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Abstract: This paper investigates the relationship between institutional pressure and corporate carbon reduction engagement, as well as the moderating effect of ultimate ownership in China. Using a sample of 2511 firms that were listed on the Shanghai and Shenzhen Stock Exchanges in 2014 and 2015, we find that institutional pressure arising from government evaluation has a positive influence on corporate carbon reduction engagement. Moreover, the positive effect is stronger for non-state-owned enterprises (NSOEs) than for state-owned enterprises (SOEs). The subsequent analysis shows that carbon reduction engagement in NSOEs is positively associated with firms' access to state-owned bank loans. We further observe that there is a momentum of carbon reduction engagement due to institutional pressure. Our findings shed light on how institutional pressure influences firms' decision to engage in carbon reduction and the effectiveness of the carbon reduction policy in China.

Keywords: Institutional pressure; Ultimate ownership; Carbon reduction engagement; Financial incentive.

1 Introduction

Scientific evidence for climate change and the heat-trapping nature of carbon dioxide and other gases is unequivocal. For the first time, all nations came to a unanimous decision to undertake collective efforts to combat climate change at the 2015 Paris Climate Summit, and 170 Parties have ratified the Paris Agreement Convention so far. Since the US pulled out of this Convention in June 2017, China has been taking a leading role in the global climate action and ecological civilization endeavor. In the past twenty years, China has achieved an average annual gross domestic product (GDP) growth rate of 10% and had the second largest GDP in the world in 2015. However, this rapid economic growth has jeopardized the environmental conditions in China, and China replaced the United States as the world's largest carbon emitter in 2009. As a result, the Chinese government is determined to improve the environmental conditions and to transform from a capital-intensive and industry-dominated economy to a more sustainable one with a particular focus on fulfilling its international responsibility to tackle climate change issues and to reduce carbon emissions. Therefore, it is interesting to study how the Chinese government has promoted its low-carbon economy and the Chinese firms' responses to these initiatives.

In China, both the central and local governments prioritized economic development over environmental concerns until the eleventh Five-Year Plan. This Plan, however, only provided a general statement on controlling climate change without specifying the actual targets or performance measures. In the twelfth Five-Year Plan, unprecedented attention was given to climate change issues, and specific targets and comprehensive measures were introduced. However, this system did not noticeably alter the local officials' political incentives to engage in carbon abatement (Sun, 2018). In addition, the policies were poorly implemented and were distorted by the local officials due to unreasonable configurations of the objectives and the imperfect statistical system (Lo, 2014). In the thirteenth Five-Year Plan, the Chinese

government further listed climate change mitigation and carbon emission reductions as one of the five focuses of its agenda. This reflects the great determination of the central government to tackle climate change issues. More importantly, since 2014, the central government has designated the National Development and Reform Commission (NDRC), a powerful authority in China, to evaluate the progress on regional carbon reductions. The evaluation can then be used as an explicit reference in the appointment, promotion, and rotation of local government officials. According to the coercive isomorphism of institutional theory (DiMaggio & Powell, 1983), the evaluation scheme is expected to exert incremental institutional pressure on local governments and firms and, as a result, a balance between sustainable economic development and continuous climate change improvements has to be achieved. Institutional pressure refers to the force that is exerted on firms within the same field to constrain organizational choices and ensure organizational conformity (Colwell & Joshi, 2013). This study takes advantage of this unique institutional dynamic to investigate firms' responses to the institutional pressures that are caused by the carbon evaluation mechanism.

While more attention has been paid to institutional pressure as an important driving force of corporate carbon reduction engagement (Baboukardos, 2017; de Aguiar & Bebbington, 2014; Herold, Farr-Wharton, Lee, & Groschopf, 2018; Herold & Lee, 2019; Lan, 2017; Luo, Lan, & Tang, 2012; Niedertscheider, Haas, & Görg, 2018; Sadler, 2016; Tang, 2018), the findings of previous studies have yielded mixed results. For instance, some studies find that institutional pressure has a positive influence on corporate carbon reduction engagement (e.g., Herold et al., 2018; Herold & Lee, 2019; Tang, 2018), while others reveal that the influence is insignificant (e.g., Lo, 2014; Sun, 2018). Moreover, firms respond heterogeneously to institutional pressure (Colwell & Joshi, 2013; Fikru, 2014), and corporate carbon reduction disclosures and performance vary extensively between firms when they are

subject to a homogeneous level of institutional pressure (Lan, 2017). Thus, it is necessary to empirically investigate the potential factors that drive firms' heterogeneous responses to institutional pressure.

Previous studies demonstrate how firm size, competitive position and the degree of internationalization moderate institutional pressure on firms' environmental engagement (Sadler, 2016), but the understanding of how ultimate ownership affects this relationship remains limited. In China, firms' ultimate ownership is an important schema for reflecting corporate traits that affect cognition and behavior. Ultimate ownership refers to the identity of the largest shareholder, that is, the ultimate owner (La Porta, Lopez-de-Silanes, & Shleifer, 1999; Ruiqi, Wang, Xu, & Yuan, 2017). State-owned enterprises (SOEs) are assets of government, and their ultimate owners belong to the government or government-controlled institutions (Ruiqi et al., 2017). SOEs are therefore perceived not simply as business entities but also as affiliations of the government. Prior studies evidence the existence of regulatory discrimination between SOEs and non-state-owned enterprises (NSOEs) (Wei & Wang, 1997; Yen & Abosag, 2016), which is exacerbated by the variation in the economic and legal institutions across different provinces in China (Kusnadi, Yang, & Zhou, 2015). Nevertheless, this linkage does not exempt firms from institutional pressure; instead, it changes the nature of firms' responsiveness to the pressure (Cui & Jiang, 2012).

