table 6 reports the regression results. As shown in columns (1) – (3), the coefficients of all three dedicated common state ownership measures are positive and statistically significant at the 1% level, indicating that the presence of dedicated common state ownership results in better CEP. These results confirm that state-owned common owners with long-term investment horizons are more likely to encourage environmental engagement in their portfolio firms.

***[Insert Table 6 about here]***

### *4.3. Endogeneity*

This section addresses the potential endogeneity. Our baseline estimation controls for the firm- and year-fixed effects to account for unidentified time-invariant firm factors, which may partially address the endogeneity problem. However, the documented results may be affected by selection bias, omitted variables (such as government policies), or driven by reverse causality. For example, a firm with better environmental performance may attract more state cross-owners. We use the propensity score matching (PSM) analysis, the Heckman two-stage

[9] On average, 4.95% of our sample firm-years have at least one dedicated state cross-owner.

analysis, and the two-stage least squares (2SLS) instrumental variable approach to address these concerns.

***4.3.1. PSM analysis***

Following Yuan et al. (2016) and De Villiers et al. (2022), we employ the PSM analysis to examine whether the baseline results are subject to sample selection bias. We first estimate a probit model to predict the likelihood of state-owned cross-owners (*Cross5Dum_State*) presence by including all control variables in Equation (1). The PSM aims to produce two statistically similar samples with and without institutional cross-owners. Then, we estimate the propensity score and perform a one-to-one PSM procedure. For each firm with common state ownership, we select one control firm with the closest propensity score and without common state ownership, constituting the matched control group.[10] Finally, we re-estimate Equation (1) using the PSM-matched sample.

Table 7 reports the regression results. Panel A reports the results from a probit model with a binary *Cross5Dum_State* dummy using the full sample. Large firms, those with higher levels of institutional ownership, and SOEs are more likely to have common state ownership. Panel B shows the regression result of the PSM sample. The coefficients on common state ownership measures ($Cross5Dum\_State$, $Cross5Num\_State$, and $Cross5Prop\_State$) remain positive and significant at least at the 1% level in Columns (2)–(4). Panel C reports the results of covariate balance checks on the mean difference of the covariates in the propensity-matched sample. The differences in means between the covariates of the treated and control groups are insignificant, suggesting the adequacy of our PSM procedure.

Overall, the results suggest that the positive relation between common state ownership and CEP is robust after mitigating the sample selection concern.

[10] We match using the nearest neighbor within a 0.01 caliper (distance) to improve matching accuracy.

**[Insert Table 7 about here]**

### *4.3.2. Heckman-two-stage analysis*

The observed relationship between common state ownership and CEP may be caused by unobservable correlated variables. Following existing studies (e.g., Yan, 2021; Li and Liu, 2023; Xia, 2023), we further employ the Heckman two-stage procedure to address self-selection bias concerns. In the first step, we estimate a probit model with binary $Cross5Dum\_State$ as the dependent variable to predict the likelihood of having a state-controlled common owner. We then estimate the inverse Mills ratio ($Mills$[11]) included in the second stage as an additional independent variable in the environmental performance regression (Equation [1]) to control for potential self-selection bias.

Table 8 reports the results of the Heckman two-stage procedure. The results of the first-step regression show that large firms and SOEs are more likely to have common state ownership. In contrast, high-growth firms and those with large controlling shareholders possessing substantial share ownership are less prone to exhibit common state ownership. The results of the second-step regressions show that the coefficients on three common state ownership measures ($Cross5Dum\_State$, $Cross5Num\_State$, and $Cross5Prop\_State$) are still positive and statistically significant at the 1% level after controlling for the inverse Mills ratio. Thus, the identified relationship between common state ownership and CEP remains valid and does not change after controlling for self-selection bias.

***[Insert Table 8 about here]***

### *4.3.3. 2SLS Instrumental variable approach*

Following prior literature (Gao et al., 2019; Fu and Qin, 2021; Xu et al., 2023; Yao et al., 2023a), we use the external shocks of having a firm newly added to or removed from the

[11] $Mills$ is expected to capture all unobserved differences between the treatment and control groups due to self-selection.

Shanghai Shenzhen 300 Stock Market Index (CSI 300 index) to further address endogeneity problems. CSI 300 index consists of the 300 largest and most liquid Chinese A-share stocks, which is the most representative index of the Chinese stock market[12]. Each adjustment of the CSI 300 index causes a wide range of reactions in the Chinese capital market (Liang et al., 2022). For example, firms newly included in the CSI 300 index tend to receive increased attention from institutional investors. Conversely, firms removed from the CSI 300 index signal a decreased appeal to these investors. Specifically, we employ $CSI300in$ and $CSI300out$ as the two instrumental variables. $CSI300in$ is a dummy variable that equals one if the firm newly enters CSI 300 index, and zero otherwise. $CSI300out$ is a dummy variable that equals one if the firm is removed from CSI 300 index, and zero otherwise. Firms that are newly added to the CSI 300 index are expected to attract more attention from investors and are thus more likely to have common state ownership. While firms removed from this index are less likely to be invested in by common state owners. The CSI 300 index is reconstituted semi-annually: in June and December. China Securities Index Co. Ltd uses the average daily market capitalization and trading volumes in the most recent year of all stocks in the Shanghai and Shenzhen stock exchanges to identify the index constituents (Li and Selvam, 2021). Therefore, the decisions of stock exchanges to add or remove a stock into the CSI 300 index are not driven by the level of CEP. Thus, $CSI300in$ and $CSI300out$ are unlikely to directly affect the environmental performance of listed firms.

Table 9 reports the results of the instrumental variable 2SLS estimation. In the first-stage estimation, $CSI300in$ ($CSI300out$) is positively (negatively) and significantly associated with common state institutional ownership measures ($Cross5Dum\_State$, $Cross5Num\_State$, $Cross5Prop\_State$). This is in line with our expectation that the firms newly added to the CSI 300 index are more likely to attract common state owners, while those removed from this index

[12] The CSI website (http://www.csindex.com.cn).

are less likely to have common state ownership. In the second-stage regression, the fitted values generated from the first-stage estimation are used as the instrumental variables of state cross-ownership measures. The coefficients on the three common state ownership measures are all positive and statistically significant at the 1% threshold level. To ensure the validity of the instrumental variables, we first conduct the weak identification test. The Cragg–Donald Wald F-statistics are all above 10, indicating that our instruments are corrected with $Cross5Dum\_State$. We then perform the over-identification test to ensure the instrumental variables selected in this study are exogenous. The p values of Sargan statistics are 0.326, 0.433, and 0.118 depending on the equation (all greater than 0.1), thereby failing to reject the null hypothesis that all instrumental variables are exogenous. This suggests that our instrumental variables are valid. Overall, the instrumental variable estimation confirms that common state owners can promote CEP.

***[Insert Table 9 about here]***

### *4.4. Mechanism analysis*

In this section, we investigate how state cross-owners promote CEP. State-owned common investors can provide portfolio firms with government connections, which may enhance their access to valuable government resources. These government-controlled resources are expected to ease the financial constraints of portfolio firms. Moreover, state-owned common owners tend to play a leadership role in promoting corporate green engagement within portfolio firms. These common owners possess industry expertise, which enables them to coordinate effectively with firms within the sector (He and Huang, 2017). Such coordination on environmental and social matters can lead to economic efficiency and yield benefits for all firms in the industry (Cheng et al., 2022). For instance, common state owners can coordinate resource allocation to increase green innovation, thereby enhancing the environmental performance of the entire industry.

### *4.4.1. Mitigating corporate financial constraints*

Financial constraints are seen as an important barrier to firm development (Yao et al., 2021), with potentially negative repercussions on CEP. Tighter financial constraints are associated with poorer environmental performance and lower green investment levels (Guérin and Suntheim, 2021). Therefore, reducing financial constraints is an important mechanism for promoting environmental performance. State cross-owners, who are ultimately controlled by the government, have the social and political objectives of promoting environmental protection. Thus, firms with common state ownership are likely to have better access to debt financing (Khwaja and Mian, 2005), be more likely to receive bailouts (Faccio et al., 2006), and receive more government subsidies (Duchin and Sosyura, 2012). Common state ownership is expected to ease the financial constraints of portfolio firms through the resource allocation mechanism, thus increasing CEP.