This study focuses on the impact of institutional pressure and ultimate ownership on corporate carbon reduction engagement in the Chinese setting. Some existing studies provide evidence on binding regulations and mandatory policies concerning firms' social and environmental engagement (Andrew & Cortese, 2011; Baboukardos, 2017), while in China, the issue of environmental policy is mainly in the form of notifications and it, essentially, lacks authority (Liao, 2018). Zhao (2012) highlights the importance of nonregulatory state-business interactions for understanding the dynamics of corporate social and environmental

responsibilities. The author calls for further studies on the institution-organization linkage to understand the nature of firms' social and environmental responsibilities beyond mere legal compliance. Our study responds to this call by investigating the association between the Chinese government's carbon evaluation scheme and corporate carbon reduction engagement. In particular, we advance the existing literature by offering a political perspective on whether the ultimate ownership influences firms' carbon reduction decisions in response to institutional pressure.

We examine a sample of Chinese listed firms from 2014 to 2015, during which the central government delegated the NDRC to evaluate the local carbon reduction performance. We employ carbon reduction reporting and carbon reduction performance as the two measures of corporate carbon reduction engagement. After controlling for other determinants that were used in the existing literature, our results show that institutional pressure arising from the evaluation scheme has been effective at promoting firms' engagement in carbon reduction. Consistent with an institutional and political view of legitimacy, NSOEs are more responsive than SOEs to such institutional pressure. Further tests reveal that the carbon reduction engagement of NSOEs has a significant impact on firms' access to state-owned bank loans while no significant impact is found for government subsidies. This partly explains why NSOEs are more responsive to government initiatives.

The contributions of this paper are threefold. First, our research identifies the motivational role of institutional pressure on firms' carbon reduction engagement in China, which complements the existing evidence on the determinants of carbon reduction engagement (Ben-Amar, Chang, & McIlkenny, 2017; Ben-Amar, McIlkenny, & Comyns, 2015; Liao, Luo, & Tang, 2015). Current literature on the role of the government in promoting corporate carbon reduction engagement often focus on the institutional pressure from formal regulatory frameworks and policies (Andrew & Cortese, 2011; Baboukardos,

2017), the institutional pressure that is perceived by firms (Lan, 2017; Tang, 2018), and the institutional pressure from government initiatives in developed economies (Liu & Yang, 2018; Tauringana & Chithambo, 2015). For developing economies such as China, businesses tend to prioritize profits and growth over social and environmental responsibilities, and thus mandatory interventions from the government are deemed to be essential (Lo, 2014; Sun, 2018). Indeed, Lo (2014) and Sun (2018) report that the Chinese government's energy-conservation target responsibility system has not noticeably changed the local governments' incentives to reduce carbon emissions. However, our findings show that the introduction of the evaluation and monitoring mechanism has imposed a stronger incentive for firms to engage in carbon reduction activities.

Second, this study advances the understanding of the influence of ultimate ownership on firms' carbon reduction decisions from a political perspective. Some institutional scholars suggest that coercive pressure results in industry and firm-level heterogeneity rather than isomorphism (Clemens & Douglas, 2006; Hoffman, 1999). Our findings highlight the importance of ultimate ownership in explaining firms' heterogeneous responsiveness to the institutional pressure, e.g., NSOEs are more responsive than SOEs. Prior research has examined the institutional mechanism in which firms are independent of institutions (Colwell & Joshi, 2013; Fikru, 2014; Herold & Lee, 2019; Tingey-Holyoak, 2014), but very few studies have examined the institutional process when firms are naturally connected to the institutions (Cui & Jiang, 2012; Lan, 2017; Tang, 2018). Our study provides a unique setting to empirically examine firms' heterogeneous responses to homogenous pressure.

Third, we provide important insights into the financial incentives motivating firms to engage in government's carbon reduction policies. According to the China Banking Regulatory Commission, firms with carbon reduction engagement could benefit from concessional loans at relatively lower interest rates. Our further analysis on firms' access to

state-owned bank loans further substantiates the existence of financial incentives that underlie the influence of institutional pressure on firms' carbon reduction engagement. Government financial support is an effective incentive to motivate firms to strike a balance between their financial performance and their social and environmental responsibilities.

The remainder of this paper is organized as follows. Section 2 reviews the related literature and develops the research hypotheses. Section 3 presents the research methodology. Section 4 discusses the empirical results and the conclusion follows in Section 5.

2 Literature Review and Hypotheses Development

2.1 Institutional pressure and carbon reduction engagement

Institutional theory is concerned with the relationship between the organization and its environment and recognizes the influence of the environment on organizational structures and processes (DiMaggio & Powell, 1983; Scott, 2006). While the efficiency incentive is not sufficient to explain why organizations are becoming more homogeneous, institutional theory posits that organizations incorporate social and institutional beliefs in order to maintain their stability and legitimacy in society rather than to achieve organizational efficiency (DiMaggio & Powell, 1983; Meyer & Rowan, 1977). Institutional theory, therefore, asserts that the external environment and the institutions create pressure for an adaptation cycle and lead to homogeneity in organizational structures and practices, where isomorphism best captures the homogenization process among organizations (DiMaggio & Powell, 1983). DiMaggio and Powell (1983) argue that coercive forces, as well as normative and mimetic forces, force organizations to adopt specific strategies. Coercive refers to the ways in which organizations are coerced into a course of actions as a result of both formal and informal pressures that exerted on the organization by other institutions. Institutions that are able to enforce such changes in organizations are usually powerful constituents, e.g., the government, certification bodies or powerful stakeholders.

Institutional theory has been applied to the study of corporate responsiveness to environmental issues. For example, institutional pressure is found to be an important determinant of corporate carbon reduction performance (Lan, 2017; Niedertscheider et al., 2018) and carbon reduction disclosures (Baboukardos, 2017; de Aguiar & Bebbington, 2014; Lan, 2017; Luo et al., 2012; Sadler, 2016; Tang, 2018). Other studies find that corporate environmental management decisions are reactions to multiple internal and external pressures that coexist and are coconstructed with institutional pressure (Herold et al., 2018; Herold & Lee, 2019; Rothenberg, 2007). In addition, institutional pressure also influences the association between corporate carbon emission disclosure and carbon emission performance (Luo, 2017). However, the empirical results of institutional pressure on firms' environmental engagement are not conclusive. Lo (2014) and Sun (2018) conclude that the institutional pressure from the energy conservation scheme in China has an insignificant influence on local officials' incentives to engage in carbon reduction.