We examine whether common state ownership can improve a firm's environmental performance by reducing corporate financial constraints in Table 10[13]. Following prior studies (e.g., Hadlock and Pierce, 2010; Linck et al., 2013; Wen et al., 2021; Kurt et al., 2022; Peng et al., 2022), we employ $SA$, which is the absolute value of the SA index,[14] to measure the level of financial constraints. Firms with higher $SA$ values experience more severe financial constraints. In the first stage, we examine whether the presence of state cross-owners decreases financial constraints. As shown in Column (1), the coefficient on $Cross5Dum\_State$ is negative and significant at the 1% level, suggesting that state ownership reduces financial constraints. The fitted values generated from the first-stage estimation are used as the variable of interest in the second-stage regression. These fitted values capture the level of financial constraint that can be mitigated through common state ownership. As shown in Column (2),

[13] We follow Ferreira and Laux (2007) and Cosset et al. (2016) to perform mechanism analysis.

[14] The SA index is calculated as: $SA\ Index_{i,t} = -0.737*Size_{i,t} + 0.043*Size^2_{i,t} - 0.040*Age_{i,t}$, where $Size$ is the natural logarithm of total assets. $Age$ is measured as the logarithm of the company's history.

the coefficient $Predicted - SA$ is negative and statistically significant at the 1% threshold level, indicating a negative effect of financial constraints on environmental performance. Overall, Table 10 suggests that state cross-owners reduce financial constraints, thereby improving CEP.

***[Insert Table 10 about here]***

***4.4.2. Improving corporate green innovation***

Green innovation is one of the most important strategies for sustainable growth because it enables firms to create a competitive advantage while protecting the environment (Porter and Linde, 1995; Berry and Rondinelli, 1998). Specifically, green innovation can help firms save energy and reduce resource consumption and environmental pollution (Ambec and Lanoie, 2008). The Chinese government has promoted green innovation as an important factor in achieving environmental sustainability (Li et al., 2018). Thus, green innovation has an important strategic value for the sustainable development of firms and society (Huang and Li, 2017; Zaman et al., 2021). We expect that common state ownership plays a leadership role in promoting green innovation, which leads to better CEP.

We examine whether common state ownership can improve CEP by increasing corporate green innovation outputs in Table 11. In the first-stage analysis, we examine whether common state ownership increases green innovation ($Green\ innovation$). $Green\ innovation$ is calculated as the natural logarithm of one plus the number of "green" patents applied. The coefficient of $Cross5Dum\_State$ is positive and statistically significant at the 1% threshold level, suggesting that common state ownership promotes green innovation. In the second-stage estimation, the fitted values generated from the first-stage regression are used as the variable of interest to capture the degree of green innovation, which can be explained by common state ownership. As shown in Column (2), the coefficient of $Predicted - Green\ innovation$ is

positive and statistically significant at the 1% level. Therefore, as Table 11 shows, state-owned common owners enhance corporate green innovation, which, in turn, improves CEP.

***[Insert Table 11 about here]***

### *4.4.3. Promoting industry overall performance*

We examine the important role played by common state owners at the industry level. As previously argued, an industry in which more firms are invested by state cross-owners is expected to have better environmental performance at the industry level. To examine whether common state ownership enhances environmental performance at the industry level, we estimate the following regression model:

$$Ind\_benefit_{i,t} = \beta_0 + \beta_1 StateCross5 - ratio_{i,t} + \sum_k \beta_k Controls_{k,i,t} + \epsilon_{i,t} \quad (2)$$

where $Ind\_benefit_{i,t}$ refers to three measures that serve as a proxy for the coordinating role of common state owners within an industry: industry green total factor productivity ($Ind - GTFP$), industry return on invested capital ($Ind - ROIC$), and industry return on long-term invested capital ($Ind - ROLC$). Green total factor productivity (GTFP) better reflects sustainable economic growth by considering energy constraints and environmental performance (Xia and Xu, 2020; Wang and Lee, 2022). Thus, an industry with a higher GTFP level has better green development. We adopt the epsilon-based measure (EBM) model developed by Tone and Tsutsui (2010) to measure the GTFP of each industry year. $Ind - ROIC$ and $Ind - ROLC$ are measures of each industry's annual profitability. *StateCross5-ratio*$_{i,t}$ is the proportion of listed firms owned by common state owners in each industry year. $Controls_{k,i,t}$ include $SOE - ratio$, $HHI$, $Ind - Size$, and $Ind - Lev$. $SOE - ratio$ is the ratio of listed firms ultimately controlled by SOEs or government agencies for all listed firms in each industry year. $HHI$ is the Herfindahl–Hirschman index based on total firm sales[15]. $Ind - Size$ is the natural logarithm of the industry's total assets. $Ind - Lev$ is the book value

[15] The detailed industry classification used in this study is shown in Appendix A.

of an industry's total debt divided by the book value of its total assets. The regressions also control for industry and year-fixed effects.

Table 12 reports the results of the effects of common state ownership on industry performance. In Column (1), the coefficient on $StateCross5-ratio$ is positive and statistically significant at the 5% threshold level, which suggests that state cross-owners increase industry GTFP. In other words, common state ownership leads to the improved green and sustainable development of the whole industry. In columns (2) and (3), $StateCross5-ratio$ is statistically significantly positively associated with $Ind-ROIC$ and $Ind-ROLC$, suggesting that an industry with a higher proportion of firms owned by state cross-owners has better profitability. Overall, the results in Table 12 highlight the important role of state-controlled common owners in improving the industry's overall performance. These results support the finding of Burbano (2016) that CSR activities can enhance the overall image of the industry, thereby benefiting the whole industry.

***[Insert Table 12 about here]***

### *4.5. The role of political connections*

A distinctive feature of the Chinese corporate sector lies in the close relationship between firms and the government. The government influences companies by imposing taxes, offering subsidies, enforcing laws, regulating market competition, and establishing environmental policies (Pastor and Veronesi, 2012). Thus, the government sets the rules of the game and political interference largely affects firm behavior. Given the ingrained nature of political interference in China, it is important to examine its effects on green commitments (Qian and Chen, 2021). In this section, we investigate the moderating effects of executives' political connections and firms' state ownership on the relationship between common state ownership and CEP.

#### *4.5.1. Executive political connection*

First, we assess the role of executives' political connections in the relationship between common state ownership and CEP. Following prior studies such as Fan et al. (2007), Wu et al. (2012), and Wang and You (2022), we construct a dummy variable $PC$ to measure a firm's political connections. This dummy variable equals one if the CEO or chair of the board is (or was) an officer of the central government, local government, a committee member of the Chinese People's Political Consultative Conference (CPPCC), or a committee member of the National People's Congress (NPC). We divide the full sample into two subsamples based on whether a firm has a politically connected CEO or chairman. Politically connected firms are more likely to receive social and government attention and are thereby associated with higher environmental responsibility (Zhang, 2017). Thus, we expect common state ownership to play a more significant role in firms without politically connected CEOs/chairpersons.

We divide our sample into $PC$=1 and $PC$=0 subsamples, including firms with and without politically connected CEOs/chairmen, respectively. We then re-estimate Equation (1) for both subsamples. Panel A of Table 13 presents these results. The positive relationship between $Cross5Dum\_State$ and $CEP$ is statistically significant at the 1% threshold level in the subsample of non-politically connected firms ($PC$=0). By contrast, this positive relationship becomes insignificant for politically connected subsample firms ($PC$=1). These results suggest that the promotional effect of state-institutional cross-owners on environmental performance is more salient for non-politically connected firms. These findings suggest the important role of common state ownership in enhancing CEP.

#### *4.5.2. State ownership*

We further examine the role of state ownership in the positive relationship between common state ownership and CEP. Substantial government ownership is an important institutional feature of the Chinese economy (Xin et al., 2019), leading to state ownership

dominating Chinese listed firms (Huang and Zhu, 2015). The nature of ownership separates Chinese firms into two distinct types: SOEs and non-SOEs. State owners ultimately control SOEs. Traditionally, SOEs are perceived as more likely to initiate and engage in CSR activities (See, 2009). Chen et al. (2018) document that the government views CSR as a critical factor in achieving social objectives. In addition, SOEs' responsiveness to government mandates is the primary driver of managerial decision-making (McWilliams and Siegel, 2001). Given that SOEs may be politically committed to CSR, the positive effect of state cross-owners on environmental performance is expected to be more pronounced among non-SOEs.

In Panel B of Table 13, we divide the full sample into $SOEs$ and $non - SOEs$ subsamples and rerun our baseline regression on these subsamples. As shown in Panel B of Table 13, the positive relationship between $Cross5Dum\_State$ and $CEP\ index$ is only statistically significant at the 5% threshold level in the $non - SOEs$ subsample, whereas this positive effect becomes insignificant in the $SOEs$ subsample. These results indicate that the positive effect of common state ownership on CEP is prevalent among non-SOEs. These findings further support the leadership role of state-controlled cross-owners in promoting CEP.

***[Insert Table 13 about here]***

## *5. Conclusion and discussion*

### *5.1. Results and theoretical contributions*

The prevalence of common ownership in the capital market is on the rise, sparking ongoing debates within the academic field regarding its impact on firm behavior. In tandem with the ascent of state capitalism, the significance of state-owned common ownership has become increasingly prominent and influential. Using a large sample of Chinese-listed firms, our study shows that common state ownership increases CEP, indicating that state-owned common owners actively implement governmental social objectives and play a leadership role in promoting environmental engagement in portfolio firms. The robustness of our results is

confirmed by considering alternative measures of both CEP and common state ownership. Furthermore, we address potential endogeneity issues through Heckman's two-stage analysis and a 2SLS–instrumental variable approach, which consistently support the validity of our findings. Further analysis suggests that state cross-ownership alleviates corporate financial constraints and stimulates portfolio firms' green innovation outputs. These mechanisms explain the positive effects of common state ownership on CEP. Moreover, the coordination effect of common state ownership benefits all firms within an industry, resulting in higher green total factor productivity and industry-level profitability. We also examine the role of political connections in the relationship between common state ownership and corporate environmental engagement. Our findings indicate that the positive influence of common state ownership is particularly pronounced in companies led by non-politically connected CEOs/chairpersons and non-SOEs. This is because SOEs and firms with executive political ties are more inclined to commit to CSR activities to achieve their political and social goals, further supporting the leadership role of state-controlled cross-owners in driving firms' environmental performance.

Our study makes the following key contributions. First, it contributes to the growing literature on the global rise of state-owned institutional investors as influential stakeholders. Literature on the role of the government as a block shareholder in publicly listed firms is still burgeoning (e.g., Carney and Child, 2013; Musacchio and Lazzarini, 2014; Musacchio et al., 2015; Megginson, 2017; Boubakri et al., 2018; Xie et al., 2019; Boubakri et al., 2020; Hsu et al., 2023). State-owned investors, an important investor category, tend to act in the public interest and are more responsive to environmental issues (Besley and Ghatak, 2001; Megginson et al., 2021; Hsu et al., 2023). We examine the effect of state-owned common ownership—a more powerful state-owned investor—on CEP. We find that common state ownership increases investee firms' access to resources and promotes green innovation, thereby leading to better CEP. Specifically, our findings indicate that state-owned common owners play a leadership

role in environmental engagement to achieve the government's social goals. These results highlight and support the findings of Megginson et al. (2021) and Hsu et al. (2023) that state-owned investors are emerging leaders with regard to addressing environmental issues.

Second, this study contributes to the expanding literature on common ownership. Prior studies provide inconclusive evidence of the relationship between common ownership and corporate environmental and social performance, which is either negative (Cheng et al., 2022; Hirose and Matsumura, 2022) or positive (Dai and Qiu, 2021; Yan, 2021; Fu et al., 2022; Hirose and Matsumura, 2022; DesJardine et al., 2023; Wu et al., 2023). Our study extends this strand of literature by showing that state-owned common ownership, an important and more subdivided type of common ownership, significantly improves portfolio firms' environmental performance. We further show that common state ownership helps firms better access resources and promotes green innovation outputs as well as the overall green total factor productivity and profitability across the industry. These results emphasize the leadership and coordinating roles of state-owned common owners in achieving the government's social objectives of enhancing environmental protection. This evidence also highlights and supports DesJardine et al.'s (2023) argument that common ownership benefits both businesses and society by promoting portfolio firms' CSR activities and mitigating their negative externalities.

Third, our study enriches research on the role of common ownership in firm behavior in emerging markets. Most previous studies are conducted in developed markets, whereas research on emerging markets is limited. State ownership is a common phenomenon in emerging markets, and governments have been suggested to be more responsive to environmental protection (Hsu et al., 2023). Hence, the effect of state-owned common ownership on environmental performance in emerging markets remains unexplored. By focusing on a large sample of Chinese listed firms, we confirm that common state ownership

plays a leadership role in increasing CEP to realize the government's social goals. Our results may also apply to other emerging markets.

### *5.2. Policy implications*

Our findings carry significant policy implications. Acknowledging the influential role of state-owned common owners in advancing CEP, policymakers should consider strategies to further amplify their pivotal involvement in fostering green innovation and environmental protection. First, our study underscores the importance of fully recognizing the role of common state ownership in advancing governments' social objectives. State-owned investors are emerging as leaders in addressing environmental issues (Megginson et al., 2021; Hsu et al., 2023). It is crucial to note that common owners benefit investee firms through their coordination effects in the industry (He and Huang, 2017). Therefore, state-owned common owners, driven by the government's social objectives, are expected to assume a leadership role in influencing firm behavior, particularly those related to political and social objectives. Existing literature suggests that governments are better positioned than corporations to efficiently manage ESG/CSR initiatives, given their ability to address market failures and negative externalities (Hart and Zingales, 2017; Gillan et al., 2021). Importantly, the government's role in emerging markets is crucial in driving environmental protection due to relatively weaker environmental regulations compared to developed economies. Overall, policymakers should leverage the leadership role of common state ownership to enhance sustainability and promote social responsibility.

Second, policymakers should pay more attention to the coordination roles of common state owners, particularly in emerging markets. Common owners possess industry expertise and tend to promote industry coordination among portfolio firms (He and Huang, 2017). Such collaboration can be effective in addressing environmental issues that may benefit all firms in the industry (Cheng et al., 2022). In addition, improvement in environmental protection within

an industry can enhance its overall image and attract better talent to the sector (Burbano 2016; DesJardine et al., 2023). Our research shows that common state ownership enhances green total factor productivity and profitability across industries. This finding supports DesJardine et al.'s (2023) argument that common ownership compels portfolio firms to engage in CSR activities and mitigate negative externalities, thereby benefiting both businesses and society. As discussed, regulations and law enforcement are still inefficient in emerging markets, and policymakers in emerging economies may better address sustainability issues by emphasizing the crucial role of common state ownership.

Third, government authorities should contemplate promoting the important role of common state ownership in private firms. The government is likely the most important promoter of CSR in China, and SOEs play a vital role in achieving social goals, including improving environmental quality (Jiang and Kim, 2020; Wang et al., 2022). Our findings indicate that the positive impact of common state ownership on CEP is more pronounced in private firms than in SOEs. Hence, policymakers can foster sustainable development in private firms by encouraging state-owned common ownership.

### *5.3. Limitations and future research*

Our study has some limitations that warrant further research. While a series of robustness checks, such as the 2SLS–instrumental variable approach, indicate that our results are unlikely to be biased by endogeneity, the absence of a strictly exogenous shock poses a challenge in addressing endogeneity. Subsequent research efforts may focus on overcoming this challenge and further enhancing the robustness of the investigated relationships. For instance, the application of difference-in-differences analysis could offer a more effective means of identifying the causal relationship between common state ownership and CEP, especially when a quasi-exogenous shock is available (e.g., the implementation of a specific government regulation that substantially encourages common state ownership).

Second, we construct a more comprehensive CEP index, considering three key aspects: environmental awareness, emissions control, and environmental investment, to gauge the overall environmental performance of listed firms. Similar to prior studies (e.g., Xiao and Shen, 2022; Yao et al., 2023b), the construction of environmental performance measures relies predominantly on the environmental information disclosed by listed companies. However, the transparency of environmental information disclosure is influenced by both costs and benefits (Berglund, 2014); for example, such information may be manipulated to present a favorable environmental report to stakeholders. The integration of advanced technologies, such as the Industrial Internet of Things, has been shown to enhance the availability of real-time environmental data, such as energy consumption (Beier et al., 2018). Therefore, real-time big data on environmental pollution emissions can serve as a more accurate proxy CEP. Due to data constraints, we are unable to measure CEP based on real-time environmental data. Future researchers could leverage these real-time data to further refine the measurement of the environmental performance of listed firms.

In conclusion, we argue that the distinctive characteristics of the state, acting as both the ultimate controller and the institutional investor, necessitate additional exploration. Conducting further empirical research would enhance our understanding of the impact of common state ownership on portfolio firms. Future studies in this field could contribute to policymakers and regulators making more informed policy decisions regarding the increasing global significance of the state as a key investor.