Indeed, the Chinese central government launched energy conservation on a nationwide scale in 2005 and introduced energy conservation into the target responsibility system to evaluate local governments in 2006. This initiative, before the introduction of the NDRC evaluation, was overshadowed by economic targets and did not promote the convergence of per capita CO_2 emissions (Sun, 2018). Since 2014, the Chinese central government has delegated the NDRC as a powerful authority to evaluate and publish regional carbon reduction progress and the results would constitute an explicit reference in the appointment, promotion, and rotation of local government officials, which is a typical reflection of a regionally decentralized authoritarian regime (RDAR). China has been characterized as an RDAR country (Xu, 2011). The RDAR features highly centralized political and personnel controls at the national level, and a regionally decentralized administrative and economic system (Xu, 2011). Despite the extensive autonomy of the local governments, the central

government retains the ultimate power to appoint, promote, and rotate local officials, which serves as a powerful incentive for local officials to follow the central government's policies.

As a transitional economy and RDAR, the Chinese government intervenes in economic and social activities not only through regulations and taxation but also through channels such as enforcement, licenses, quotas, permits, and franchise assignments (Lee, Walker, & Zeng, 2017; Wong, 2016). Although the central government has not directly intervened in carbon reduction, the launch of a regional carbon reduction evaluation scheme could play a vital role in urging local governments and their regional enterprises to engage. According to the coercive isomorphism of institutional theory, firms are coerced into a course of actions as a result of both formal and informal pressures that exerted on the organization by other institutions (DiMaggio & Powell, 1983). Although the energy conservation initiative is found to have an insignificant influence on carbon abatement in its earlier stage (Lo, 2014; Sun, 2018), we argue that when the central government prioritized carbon reduction in its agenda and appointed the NDRC to monitor the progress, coercive pressure was formed on local governments and firms. This discussion leads to our first hypothesis:

H1 Corporate carbon reduction engagement is positively associated with institutional pressure.

2.2 Institutional pressure, ultimate ownership and carbon reduction engagement

Some institutional scholars argue that institutional pressure, particularly coercive pressure, results in industry and firm-level variations in strategies and practices rather than isomorphism (Clemens & Douglas, 2006; Hoffman, 1999). Firms will consider their current circumstances when making decisions under institutional pressure (Berrone, Fosfuri, Gelabert, & Gomez-Mejia, 2013). Previous study demonstrates how firm size, competitive position and the degree of internationalization moderate institutional pressure on firms' environmental engagement (Sadler, 2016); however, the understanding of the effect of ultimate ownership

on such a relationship remains limited. Ultimate ownership affects corporate responsiveness to institutional pressure in the following ways.

First, firms need to proactively secure legitimacy for their long-term growth prospects (Dowling & Pfeffer, 1975), which is especially vital for NSOEs. With institutional pressure from local government, NSOEs are expected to be more responsive in promptly adopting the government's policies. In contrast, when facing institutional dynamics, SOEs have very limited legitimacy threats due to government protection. As such, NSOEs are likely to be more responsive to institutional pressure than SOEs.

Second, SOEs, whose ultimate owner is the government, are highly influenced by national policies to assist the government in accomplishing broader political and social goals (Jefferson, 1998). The management of SOEs in China is composed of quasi-government officials who are evaluated by a bureaucratic system that is not necessarily focusing on firms' profitability but rather on carrying out government policy mandates (Dong & Putterman, 2003). Consequently, SOEs are more likely to actively engage in carbon reduction due to their nature than NSOEs and are not just limited to despondence to institutional pressure. Therefore, the link between institutional pressure and carbon reduction engagement should be weaker in SOEs.

Third, because of being highly connected to the government, SOEs have soft budget constraints and are also entitled to more financial resources than NSOEs (Dong & Putterman, 2003; Wong, 2016). Generally, SOEs have better access to government-supported resources, which help them to engage in environmental-friendly activities (Lee et al., 2017). NSOEs need to cultivate/maintain connections with the government to acquire better operating environments and financial benefits (Kusnadi et al., 2015; Yen & Abosag, 2016), such as easier access to the debt market (Herbohn, Gao, & Clarkson, 2017; Jung, Herbohn, & Clarkson, 2016) and government subsidies (Lee et al., 2017). The government often uses

financial policy, such as concessional loans and government subsidies, to inspire firms to conform to the institutional pressure. To gain access to more financial resources, NSOEs are expected to be more sensitive to government carbon reduction initiatives than SOEs.

From these perspectives, we argue that NSOEs' carbon reduction engagement is more correlated with institutional pressure than that of SOEs'. Based on the above arguments, we posit our second hypothesis as follows:

H2 The positive relationship between institutional pressure and corporate carbon reduction engagement is more pronounced among NSOEs than SOEs.

3 Research Design

3.1 Sample and data

Our initial sample includes all A-share listed companies in China from 2014 to 2015. We investigate the period from 2014 to 2015 for the following reasons: (1) the evaluation of provincial carbon reductions by the NDRC began in 2014, (2) the evaluation was restructured after 2015 with the start of the next Five-Year Plan in which there are incomparable regional carbon reduction targets (Yuan & Zuo, 2011), and (3) the data of the regional evaluation results of the Thirteenth Five-Year Plan are not publicly available. We process the sample according to the following criteria: (1) companies in the financial industry are excluded (101 observations), and (2) samples with missing data are excluded (1,305 observations). Our final sample includes 4,663 firm-year observations of 2,511 listed companies. Financial and corporate governance data are obtained from the China Securities Markets and Accounting Research database (CSMAR).

3.2 Dependent variable: corporate carbon reduction engagement

Concerning corporate carbon reduction engagement, we consider both carbon reduction reporting and carbon reduction performance. In recent climate change studies, it is consistently accepted that carbon emission performance or carbon emission reporting should

not be examined alone without considering the other (Matsumura, Prakash, & Vera-Muñoz, 2014). We therefore employ two measures of carbon reduction engagement: carbon reduction reporting (*CRE1*) and carbon reduction performance (*CRE2*).

With regard to *CRE1*, we follow a qualitative content analysis approach to rate the disclosure quality of firms' annual reports and CSR reports (Qiu, Shaukat, & Tharyan, 2016; Wiseman, 1982). Each report was hand-reviewed to acquire the detail descriptions of the carbon reduction information. A score of 2 was assigned if quantitative carbon reduction related information was present, a score of 1 was assigned if only qualitative carbon reduction related information is disclosed, and a score of 0 was assigned otherwise.

CRE2 is measured using the Energy Saving Scores from the Hexun.com CSR database. Hexun.com was founded in 1996 and has become one of China's largest financial information portals. Its Social and Environmental Responsibility ratings are designed to evaluate a firm's engagement in the supply chain, employee welfare, shareholder interests, and social and environmental issues, which are widely used in previous research (Han, You, & Nan, 2019; Li, Zhang, & Foo, 2013). The Environment Responsibility rating covers five areas: Energy Savings, Types of Pollution, Investment in Environment Protection, the Accreditation of the Environment Management System, and Environmental Consciousness. Energy Savings is one of the most efficient ways for carbon reduction and it can also be implemented in any sector. We therefore employ the energy saving data as a proxy of a firm's carbon reduction performance.

3.3 Independent variable: institutional pressure

Institutional pressure (*IP*) is measured based on the NDRC's evaluation results of the carbon reduction in different regions. Since 2014, the NDRC, on behalf of the Chinese central government, has taken the responsibility to assess and rank the carbon reduction progress of each province. In addition to ranking the provincial carbon reduction performance,

the NDRC also grades the results into outstanding, good, pass and fail. The results constitute an important reference for the appointment, promotion, and rotation of local government officials. Based on institutional theory, we expect that the evaluation results will create significant institutional pressure for local governments to improve their carbon performance in the following year, and the institutional pressure will be higher for companies with lower grades. We therefore score *IP* from 1 to 4 according to the evaluation results (1 = the evaluation grade is outstanding, and 4 = the evaluation grade is failing). As a robustness test, we also replace institutional pressure with the ranking in the evaluation result (*IP_R*). The details of the evaluation results for the years 2013 and 2014 from the NDRC website are shown in Table 1.

[Insert Table 1 about here]

3.4 Moderating variable: ultimate ownership

We rely on ultimate ownership (SOEs vs NSOEs) as a moderator of the relationship between institutional pressure and carbon reduction engagement. *SOE* is an indicator variable that equals 1 if the ultimate owner is the government or a government-controlled institution, and it is 0 otherwise (Ruiqi et al., 2017). The information is obtained from CSMAR.

3.5 Control variables

Following prior studies (Ioannou, Li, & Serafeim, 2016; Matsumura et al., 2014; Sadler, 2016), we control for the province- and firm-specific factors in our regression analysis. For the macro province-specific factors, we use regional GDP growth as a proxy for degree of local economic development attention (*GDPgrowth*) and area distinction to measure regional economic, legal and culture differences (*Area*). For the firm-specific factors, we control for industries based on the categories that are used in the NDRC's guidelines. The NDRC issues guidelines on the measuring and reporting greenhouse gas emissions, which requests that high pollution industries report their carbon emission data. The industry difference (*INDD*) is

coded as one if the industry is classified as a high pollution industry in the NDRC guidelines and zero otherwise. Following Sadler (2016), we also control for market force factors in our model, which include the degree of internationalization (*Export*) and competitive position (*Marketshare*). A firm's fixed-asset investment usually requires related environmental assessments, and we control for the increase of fixed assets (*Invest*) in the model (Ioannou et al., 2016). Corporate governance practices have potential effects on carbon reduction strategies, and, therefore, the institutional shareholding ratio (*II*), the shareholding ratio of the largest shareholder (*F1*), and the total number of directors (*Direc*tor) are controlled (Ben-Amar et al., 2017; Dyck, Lins, Roth, & Wagner, 2019). We further control for firm growth using the book-to-market ratio *(BTM*) (Matsumura et al., 2014). Finally, we also consider the firms' financial characteristics that affect corporate climate-change strategies, such as firm size (*Size*), firm leverage (*Lev*), and firm profitability (*ROA*) (Clarkson, Li, Richardson, & Vasvari, 2010). Table 2 presents the detailed descriptions of all the variables in the models.

[Insert Table 2 about here]

3.6 Model specification

To test the effect of institutional pressure on corporate carbon reduction engagement, as well as the moderating effect of ultimate ownership, our regression models are as follows:

$$\begin{aligned} CRE_{i,t} = {} & \alpha_0 + \alpha_1 IP_{i,t} + \alpha_2 SOE_{i,t} + \alpha_3 GDPgrowth_{i,t} + \alpha_4 Area_{i,t} + \alpha_5 INDD_{i,t} + \alpha_6 Export_{i,t} + \alpha_7 Marketshare_{i,t} \\ & + \alpha_8 Invest_{i,t} + \alpha_9 II_{i,t} + \alpha_{10} F1_{i,t} + \alpha_{11} Director_{i,t} + \alpha_{12} BTM_{i,t} + \alpha_{13} Size_{i,t} + \alpha_{14} Lev_{i,t} + \alpha_{15} ROA_{i,t} \\ & + \sum Industry + \sum Year + \varepsilon \end{aligned} \quad (1)$$