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**Table 1. Descriptive statistics**

This table reports the descriptive statistics of the main variables used in the study. The sample consists of firms listed on the SHSE and SZSE from 2008 to 2019 (24,706 observations). Detailed definitions of variables are presented in Appendix A.

| | (1) Mean | (2) Standard deviation | (3) Minimum | (4) First quartile | (5) Median | (6) Third quartile | (7) Maximum |
|---|---|---|---|---|---|---|---|
| *CEP index* | 0.145 | 0.241 | 0.000 | 0.000 | 0.000 | 0.133 | 1.000 |
| *Awareness* | 0.127 | 0.207 | 0.000 | 0.000 | 0.000 | 0.250 | 1.000 |
| *Emission* | 0.182 | 0.386 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| *Investment* | 0.124 | 0.264 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| *Cross5Dum_State* | 0.074 | 0.261 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| *Cross5Num_State* | 0.052 | 0.187 | 0.000 | 0.000 | 0.000 | 0.000 | 0.693 |
| *Cross5Prop_State* | 0.023 | 0.095 | 0.000 | 0.000 | 0.000 | 0.000 | 0.521 |
| *Firm size* | 22.150 | 1.281 | 19.830 | 21.217 | 21.970 | 22.872 | 26.110 |
| *Leverage* | 0.434 | 0.204 | 0.055 | 0.271 | 0.430 | 0.590 | 0.876 |
| *ROA* | 0.039 | 0.055 | –0.201 | 0.015 | 0.036 | 0.065 | 0.192 |
| *Sales growth* | 0.186 | 0.426 | –0.528 | –0.013 | 0.113 | 0.276 | 2.796 |
| *OCF* | 0.048 | 0.070 | –0.158 | 0.008 | 0.046 | 0.089 | 0.245 |
| *IO* | 0.457 | 0.242 | 0.000 | 0.274 | 0.481 | 0.648 | 0.908 |
| *Big4/10* | 0.531 | 0.499 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 |
| *Board size* | 2.143 | 0.199 | 1.609 | 1.946 | 2.197 | 2.197 | 2.708 |
| *Independence* | 0.374 | 0.053 | 0.333 | 0.333 | 0.333 | 0.429 | 0.571 |
| *Duality* | 0.243 | 0.429 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| *SOE* | 0.422 | 0.494 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 |
| *Top1* | 0.355 | 0.148 | 0.148 | 0.237 | 0.336 | 0.456 | 0.749 |
| *Firm age* | 2.738 | 0.387 | 1.386 | 2.485 | 2.773 | 2.996 | 3.434 |
| *Tangible* | 0.225 | 0.167 | 0.002 | 0.094 | 0.192 | 0.322 | 0.719 |
| *GDPG* | 0.105 | 0.058 | –0.250 | 0.077 | 0.100 | 0.123 | 0.323 |
| *POPG* | 0.009 | 0.019 | –0.084 | 0.003 | 0.006 | 0.012 | 0.199 |

**Table 2: Correlation matrix**

This table reports the Pearson correlation matrix for the variables in the analysis. Detailed definitions of variables are presented in Appendix A.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (19) | (20) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *1. CEP index* | 1.000 | | | | | | | | | | | | | | | | | | | |
| *2. Cross5Dum-State* | 0.140*** | 1.000 | | | | | | | | | | | | | | | | | | |
| *3. Cross5Num-State* | 0.139*** | 0.995*** | 1.000 | | | | | | | | | | | | | | | | | |
| *4. Cross5Prop_State* | 0.153*** | 0.868*** | 0.873*** | 1.000 | | | | | | | | | | | | | | | | |
| *5. Firm size* | 0.493*** | 0.197*** | 0.196*** | 0.210*** | 1.000 | | | | | | | | | | | | | | | |
| *6. Leverage* | 0.175*** | 0.133*** | 0.131*** | 0.133*** | 0.493*** | 1.000 | | | | | | | | | | | | | | |
| *7. ROA* | 0.041*** | –0.035*** | –0.035*** | –0.039*** | –0.005 | –0.360*** | 1.000 | | | | | | | | | | | | | |
| *8. Sales growth* | –0.041*** | –0.025*** | –0.024*** | –0.025*** | 0.046*** | 0.041*** | 0.203*** | 1.000 | | | | | | | | | | | | |
| *9. OCF* | 0.095*** | 0.029*** | 0.029*** | 0.023*** | 0.038*** | –0.152*** | 0.372*** | 0.001 | 1.000 | | | | | | | | | | | |
| *10. IO* | 0.259*** | 0.184*** | 0.183*** | 0.194*** | 0.429*** | 0.229*** | 0.102*** | 0.036*** | 0.121*** | 1.000 | | | | | | | | | | |
| *11. Big4/10* | 0.085*** | 0.037*** | 0.034*** | 0.046*** | 0.146*** | –0.004 | 0.035*** | –0.005 | 0.033*** | 0.031*** | 1.000 | | | | | | | | | |
| *12. Bpard size* | 0.174*** | 0.116*** | 0.115*** | 0.101*** | 0.249*** | 0.157*** | 0.018** | –0.016* | 0.055*** | 0.232*** | 0.002 | 1.000 | | | | | | | | |
| *13. Independence* | 0.004 | –0.030*** | –0.028*** | –0.013* | 0.026*** | –0.012 | –0.023*** | 0.007 | –0.026*** | –0.065*** | 0.028*** | –0.510*** | 1.000 | | | | | | | |
| *14. Duality* | –0.116*** | –0.104*** | –0.102*** | –0.103*** | –0.174*** | –0.149*** | 0.041*** | 0.024*** | –0.015* | –0.210*** | 0.032*** | –0.186*** | 0.113*** | 1.000 | | | | | | |
| *15. SOE* | 0.255*** | 0.271*** | 0.268*** | 0.265*** | 0.334*** | 0.303*** | –0.102*** | –0.069*** | 0.013* | 0.425*** | –0.023*** | 0.279*** | –0.063*** | –0.296*** | 1.000 | | | | | |
| *16. Top1* | 0.127*** | 0.068*** | 0.063*** | 0.135*** | 0.220*** | 0.076*** | 0.115*** | 0.010 | 0.087*** | 0.525*** | 0.061*** | 0.031*** | 0.047*** | –0.051*** | 0.219*** | 1.000 | | | | |
| *17. Firm age* | 0.099*** | 0.064*** | 0.064*** | 0.046*** | 0.166*** | 0.144*** | –0.086*** | –0.040*** | –0.006 | 0.030*** | 0.034*** | –0.005 | –0.010 | –0.076*** | 0.136*** | –0.129*** | 1.000 | | | |
| *18. Tangible* | 0.144*** | 0.153*** | 0.154*** | 0.153*** | 0.083*** | 0.081*** | –0.103*** | –0.085*** | 0.253*** | 0.145*** | –0.010 | 0.172*** | –0.061*** | –0.098*** | 0.212*** | 0.086*** | –0.024*** | 1.000 | | |
| *19. GDPG* | –0.044*** | 0.013* | 0.014* | 0.014* | –0.081*** | 0.055*** | 0.032*** | 0.061*** | –0.013* | 0.067*** | –0.123*** | 0.072*** | –0.029*** | –0.040*** | 0.093*** | 0.021** | –0.188*** | 0.039*** | 1.000 | |
| *20. POPG* | 0.005 | 0.026*** | 0.027*** | 0.045*** | 0.005 | 0.020** | 0.040*** | 0.035*** | –0.004 | 0.040*** | –0.011 | 0.033*** | –0.009 | –0.020** | 0.062*** | 0.048*** | –0.083*** | –0.028*** | 0.147*** | 1.000 |

**Table 3. Common state ownership and corporate environment performance**

This table reports the results of the regression as follows:

$$CEP\ index_{i,t} = \beta_0 + \beta_1 Common5\_State_{i,t} + \sum_k \beta_k Controls_{k,i,t} + \epsilon_{i,t}\ .$$