$$\begin{aligned} CRE_{i,t} = {} & \alpha_0 + \alpha_1 IP_{i,t} + \alpha_2 SOE_{i,t} + \alpha_3 IP_{i,t} * SOE_{i,t} + \alpha_4 GDPgrowth_{i,t} + \alpha_5 Area_{i,t} + \alpha_6 INDD_{i,t} + \alpha_7 Export_{i,t} \\ & + \alpha_8 Marketshare_{i,t} + \alpha_9 Invest_{i,t} + \alpha_{10} II_{i,t} + \alpha_{11} F1_{i,t} + \alpha_{12} Director_{i,t} + \alpha_{13} BTM_{i,t} + \alpha_{14} Size_{i,t} \\ & + \alpha_{15} Lev_{i,t} + \alpha_{16} ROA_{i,t} + \sum Industry + \sum Year + \varepsilon \end{aligned} \quad (2)$$

In all models, *i* and *t* denote the firm and year, respectively. We include industry and year fixed effects and use ordinary least squares (OLS) regressions for the estimation. Based on H1, we expect the coefficient of *IP* to be significantly positive. To test the moderating effect of ultimate ownership on the relationship between institutional pressure and carbon

reduction engagement, we add the interaction item between institutional pressure (*IP*) and ultimate ownership (*SOE*) in model (2). The coefficient of the interaction item (*IP***SOE*) is expected to be significantly negative according to H2.

4 Empirical results

4.1 Descriptive statistics

Table 3 presents the descriptive statistics of the sample firms. Firms' engagement in carbon reduction is quite low in terms of both reporting and performance. The average carbon reduction reporting (*CRE1*) is only 0.264 while the maximum score that a firm could get is 2. Regarding the carbon reduction performance (*CRE2*), the mean is 0.333 with a maximum score of 7 and a minimum of zero. The decisions to disclose carbon information and to reduce carbon emissions are both very low (mean of *CRE1_D*: 0.171 and mean of *CRE2_D*: 0.077). Institutional pressure (*IP*) ranges from 1 to 4 with a mean of 1.228, which indicates that the pressure for most companies is mild and less dispersed (sd =0.525). The second measure of institutional pressure (*IP_R*) using the evaluation ranking for the robustness check ranges from 1 to 31. The variable *SOE* averages 0.395 and reflects that 39.5% of sample firms are SOEs.

[Insert Table 3 about here]

4.2 Multivariate analysis

Institutional pressure and corporate carbon reduction engagement

Table 4 presents the results of our regression with different measures of carbon reduction engagement and different sets of fixed effects. The results using carbon disclosure measures are presented in columns 4-1 to 4-4 and the results using energy saving measures are presented in columns 4-5 to 4-8. *IP* is significantly positively associated with *CRE1* (coefficient = 0.031 and t-stat = 2.220 in column 4-4) and *CRE2* (coefficient = 0.203 and t-stat = 3.869 in column 4-8), which is consistent with our prediction in hypothesis H1. In

terms of marginal effects, a one unit increase in institutional pressure increases the carbon reduction reporting by 0.031 and the carbon reduction performance by 0.203, which is economically significant compared with the mean of carbon reduction engagement. Our results indicate that institutional pressure from governmental carbon reduction evaluations is more likely to promote firms' engagement in carbon reduction activities. Moreover, ultimate ownership is also positively associated with firms' carbon reduction reporting (coefficient = 0.114 and t-stat = 5.527 in column 4-4) and carbon reduction performance (coefficient = 0.126 and t-stat = 2.242 in column 4-8), suggesting that SOEs are more active in carbon reduction engagement than NSOEs.

[Insert Table 4 about here]

Institutional pressure, ultimate ownership and corporate carbon reduction engagement

Table 5 presents the evidence for hypothesis H2. First, we decompose the full sample into SOEs and NSOEs and separately compare the coefficients of institutional pressure between the two groups. The results show that institutional pressure is significantly and positively associated with a firm's disclosure of carbon information for the NSOE group (*CRE1* coefficient = 0.076 and t-stat = 3.162) while the association is insignificant for the SOE group (*CRE1* coefficient = 0.003 and t-stat = 0.126). Moreover, the coefficient of carbon reduction performance (*CRE2*) is higher for the NSOEs (coefficient = 0.278 and t-stat = 6.959) than for the SOEs (coefficient = 0.164 and t-stat = 2.513). For comparison, we use the seemingly unrelated estimation (suest) and conduct a χ^2 test to test the differences in the coefficients of *IP*. We find a significant difference for *CRE1* and a marginal difference for *CRE2*. This is preliminarily consistent with hypothesis H2. Second, we apply Model (2) to investigate the interaction effect between institutional pressure and ultimate ownership on corporate carbon reduction engagement. The coefficients of *IP*SOE* on *CRE1* and *CRE2* are both significantly negative, suggesting that NSOEs are more responsive to institutional

pressure than SOEs. The results indicate that the effects of institutional pressure on carbon reduction engagement are distinguishable between SOEs and NSOEs. Our findings support H2 that the positive association between institutional pressure and carbon reduction engagement is more pronounced for NSOEs than SOEs. From a public policy perspective, our results highlight the importance of nonregulatory state-business interactions beyond legal compliance.

[Insert Table 5 about here]

4.3 Further analysis

Carbon reduction engagement and financial resources

Having documented that institutional pressure increases firms' carbon reduction reporting and promotes more carbon reduction performance, we try to further substantiate our conjecture that firms' concern over access to different financial resources drives their carbon reduction engagement (Jung et al., 2016; Kusnadi et al., 2015). For example, according to the China Banking Regulatory Commission, firms with carbon reduction engagement could obtain concessional loans at relatively lower interest rates. Concerning financial resources, we focus on concessional loans and subsidies from the government, which are found to be linked with firms' social and environmental related activities in the previous literature (Jung et al., 2016; Lee et al., 2017).

We divide the sample into two groups according to their ultimate ownership: SOEs and NSOEs. Regarding concessional loans, we use whether a firm can obtain loans from a state-owned bank (*Loanstate*) as a proxy (Firth, Lin, & Wong, 2008; Sapienza, 2004). As discussed in previous research, state-owned banks charge lower interest rates, impose fewer restrictions on capital expenditures (Firth et al., 2008; Sapienza, 2004), and especially favor SOEs over NSOEs (Wei & Wang, 1997). Following Sapienza (2004), we code *Loanstate* as 1 if a firm gets one or more loans from a state-owned bank (Agricultural Bank of China,

Agricultural Development Bank of China, Bank of China, Bank of Communications, China Construction Bank, China Development Bank, Industrial and Commercial Bank of China, Postal Savings Bank of China, or Export-Import Bank of China), and 0 otherwise. Referring to Lim, Wang & Zeng (2015) and Minnis (2011), we also include several control variables for the potential effect on *Loanstate* in model (3), including the area distinction (*Area*), industry difference (*INDD*), the book-to-market ratio (*BTM*), firm size (*Size*), leverage (*Lev*), firm profitability (*ROA*), the shareholding ratio of the largest shareholder (*F1*), the tangible asset ratio (*TOA*), cash flows (*CFO*), and firm age (*Age*).

Concerning government subsidies, we focus on corporate carbon related subsidies that are identified from the footnote information in financial statements in the CSMAR database. First, we identify the carbon related subsidies whose account abstracts contain the following key words: 'carbon', 'environment', 'green', 'energy saving', 'clean technology' and 'ecology'. Then, we aggregate the subsidies by firm and year, and get the carbon related subsidies and the total amount of carbon related subsidies. Last, we scale the carbon related subsidies using the total revenue. Following Lim et al. (2015), we also consider a number of factors as possible determinants of subsidies by including the area distinction (*Area*), the industry difference (*INDD*), the book-to-market ratio (*BTM*), firm size (*Size*), leverage (*Lev*), firm profitability (*ROA*), the shareholding ratio of the largest shareholder (*F1*), the firm tax rate (*Htax*), the earning target (*ET*) and the carbon related subsidies of the last year (*LSubsidy*) in model (4).

All the data of above variables is obtained from CSMAR. Industry and year fixed effects are included in all models. The detailed descriptions of the variables' definitions are given in Table 2. Our regression models are as follows:

$$\begin{aligned} Loanstate_{i,t} = {} & \delta_0 + \delta_1 CRE_{i,t} + \delta_2 Area_{i,t} + \delta_3 INDD_{i,t} + \delta_4 BTM_{i,t} + \delta_5 Size_{i,t} + \delta_6 Lev_{i,t} + \delta_7 ROA_{i,t} + \delta_8 F1_{i,t} \\ & + \delta_9 TOA_{i,t} + \delta_{10} CFO_{i,t} + \delta_{11} Age_{i,t} + \sum Industry + \sum Year + \varepsilon \end{aligned} \quad (3)$$

$$Subsidy_{i,t} = \chi_0 + \chi_1 CRE_{i,t} + \chi_2 Area_{i,t} + \chi_3 INDD_{i,t} + \chi_4 BTM_{i,t} + \chi_5 Size_{i,t} + \chi_6 Lev_{i,t} + \chi_7 ROA_{i,t} + \chi_8 F1_{i,t} + \chi_9 Htax_{i,t} + \chi_{10} ET_{i,t} + \chi_{11} LSubsidy_{i,t} + \sum Industry + \sum Year + \varepsilon \quad (4)$$

Table 6 shows that carbon reduction reporting and performance are significantly and positively associated with firms' access to state-owned bank loans for NSOEs (shown in columns 6-2 and 6-6), while the results are insignificant for SOEs. In addition, when using the seemingly unrelated estimation (suest) and conducting a χ^2 test to compare the coefficients of *CRE*, we find statistically significant differences between SOEs and NSOEs regarding firms' access to state-owned bank loans. The likelihood of NSOEs' access to state-owned bank loans increases by 15.2% (which is double the marginal effect of *CRE1* on *Loanstate*, 0.076) and 25.9% (which is seven times the marginal effect of *CRE2* on *Loanstate*, 0.037), respectively, when *CRE1* and *CRE2* increase from their minimum to maximum. Government subsidies are not found to be linked with firms' carbon reduction engagement. Overall, the findings substantiate our inference that financial incentives, especially concessional loans, drive NSOEs' responses to government carbon reduction initiatives, which is consistent with the assumption of H2.

[Insert Table 6 about here]

Corporate carbon reduction engagement before and after the evaluation

From the above discussion, we find that the institutional pressure from the evaluation scheme has a positive influence on corporate carbon reduction engagement. While our research design has the advantage of observing the corporate response to institutional pressure in a pure carbon reduction setting, the relatively short time period we examined does not allow us to fully address the heterogeneity across the firms. To enable a comparison of corporate carbon reduction engagement before and after the evaluation was launched, we collected additional data on our sample firms during the years 2012 and 2013 using the same coding approach. To empirically test the difference, we add a period dummy variable (*Post*)

in the original models, which equals 1 if the year is 2014 and 2015, and 0 otherwise. We also add the interaction term between institutional pressure (*IP*) and the period dummy variable (*Post*), which is expected to have a positive coefficient according to hypothesis H1. The regression statistics are presented in Table 7 and the results are consistent. Particularly, the interaction term (*Post*IP*) is significantly positive, showing that the institutional pressure during the evaluation period can truly enhance corporate carbon engagement after controlling for the potential effect of the evaluation's implementation.