$CEP\ index_{i,t}$ represents the *CEP index*, which measures firms' overall environmental performance. $Common5\_State_{i,t}$ represents the common state ownership measures, including *Cross5Dum_State*, *Cross5Num_State*, and *Cross5Prop_State*. Appendix A presents the detailed variable definitions. All continuous variables are winsorized at the 1% level in each tail. The regressions control for firm- and year-fixed effects and *t*-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

| | (1) | (2) | (3) |
|---|---|---|---|
| | *CEP index* | *CEP index* | *CEP index* |
| *Cross5Dum_State* | 0.022*** | | |
| | (3.835) | | |
| *Cross5Num_State* | | 0.032*** | |
| | | (3.904) | |
| *Cross5Prop_State* | | | 0.059*** |
| | | | (3.417) |
| *Firm size* | 0.034*** | 0.034*** | 0.034*** |
| | (13.890) | (13.888) | (13.956) |
| *Leverage* | –0.048*** | –0.048*** | –0.048*** |
| | (–4.834) | (–4.831) | (–4.848) |
| *ROA* | 0.021 | 0.021 | 0.021 |
| | (0.899) | (0.902) | (0.907) |
| *Sales growth* | –0.006*** | –0.006*** | –0.006*** |
| | (–2.892) | (–2.893) | (–2.912) |
| *OCF* | 0.009 | 0.009 | 0.009 |
| | (0.578) | (0.581) | (0.583) |
| *IO* | –0.045*** | –0.045*** | –0.044*** |
| | (–4.186) | (–4.189) | (–4.067) |
| *Big 4/10* | –0.002 | –0.002 | –0.002 |
| | (–0.876) | (–0.872) | (–0.852) |
| *Board size* | –0.010 | –0.010 | –0.010 |
| | (–1.011) | (–1.015) | (–1.012) |
| *Independence* | –0.059* | –0.059* | –0.060* |
| | (–1.943) | (–1.946) | (–1.954) |
| *Duality* | –0.003 | –0.003 | –0.003 |
| | (–0.978) | (–0.979) | (–0.946) |
| *SOE* | 0.005 | 0.005 | 0.005 |
| | (0.646) | (0.646) | (0.662) |
| *Top1* | 0.010 | 0.010 | 0.006 |
| | (0.608) | (0.612) | (0.359) |
| *Firm age* | 0.007 | 0.007 | 0.006 |
| | (0.562) | (0.565) | (0.486) |
| *Tangible* | 0.054*** | 0.054*** | 0.055*** |
| | (4.445) | (4.443) | (4.509) |
| *GDPG* | 0.025 | 0.025 | 0.024 |
| | (1.163) | (1.161) | (1.128) |
| *POPG* | –0.100* | –0.100* | –0.101* |
| | (–1.775) | (–1.783) | (–1.793) |
| Constant | –0.631*** | –0.631*** | –0.631*** |
| | (–10.156) | (–10.155) | (–10.154) |
| Firm FE | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes |
| Observations | 24,706 | 24,706 | 24,706 |
| Adjusted $R^2$ | 0.713 | 0.714 | 0.714 |

**Table 4. Alternative measures of CEP**

This table reports the results of the regression as follows:

$$Alt - CEP_{i,t} = \beta_0 + \beta_1 Cross5Dum\_State_{i,t} + \sum_k \beta_k Controls_{k,i,t} + \epsilon_{i,t}$$

$Alt - CEP_{i,t}$ represents the alternative CEP measures, including *Awareness*, *Emission*, and *Investment*. $Cross5Dum\_State_{i,t}$ is the measure of common state ownership. Appendix A presents the detailed variable definitions. All continuous variables are winsorized at the 1% level in each tail. The regressions control for the firm- and year-fixed effects, and *t*-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

| | (1) *Awareness* | (2) *Emission* | (3) *Investment* |
|---|---|---|---|
| *Cross5Dum_State* | 0.023*** | 0.385** | 0.011* |
| | (3.304) | (2.210) | (1.785) |
| *Firm size* | 0.017*** | 0.953*** | 0.046*** |
| | (5.347) | (9.980) | (12.866) |
| *Leverage* | –0.041*** | –1.680*** | –0.031** |
| | (–3.451) | (–4.508) | (–2.305) |
| *ROA* | 0.045* | 0.313 | –0.002 |
| | (1.726) | (0.346) | (–0.052) |
| *Sales growth* | –0.006*** | 0.052 | –0.012*** |
| | (–2.586) | (0.625) | (–4.202) |
| *OCF* | –0.004 | 0.423 | 0.023 |
| | (–0.258) | (0.738) | (1.145) |
| *IO* | –0.034*** | –0.948** | –0.024 |
| | (–2.642) | (–2.325) | (–1.632) |
| *Big 4/10* | –0.002 | –0.000 | –0.005 |
| | (–0.556) | (–0.004) | (–1.405) |
| *Board size* | –0.032*** | 0.020 | –0.011 |
| | (–2.731) | (0.060) | (–0.863) |
| *Independence* | –0.063* | –1.743* | –0.077** |
| | (–1.849) | (–1.794) | (–1.968) |
| *Duality* | –0.003 | –0.001 | –0.008* |
| | (–0.700) | (–0.007) | (–1.847) |
| *SOE* | 0.006 | 0.366 | –0.021** |
| | (0.667) | (1.319) | (–2.007) |
| *Top1* | 0.077*** | –0.667 | 0.024 |
| | (3.815) | (–1.140) | (1.057) |
| *Firm age* | 0.049*** | 0.255 | –0.031** |
| | (3.493) | (0.590) | (–1.971) |
| *Tangible* | 0.060*** | 0.577 | 0.025 |
| | (4.169) | (1.323) | (1.492) |
| *GDPG* | –0.008 | 0.120 | 0.050* |
| | (–0.330) | (0.172) | (1.851) |
| *POPG* | –0.153** | 2.184 | –0.087 |
| | (–2.504) | (1.307) | (–1.239) |
| Constant | –0.414*** | | –0.768*** |
| | (–5.348) | | (–8.654) |
| Firm FE | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes |
| Observations | 24,706 | 7,388 | 24,706 |
| Adjusted $R^2$ | 0.557 | | 0.645 |
| LR chi2 | | 636.07 | |

**Table 5. Alternative measures of common state ownership**

This table reports the results of the regression as follows:

$$CEP\ index_{i,t} = \beta_0 + \beta_1 Common3\_State_{i,t} + \sum_k \beta_k Controls_{k,i,t} + \epsilon_{i,t}$$

$CEP\ index_{i,t}$ represents the *CEP index*. $Common3\_State_{i,t}$ represents the alternative measures of common state ownership, including *Cross3Dum_State*, *Cross3Num_State*, and *Cross3Prop_State*. *Cross3Dum_State* refers to a dummy variable that equals one if the firm has at least one state institutional cross-owner (at least 3% of the outstanding shares) in any of the four quarters of a fiscal year, and zero otherwise. *Cross3Num_State* is calculated as the natural logarithm of one plus the average number of state institutional cross-owners (at least 3% of the outstanding shares) in a firm across the four quarters of a fiscal year. *Cross3Prop_State* is calculated as the proportion of shares held by all state institutional cross-owners (at least 3% of the outstanding shares) in the focal firm averaged over the four quarters in a year. Controls are the same as in Table 3. Appendix A presents the detailed definitions of other variables. All continuous variables are winsorized at the 1% level in each tail. The regressions control for the firm- and year-fixed effects, and *t*-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

| | (1) | (2) | (3) |
|---|---|---|---|
| | *CEP index* | *CEP index* | *CEP index* |
| *Cross3Dum_State* | 0.012** | | |
| | (2.530) | | |
| *Cross3Num_State* | | 0.022*** | |
| | | (3.632) | |
| *Cross3Prop_State* | | | 0.086*** |
| | | | (5.686) |
| Constant | –0.633*** | –0.635*** | –0.633*** |
| | (–10.197) | (–10.219) | (–10.192) |
| Controls | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes |
| Observations | 24,706 | 24,706 | 24,706 |
| Adjusted $R^2$ | 0.713 | 0.714 | 0.714 |

**Table 6. Dedicated common state ownership**

This table reports the results of the impact of dedicated common state ownership on CEP. Dedicated state cross-owners are defined as those who hold at least 5% shares for at least three consecutive quarters in a fiscal year. *State-Cross5Ded_*Dum refers to a dummy variable that equals one if the firm has at least one state-dedicated institutional cross-owner (at least 5% of the outstanding shares) in any of the four quarters of a fiscal year, and zero otherwise. *State-Cross5Ded_Num* is calculated as the average value of the natural logarithm of one plus the number of state-dedicated cross-owners (at least 5% of the outstanding shares) in a firm across the four quarters of a fiscal year. *State-Cross5Ded_MaxPeriod* is calculated as the natural logarithm of one plus the number of the maximum holding period (measured by quarter) of state-dedicated cross-owners in a year. Controls are the same as in Table 3. Appendix A presents the detailed definitions of other variables. All continuous variables are winsorized at the 1% level in each tail. The regressions control for the firm- and year-fixed effects, and *t*-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

| | (1)<br>*CEP index* | (2)<br>*CEP index* | (3)<br>*CEP index* |
|---|---|---|---|
| *State-Cross5Ded_Dum* | 0.024***<br>(4.106) | | |
| *State-Cross5Ded_Num* | | 0.035***<br>(4.106) | |
| *State-Cross5Ded_MaxPeriod* | | | 0.016***<br>(4.210) |
| Constant | –0.634***<br>(–10.226) | –0.635***<br>(–10.228) | –0.636***<br>(–10.230) |
| Controls | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes |
| Observations | 24,706 | 24,706 | 24,706 |
| Adjusted $R^2$ | 0.713 | 0.714 | 0.714 |