[Insert Table 7 about here]

Institutional pressure and subsequent corporate carbon reduction engagement

Corporate carbon reduction engagement may be limited by existing conditions and may be realized in the next few years. We therefore further test the influence of institutional pressure on subsequent corporate carbon reduction engagement. We have collected the data for the year 2016, which is the beginning of the Thirteen Five-Year Plan, and we expect that there is a momentum of corporate carbon reduction under institutional pressure.

Table 8 shows the empirical results. Institutional pressure (IP_{t-1}) in the year 2015 has a significantly positive effect on corporate carbon reduction reporting and performance in the year 2016, while there is no positive effect of the institutional pressure in the year 2014 (IP_{t-2}). The results evidence a momentum of carbon reduction under institutional pressure, which may persist for one year. We also examine the interaction effect of previous institutional pressure and ultimate ownership on corporate carbon reduction engagement and find insignificant results (the coefficients of $IP_{t-1}*SOE_t$ and $IP_{t-2}*SOE_t$ are both insignificant). This means that NSOEs are more likely to strategically manage their carbon reduction engagement in response to the temporal institutional pressure.

[Insert Table 8 about here]

4.4 Robustness check

Alternative regression model

Because the dependent variables *CRE1* and *CRE2* are nonnegative, we use a negative binomial model to test hypotheses H1 and H2 for robustness check. The empirical results are shown in Table 9 Panel A. The coefficients of *IP* are all significantly positive and the interaction item (*IP*SOE*) is significantly negative, which is similar to the main results.

Alternative measures of key variables

As a robustness check, we replicate our tests of hypotheses H1 and H2 with alternative measures of our key variables *IP*, *CRE1* and *CRE2*. We first use the natural logarithm of *IP* to diminish the variance of the institutional pressure measure. Second, we change the independent variable (*IP*) to the ranking, which ranges from 1 to 31 (*IP_R*). The results that are shown in Panel B (1) and (2) of Table 9 also support our hypotheses H1 and H2.

We further assess the robustness of our measurement choice of corporate carbon reduction engagement. We use dummy variables to measure corporate carbon reduction engagement (*CRE1_D* and *CRE2_D*) in our model to test hypotheses H1 and H2 by applying a logistic regression. We get consistent results, as shown in Table 9 Panel B (3). We also use the dummy variables *CRE1* and *CRE2* to test the effects of carbon reduction engagement on firms' access to state-owned bank loans and government subsidies. The results that are shown in Table 10 Panel A remain robust.

Alternative sample–excluding NSOEs with political connections

NSOEs with political connections have informal ties with bureaucrats and can receive unique resources from the government (Wang, Xu, Zhang, & Shu, 2018). We therefore conduct an additional test to check whether there is any potential endogeneity issue due to the political connections of some NSOEs. We exclude the NSOEs with political connections from our original sample. Following prior research (Feng, Johansson, & Zhang, 2015; Wang

et al., 2018), an NSOE is politically connected if the firm's ultimate owner, board member or CEO is the member of the People's Congress or the People's Political Consultative Conference. The results that are shown in Panel C of Table 9 and Panel B of Table 10 are consistent with the main analysis.

[Insert Table 9 and Table 10 about here]

4.5 Other endogeneity issues

To eliminate concerns over the selection bias of engaging in carbon reduction activities, we use the propensity-score matching method to compare the loans and subsides of firms that engage in carbon reduction with a matched sample of firms that are not involved in carbon reduction activities, assuming that selection occurs using observable firm characteristics.

Specifically, following the prior literature (Rosenbaum & Rubin, 1983), we first use the carbon reduction engagement dummy variables (*CRE1_D* and *CRE2_D*) as independent variables and apply a probit model, which is similar to model (1), to estimate the probability of engaging in carbon reduction activities within the full sample. Next, we calculate the propensity score for each observation based on the above regression and match each engaging firm with non-engaging firms having a caliper distance of 0.1 per year and industry without replacement. Finally, we get 312 observations with carbon reduction reporting, 1323 observations without carbon reduction reporting, 311 observations with carbon reduction performance, and 1318 observations without carbon reduction performance.

We compare the difference of variables in model (3) and model (4) before and after matching. After matching, there is no significant difference between the treated group and the control group in terms of the mean of the dependent variables. From the untabulated results, we can know that there is a significant difference in *Loanstate* between firms with carbon reduction reporting and firms without ($p = 0.062$), but after matching, the significant difference is eliminated ($p = 0.304$). In addition, firms' key characteristics, such as firm size,

leverage, and the book-to-market ratio, are also less selective after matching. Using the matching sample, we get similar results for the effects of carbon reduction engagement on firms' access to bank loans and government subsidies varying among SOEs and NSOEs, which are shown in Table 11.

[Insert Table 11 about here]

5 Conclusion

This study contributes to the growing literature on corporate carbon reduction engagement by examining the impact of institutional pressure arising from the government carbon evaluation scheme, as well as the influence of ultimate ownership on such an impact, in the Chinese setting. Using a sample of Chinese listed firms from 2014 to 2015, we obtain the following original findings. First, we find a significantly positive association between institutional pressure and corporate carbon reduction engagement, which is measured using carbon reduction reporting and carbon reduction performance. Second, we document that the association is stronger for NSOEs than SOEs. These results show that firms' reactions to government evaluation pressure are moderated by the ultimate ownership. Third, we further discover that the carbon reduction engagement of the NSOEs is positively linked with firms' access to state-owned bank loans. Fourth, the empirical results also show that there is a momentum of corporate carbon reduction engagement under the institutional pressure.

From a public policy perspective, our results highlight the importance of nonregulatory state-business interactions beyond legal compliance. Although the carbon reduction engagement in Chinese companies is, overall, rather low, we do find that institutional pressure can play an important role in promoting corporate carbon reduction engagement. In the meantime, the Chinese government should consider providing more financial incentives to firms, especially NSOEs, to engage in such a strategy. The NSOEs in developing countries usually have difficulties accessing bank loans, securing property rights, and enforcing

contracts (Kusnadi et al., 2015; Yen & Abosag, 2016). They would therefore have a stronger motivation to closely follow the state strategy to build up and/or strengthen their relationship with the government. Our results are also of great interest to potential investors in Chinese listed firms. Investors would be interested to know that active engagement with government initiatives to reduce carbon emissions is a significant mitigation strategy allowing firms to reduce their financing costs. It could also reflect a decrease in firms' operational and compliance risks.