**Table 7. PSM test**

This table reports the regression results using a PSM procedure. Panel A reports the results from a probit model with a binary *Cross5Dum_State* dummy using the full sample. Panel B presents the regression results using the propensity-matched sample. Panel C reports the results of covariate balance checks on the mean difference of the covariates in the propensity-matched sample. Variable definitions are provided in Appendix A. All the continuous variables are winsorized at the 1% and 99% levels. The regression in Panel A controls for the industry- and year-fixed effects with standard errors clustered at the firm level. The regressions in Panel B control for the firm- and year-fixed effects. The t-statistics reported in parentheses *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

| Panel A | | Panel B | | |
|---|---|---|---|---|
| | *Cross5Dum_State* | *CEP index* | *CEP index* | *CEP index* |
| | (1) | (2) | (3) | (4) |
| *Cross5Dum_State* | | 0.035*** | | |
| | | (2.621) | | |
| *Cross5Num_State* | | | 0.052*** | |
| | | | (2.785) | |
| *Cross5Prop_State* | | | | 0.079** |
| | | | | (2.410) |
| *Firm size* | 0.091*** | 0.020** | 0.020** | 0.022** |
| | (2.646) | (1.975) | (2.019) | (2.217) |
| *Leverage* | 0.327 | 0.067 | 0.067 | 0.064 |
| | (1.614) | (1.555) | (1.548) | (1.478) |
| *ROA* | –0.509 | 0.119 | 0.121 | 0.119 |
| | (–0.922) | (1.192) | (1.218) | (1.192) |
| *Sales growth* | –0.105*** | -0.023*** | -0.023*** | -0.023*** |
| | (–2.740) | (-2.645) | (-2.679) | (-2.720) |
| *OCF* | –0.117 | 0.096 | 0.096 | 0.095 |
| | (–0.325) | (1.430) | (1.433) | (1.412) |
| *IO* | 1.139*** | -0.053 | -0.056 | -0.052 |
| | (4.763) | (-1.100) | (-1.151) | (-1.066) |
| *Big 4/10* | 0.086 | -0.006 | -0.006 | -0.006 |
| | (1.411) | (-0.590) | (-0.625) | (-0.602) |
| *Board size* | –0.109 | -0.034 | -0.035 | -0.032 |
| | (–0.569) | (-0.939) | (-0.965) | (-0.871) |
| *Independence* | –0.313 | -0.079 | -0.083 | -0.072 |
| | (–0.475) | (-0.730) | (-0.766) | (-0.663) |
| *Duality* | –0.111 | 0.003 | 0.003 | 0.003 |
| | (–1.353) | (0.182) | (0.189) | (0.192) |
| *SOE* | 0.832*** | 0.060 | 0.060 | 0.053 |
| | (9.573) | (1.297) | (1.296) | (1.138) |
| *Top1* | –0.831*** | -0.087 | -0.085 | -0.119* |
| | (–2.924) | (-1.422) | (-1.381) | (-1.935) |
| *Firm age* | 0.161 | 0.053 | 0.053 | 0.047 |
| | (1.289) | (0.996) | (0.998) | (0.883) |
| *Tangible* | 0.354 | 0.029 | 0.029 | 0.030 |
| | (1.522) | (0.723) | (0.731) | (0.750) |
| *GDPG* | –0.042 | 0.230** | 0.230** | 0.224** |
| | (–0.096) | (2.448) | (2.446) | (2.381) |
| *POPG* | 1.671* | -0.744** | -0.747** | -0.749** |
| | (1.755) | (-2.522) | (-2.533) | (-2.540) |
| Constant | –4.809*** | -0.445* | -0.450* | -0.465* |
| | (–5.437) | (-1.664) | (-1.686) | (-1.742) |

| | | | | |
|---|---|---|---|---|
| Industry FE | Yes | No | No | No |
| Year FE | Yes | Yes | Yes | Yes |
| Firm FE | No | Yes | Yes | Yes |
| Observations | 21,751 | 3,436 | 3,436 | 3,436 |
| Adjusted $R^2$ | | 0.713 | 0.713 | 0.713 |
| Pseudo $R^2$ | 0.253 | | | |

| Panel C | Firms with common state ownership | Firms without common state ownership | Diff. in means (t-stat) | Standardized Bias (%) |
|---|---|---|---|---|
| *Firm size* | 22.945 | 22.961 | –0.016 | -1.2 |
| | | | (–0.34) | |
| *Leverage* | 0.522 | 0.520 | 0.002 | 1.4 |
| | | | (0.42) | |
| *ROA* | 0.032 | 0.034 | -0.002 | -2.9 |
| | | | (-0.88) | |
| *Sales growth* | 0.152 | 0.163 | -0.010 | -2.9 |
| | | | (-0.85) | |
| *OCF* | 0.054 | 0.055 | -0.001 | -2.4 |
| | | | (-0.72) | |
| *IO* | 0.606 | 0.605 | 0.001 | 0.3 |
| | | | (0.11) | |
| *Big 4/10* | 0.577 | 0.571 | 0.006 | -1.3 |
| | | | (-0.38) | |
| *Board size* | 2.215 | 2.211 | 0.004 | 1.8 |
| | | | (0.54) | |
| *Independence* | 0.369 | 0.372 | –0.003 | -4.4 |
| | | | (–1.29) | |
| *Duality* | 0.091 | 0.104 | –0.013 | -3.5 |
| | | | (–1.27) | |
| *SOE* | 0.890 | 0.880 | 0.010 | 2.4 |
| | | | (0.91) | |
| *Top1* | 0.389 | 0.389 | 0.000 | 0.1 |
| | | | (0.02) | |
| *Firm age* | 2.819 | 2.823 | -0.004 | -0.9 |
| | | | (-0.29) | |
| *Tangible* | 0.303 | 0.316 | –0.013 | -6.6 |
| | | | (–1.78) | |
| *GDPG* | 0.108 | 0.108 | 0.000 | 1.0 |
| | | | (0.29) | |
| *POPG* | 0.010 | 0.010 | 0.000 | -1.5 |
| | | | (–0.42) | |

**Table 8. Heckman two-stage analysis**

This table reports the regression results using a Heckman two-stage analysis. Panel A reports the results from a probit model with a binary *Cross5Dum_State* dummy using the full sample. We estimate the inverse Mills ratio (*Mills*), and in the second stage, we include *Mills* as an additional independent variable in the baseline regression (Eq. (1)). Panel B presents the regression results after controlling for *Mills*. Variable definitions are provided in Appendix A. All the continuous variables are winsorized at the 1% and 99% levels. The regression in Panel A controls for the industry- and year-fixed effects with standard errors clustered at the firm level. The regressions in Panel B control for the firm- and year-fixed effects. The t-statistics reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

| Panel A | | Panel B | | |
|---|---|---|---|---|
| | *Cross5Dum_State* | *CEP index* | *CEP index* | *CEP index* |
| | (1) | (2) | (3) | (4) |
| *Cross5Dum_State* | | 0.017*** | | |
| | | (2.902) | | |
| *Cross5Num_State* | | | 0.026*** | |
| | | | (2.983) | |
| *Cross5Prop_State* | | | | 0.045** |
| | | | | (2.531) |
| *Firm size* | 0.091*** | 0.032*** | 0.032*** | 0.033*** |
| | (2.646) | (12.031) | (12.030) | (12.072) |
| *Leverage* | 0.327 | –0.047*** | –0.047*** | –0.048*** |
| | (1.614) | (–4.354) | (–4.351) | (–4.377) |
| *ROA* | –0.509 | 0.015 | 0.015 | 0.015 |
| | (–0.922) | (0.601) | (0.603) | (0.606) |
| *Sales growth* | –0.105*** | –0.005** | –0.005** | –0.005** |
| | (–2.740) | (–2.019) | (–2.021) | (–2.026) |
| *OCF* | –0.117 | 0.013 | 0.013 | 0.013 |
| | (–0.325) | (0.772) | (0.773) | (0.777) |
| *IO* | 1.139*** | –0.068*** | –0.068*** | –0.067*** |
| | (4.763) | (–5.368) | (–5.369) | (–5.292) |
| *Big 4/10* | 0.086 | –0.005* | –0.005* | –0.005* |
| | (1.411) | (–1.664) | (–1.661) | (–1.650) |
| *Board size* | –0.109 | –0.011 | –0.011 | –0.011 |
| | (–0.569) | (–0.980) | (–0.983) | (–0.981) |
| *Independence* | –0.313 | –0.062* | –0.062* | –0.062* |
| | (–0.475) | (–1.873) | (–1.876) | (–1.880) |
| *Duality* | –0.111 | –0.002 | –0.002 | –0.002 |
| | (–1.353) | (–0.548) | (–0.549) | (–0.514) |
| *SOE* | 0.832*** | –0.014 | –0.014 | –0.014 |
| | (9.573) | (–1.609) | (–1.608) | (–1.625) |
| *Top1* | –0.831*** | 0.015 | 0.015 | 0.011 |
| | (–2.924) | (0.821) | (0.825) | (0.631) |
| *Firm age* | 0.161 | 0.005 | 0.005 | 0.004 |
| | (1.289) | (0.391) | (0.394) | (0.328) |
| *Tangible* | 0.354 | 0.039*** | 0.039*** | 0.040*** |
| | (1.522) | (2.943) | (2.941) | (2.981) |
| *GDPG* | –0.042 | 0.033 | 0.033 | 0.032 |
| | (–0.096) | (1.409) | (1.407) | (1.379) |
| *POPG* | 1.671* | –0.134** | –0.135** | –0.136** |
| | (1.755) | (–2.192) | (–2.198) | (–2.216) |
| *Mills* | | –0.207*** | –0.206*** | –0.210*** |
| | | (–4.329) | (–4.323) | (–4.394) |

| | | | | |
|---|---|---|---|---|
| Constant | –4.809***<br>(–5.437) | –0.424***<br>(–5.117) | –0.424***<br>(–5.120) | –0.421***<br>(–5.081) |
| Firm FE | No | Yes | Yes | Yes |
| Industry FE | Yes | No | No | No |
| Year FE | Yes | Yes | Yes | Yes |
| Observations | 21,751 | 21,751 | 21,751 | 21,751 |
| Adjusted $R^2$ | | 0.716 | 0.717 | 0.717 |
| Pseudo $R^2$ | 0.253 | | | |

**Table 9. Instrumental variable estimation**

This table presents the impact of common state ownership on CEP using instrumental variable estimation. We use *CSI300in* and *CSI300out* as the instrumental variables of common state ownership. In the first-stage analysis, we regress *CSI300in* and *CSI300out* on common state ownership measures (*Cross5Dum_State*, *Cross5Num_State*, *Cross5Prop_State*) with other independent variables included. In the second-stage analysis, the fitted values generated from the first-stage estimation are employed as the instrumental variable for common state ownership and rerun the baseline regression. The regressions control for the firm- and year-fixed effects. t-statistics are reported in parentheses and *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

| | First stage | | | Second stage | | |
|---|---|---|---|---|---|---|
| | *Cross5Dum_State* | *Cross5Num_State* | *Cross5Prop_State* | *CEP index* | *CEP index* | *CEP index* |
| | | | | (1) | (2) | (3) |
| *CSI300in* | 0.026*** | 0.016*** | 0.013*** | | | |
| | (3.331) | (2.847) | (4.356) | | | |
| *CSI300out* | –0.016** | –0.011** | –0.005* | | | |
| | (–2.074) | (–2.021) | (–1.722) | | | |
| *Cross5Dum_State* | | | | 0.118*** | | |
| | | | | (4.923) | | |
| *Cross5Num_State* | | | | | 0.162*** | |
| | | | | | (4.789) | |
| *Cross5Prop_State* | | | | | | 0.174*** |
| | | | | | | (2.594) |
| Constant | –0.010 | –0.000 | –0.049 | –0.622*** | –0.624*** | –0.623*** |
| | (–0.113) | (–0.004) | (–1.513) | (–10.013) | (–10.037) | (–10.026) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 24,706 | 24,706 | 24,706 | 24,706 | 24,706 | 24,706 |
| Adjusted $R^2$ | 0.674 | 0.680 | 0.664 | 0.713 | 0.714 | 0.714 |
| Cragg-Donald Wald F statistic | 12.33 | 12.28 | 11.44 | | | |
| Sargan statistics (p-value) | 0.326 | 0.433 | 0.118 | | | |

**Table 10. Mechanism test: Mitigating corporate financial constraints.**

This table presents the impact of common state ownership on CEP through reducing firm financial constraints. Column (1) reports the results of the impact of common state ownership (*Cross5Dum_State*) on financial constraints (*SA*). The larger the value of *SA*, the higher the level of financial constraints. Column (2) presents the results of the impact of financial constraints (*SA*) on firm environmental performance (*CEP index*). Controls are the same as in Table 3. All continuous variables are winsorized at the 1% level in each tail. Appendix A presents the detailed variable definitions. The regressions control for the firm- and year-fixed effects, and *t*-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

| | (1)<br>*SA* | (2)<br>*CEP index* |
|---|---|---|
| *Cross5Dum_State* | –0.024***<br>(–9.737) | |
| *Predicted–SA* | | –0.980***<br>(–3.977) |
| Constant | 2.994***<br>(115.269) | 2.300***<br>(3.106) |
| Controls | Yes | Yes |
| Firm FE | Yes | Yes |
| Year FE | Yes | Yes |
| Observations | 24,670 | 24,670 |
| Adjusted $R^2$ | 0.951 | 0.719 |

**Table 11. Mechanism test: Promoting corporate green innovation**

This table reports the results of the impact of common state ownership on CEP through increasing corporate green innovation. Column (1) reports the results of the impact of common state ownership (*Cross5Dum_State*) on firm green innovation (*Green innovation*). Column (2) presents the results of the impact of green innovation (*Green innovation*) on CEP (*CEP index*). Controls are the same as in Table 3. All continuous variables are winsorized at the 1% level in each tail. Appendix A presents the detailed variable definitions. The regressions control for the firm- and year-fixed effects, and *t*-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

| | (1)<br>*Green Innovation* | (2)<br>*CEP index* |
|---|---|---|
| *Cross5Dum_State* | 0.085*** | |
| | (2.998) | |
| *Predicted-Green Innovation* | | 0.261*** |
| | | (3.835) |
| Constant | –6.454*** | 1.057** |
| | (–21.247) | (2.375) |
| Controls | Yes | Yes |
| Firm FE | Yes | Yes |
| Year FE | Yes | Yes |
| Observations | 24,706 | 24,706 |
| Adjusted $R^2$ | 0.694 | 0.714 |

**Table 12. Common state ownership and industry overall performance**
This table reports the results of the regression as follows:

$$Ind\_benefit_{i,t} = \beta_0 + \beta_1 StateCross5 - ratio_{i,t} + \sum_k \beta_k Controls_{k,i,t} + \epsilon_{i,t}$$

$Ind\_benefit_{i,t}$ refers to three measures that proxy the coordination effects of common state ownership in the industry, including *Ind-GTFP*, *Ind-ROIC*, and *Ind-ROLC*. $Controls_{k,i,t}$ includes *SOE-ratio*, *HHI*, *Ind-Size*, and *Ind-Lev*. All continuous variables are winsorized at the 1% level in each tail. Appendix A presents the detailed variable definitions. The regressions control for the industry- and year-fixed effects and t-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

| | (1)<br>*Ind-GTFP* | (2)<br>*Ind-ROIC* | (3)<br>*Ind-ROLTC* |
|---|---|---|---|
| *StateCross5-ratio* | 0.587** | 0.135*** | 0.103*** |
| | (2.337) | (3.851) | (3.129) |
| *SOE-ratio* | –0.285*** | 0.013 | 0.010 |
| | (–3.254) | (0.784) | (0.664) |
| *HHI* | 0.099 | 0.048*** | 0.019 |
| | (0.650) | (2.758) | (1.144) |
| *Ind-Size* | –0.001 | 0.004 | 0.004 |
| | (–0.040) | (1.091) | (1.253) |
| *Ind-Lev* | 0.241 | –0.107*** | –0.125*** |
| | (1.403) | (–4.671) | (–5.833) |
| Constant | 0.709* | –0.012 | –0.004 |
| | (1.710) | (–0.125) | (–0.052) |
| Industry FE | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes |
| Observations | 514 | 514 | 514 |
| Adjusted $R^2$ | 0.885 | 0.605 | 0.674 |

**Table 13. Political connection**

Panel A of the table and Panel B show the regression results of subsample analyses based on executive political connection and state ownership, respectively.

Panel A. Executive political connection

Panel A shows the regression results of subsample analyses based on executive political connections. *PC* is a dummy variable that equals one if the CEO or chairman is politically connected, and 0 otherwise. *Cross5Dum_State*, *CEP index*, and controls are the same as in Table 3. Appendix A presents the detailed variable definitions. The regressions control for the firm- and year-fixed effects, and *t*–statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

| | *PC*=1 | *PC*=0 |
|---|---|---|
| | (1) | (2) |
| | *CEP index* | *CEP index* |
| *Cross5Dum_State* | -0.002 | 0.024*** |
| | (–0.148) | (3.485) |
| Constant | –0.861*** | –0.616*** |
| | (–6.522) | (–7.812) |
| Controls | Yes | Yes |
| Firm FE | Yes | Yes |
| Year FE | Yes | Yes |
| Observations | 8,632 | 16,074 |
| Adjusted $R^2$ | 0.725 | 0.732 |

Panel B. State ownership

Panel B shows the regression results of subsample analyses based on ownership structure. The government ultimately controls SOEs. A more precise state cross-owner dummy, *Cross5Dum_State*, is constructed to capture the setting that a firm only has state cross-owners without the representative of privately owned cross-owners. The *CEP index* and controls are the same as in Table 3. Appendix A presents the detailed variable definitions. All continuous variables are winsorized at the 1% level in each tail. The regressions control for the firm- and year-fixed effects, and *t*-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

| | SOEs | non-SOEs |
|---|---|---|
| | (1) | (2) |
| | *CEP index* | *CEP index* |
| *Cross5Dum_State* | 0.007 | 0.029** |
| | (0.854) | (2.368) |
| Constant | –1.033*** | –0.599*** |
| | (–8.366) | (–8.578) |
| Controls | Yes | Yes |
| Firm FE | Yes | Yes |
| Year FE | Yes | Yes |
| Observations | 10,422 | 14,284 |
| Adjusted $R^2$ | 0.713 | 0.683 |

**Appendix A: Variable Definition**

| | |
|---|---|
| *CEP index* | Corporate environmental performance index is the average value of the three sub–measures that include environmental awareness, emission, and environmental investment. |
| *Awareness* | Environmental awareness index. *Awareness* is calculated as (environmental awareness score of a firm – the minimum awareness score of the year)/(the maximum awareness score of the year – the minimum awareness score of the year). The awareness score is the aggregation of eight dummy variables, including (i) whether the firm releases environmental protection concepts, environmental guidelines, environmental management organizational structure, recycling economy development model, and green development in the annual report; (ii) whether the firm releases the achievement of environmental targets in the past year and the future environmental targets; (iii) whether the firm formulates relevant environmental management system, regulations, obligations; (iv) whether the firm conducts environmental education and training; (v) whether the firm engages in environmental protection public welfare activities; (vi) whether the firm constructs emergency response mechanism for major environment-related emergencies; (vii) whether the firm receives awards in environmental protection; and (viii) whether the firm implements the "Three Simultaneity" system. |
| *Emission* | Emission control index, an indicator variable, equals one if the firm adopts policies, measures, or techniques to reduce wastewater, gas, sludge, and greenhouse gas discharge, and zero otherwise. |
| *Investment* | Environmental investment index. *Investment* is calculated as (environmental investment score of a firm – the minimum investment score of the year)/(the maximum investment score of the year – the minimum investment score of the year). The investment score is the aggregation of three dummy variables, including (i) whether the firm exploits or adopts innovative products, equipment, or techniques that are beneficial to the environment; (ii) whether the firm adopts renewable energy or policies and measures of the circular economy; (iii) whether the firm adopts policies, measures, or techniques to save energy and resources. |
| *Cross5Dum_State* | A dummy variable that equals one if the focal firm has at least one state institutional cross-owner (at least 5% of the outstanding shares) in any of the four quarters of a fiscal year, and zero otherwise. |
| *Cross5Num_State* | The natural logarithm of one plus the average number of state institutional cross-owners (at least 5% of the outstanding shares) in a firm across the four quarters of a year. |
| *Cross5Prop_State* | The proportion of shares held by all state institutional cross-owners (at least 5% of the outstanding shares) in the focal firm averaged over the four quarters in a year. |
| *Cross3Dum_State* | A dummy variable that equals one if the firm has at least one state institutional cross-owner (at least 3% of the outstanding shares) in any of the four quarters of a fiscal year, and zero otherwise. |
| *Cross3Num_State* | The natural logarithm of one plus the average number of state institutional cross-owners (at least 3% of the outstanding shares) in a firm across the four quarters of a fiscal year. |

| | |
|---|---|
| *Cross3Prop_State* | The proportion of shares held by all state institutional cross-owners (at least 3% of the outstanding shares) in the focal firm averaged over the four quarters in a year. |
| *State-Cross5Ded_Dum* | A dummy variable that equals one if the firm has at least one state-dedicated institutional cross-owner (at least 5% of the outstanding shares) in any of the four quarters of a fiscal year, and zero otherwise. |
| *State-Cross5Ded_Num* | The average value of the natural logarithm of one plus the number of state-dedicated cross-owners (at least 5% of the outstanding shares) in a firm across the four quarters of a fiscal year. |
| *State-Cross5Ded_MaxPeriod* | The natural logarithm of one plus the number of the maximum holding period (measured by quarter) of state-dedicated cross-owners in a year. |
| *Firm size* | The natural logarithm of total assets. |
| *Leverage* | The book value of total debt divided by the book value of total assets. |
| *ROA* | Net income divided by total assets. |
| *Sales growth* | The annual growth rate of sales income. |
| *OCF* | The ratio of net cash flows from operating activities to total assets. |
| *IO* | The percentage of shares held by institutional investors. |
| *Big4/10* | A dummy variable that equals one if the firm hires an international Big4 auditor or national Big10 auditor, and zero otherwise. |
| *Board size* | The natural logarithm of the total number of directors on the board. |
| *Independence* | The proportion of independent directors to the total number of directors on the board. |
| *Duality* | A dummy variable that equals one if the same person holds the chief executive officer (CEO) and board chair positions, and zero otherwise. |
| *SOE* | A dummy variable that equals one if the ultimate controller is an SOE or government agency, and zero otherwise. |
| *Top1* | Percentage of shares owned by the largest shareholder. |
| *Firm age* | The natural logarithm of one plus the number of years since a firm's establishment. |
| *Tangible* | Tangible assets over total assets. |
| *GDPG* | The annual provincial GDP growth rate. |
| *POPG* | The annual provincial population growth rate. |
| *SA* | The absolute value of the SA index following Hadlock and Pierce (2010). |
| *Green innovation* | The natural logarithm of one plus the number of patents applied that are "green." |
| *CSI300in* | A dummy variable that equals one if the firm newly enters the CSI 300 index and zero otherwise. |
| *CSI300out* | A dummy variable that equals one if the firm is removed from the CSI 300 index and zero otherwise. |

| | |
|---|---|
| *StateCross5-ratio* | The ratio of listed firms held by common state owners of all listed firms in each industry year. |
| *SOE-ratio* | The ratio of listed firms is ultimately controlled by SOEs or government agencies of all listed firms in each industry year. |
| *HHI* | Herfindahl–Hirschman Index is based on the corporate total sales computed at the 47 industries. |
| *Ind-Size* | The natural logarithm of total assets of an industry. |
| *Ind-Lev* | The book value of the total debt of an industry divided by the book value of the industry's total assets. |
| *Ind-GTFP* | Green total factor productivity of an industry. |
| *Ind-ROIC* | Return on invested capital of an industry, which is measured as (Net profit + Financial expenses) / (Total assets – Total current liabilities + Notes payable + Short-term borrowings + Non-current liabilities due within one year). |
| *Ind-ROLC* | Return on long-term invested capital of an industry, measured as (Total profit + financial expenses)/ (Total average balance of non-current liabilities + Total average balance of owner's equity). |
| *Industry classification* | Industry is set according to the industry classification code issued by the China Securities Regulatory Commission in 2012; for manufacturing, the industry is set according to the industry category code plus the first two digits of the industry segmentation code, whereas other industries are set according to the industry category code. There are 47 industries in total. |

# The rise of common state ownership and corporate environmental performance

## Highlights

Common state ownership comes with higher corporate environmental performance.

Common state ownership promotes environmental performance by easing financial constraints.

Common state ownership enhances environmental performance by promoting green innovation.

Common state ownership increases industry green total factor productivity and profitability.

The positive relationship is weaker for politically connected firms.