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Table 1 Regional carbon reduction evaluation grades and rankings of year 2013 and 2014 from NDRC website

Provinces	Evaluation grades of year 2013	Evaluation rankings of year 2013	Evaluation grades of year 2014	Evaluation rankings of year 2014
Anhui	Outstanding	18	Outstanding	11
Beijing	Outstanding	4	Outstanding	1
Chongqing	Outstanding	5	Outstanding	15
Fujian	Outstanding	19	Good	21
Gansu	Good	24	Good	27
Guangdong	Outstanding	3	Outstanding	13
Guangxi	Fail	29	Outstanding	14
Guizhou	Good	20	Outstanding	17
Hainan	Good	26	Good	26
Hebei	Outstanding	17	Outstanding	3
Henan	Good	23	Good	24
Heilongjiang	Good	25	Good	20
Hubei	Outstanding	8	Outstanding	12
Hunan	Good	22	Good	25
Jilin	Outstanding	7	Outstanding	7
Jiangsu	Outstanding	2	Outstanding	9
Jiangxi	Good	21	Good	22
Liaoning	Outstanding	15	Outstanding	6
Inner Mongoria	Outstanding	14	Outstanding	5
Ningxia	Pass	27	Good	29
Qinghai	Fail	31	Good	28
Shandong	Outstanding	16	Good	23
Shanxi	Outstanding	6	Outstanding	4
Shaanxi	Outstanding	13	Outstanding	19
Shanghai	Outstanding	1	Outstanding	8
Sichuan	Outstanding	10	Outstanding	16
Tianjing	Outstanding	11	Outstanding	2
Tibet	Pass	28	Pass	30
Xinjiang	Fail	30	Pass	31
Yunnan	Outstanding	9	Outstanding	18
Zhejiang	Outstanding	12	Outstanding	10

Table 2 Variable definitions

Variables	Descriptions	Source
Dependent Variables		
CRE1	Corporate carbon reduction engagement, which is coded as 2 if quantitative information is disclosed in the annual/CSR reports, coded as 1 if only qualitative information is disclosed in year t, and 0 otherwise.	Manually Coded
CRE2	Corporate carbon reduction engagement, which is measured as the energy saving scores in year t.	HeXun website
CRE1_D	Dummy variable of *CRE1*, which is coded as 1 if the value of *CRE1* is larger than 0 in year t, and 0 otherwise.	Manually Coded
CRE2_D	Dummy variable of *CRE2*, which is coded as 1 if the value of *CRE2* is larger than 0 in year t, and 0 otherwise.	HeXun website
Loanstate	Dummy variable that equals 1 if a firm gets one or more loans from a state-owned bank, and 0 otherwise.	CSMAR database
Subsidies	The total amount of the carbon related subsidies scaled by the total revenue in year t.	CSMAR database
Independent Variables		
IP	Institutional pressure that equals 1, 2, 3, and 4 when NDRC's evaluation grades is outstanding, good, pass, and fail, respectively, in the last year (see Table 1).	Manually Coded
IP_R	Institutional pressure that equals 1, 2, 3,…31, which is the same as the ranking in the evaluation results of the last year (see Table 1).	Manually Coded
Moderator variable		
SOE	Ultimate ownership of listed companies, which is a dummy variable that is coded as 1 if the ultimate owner belongs to the government or government-controlled institutions in year t, and 0 otherwise.	CSMAR database
Control Variables		
GDPgrowth	Percentage of GDP growth in the province where a firm operated in year t.	CSMAR database
Area	Area distinction that is coded as 1 if the firm operated in eastern provinces such as Shanghai and Jiangsu, and 0 otherwise.	CSMAR database
INDD	Industry difference that is coded as 1 if firm is in a high pollution industry in year t, and 0 otherwise.	NDRC website
Export	Degree of internationalization, which is the ratio of firm's foreign sales to its total sales in year t.	CSMAR database
Marketshare	Competitive position, which is the ratio of a firm's sales to the total amount of industry sales in year t.	CSMAR database
Invest	The increase of fixed assets and construction scaled by total assets in year t.	CSMAR database
II	Percentage of total outstanding shares that is held by institutional investors in year t.	CSMAR database
F1	Percentage of total outstanding shares that is held by the largest shareholder in year t.	CSMAR database
Director	Total number of directors at the end of year t.	CSMAR database
BTM	Book-to-market ratio, which is the ratio of the book value to market value of equity in year t.	CSMAR database
Size	Natural logarithm of the book value of total assets in year t.	CSMAR database
Lev	Book value of total liabilities scaled by total assets in year t.	CSMAR database
ROA	Net income scaled by total assets in year t.	CSMAR database
TOA	Tangible assets scaled by total assets in year t.	CSMAR database
CFO	Ratio of the net cash flow divided by total assets in year t.	CSMAR database
Age	Number of publicly listed years of a company in year t.	CSMAR database
Htax	High tax rate condition that equals 1 if the company's income tax rate is greater than the statutory 25% in year t, and 0 otherwise.	CSMAR database

ET	Indicator variable that equals 1 if a firm's ROE after their nonrecurring gains and losses deduction ranges from -1% to 1% in year t.	CSMAR database
LSubsidies	The total amount of carbon related subsidies scaled by total revenue in the year before t.	CSMAR database

Table 3 Descriptive statistics

Variable	N	Mean	Min	Max	Sd	P25	P50	P75
CRE1	4663	0.264	0	2	0.618	0	0	0
CRE1_D	4663	0.171	0	1	0.377	0	0	0
CRE2	4663	0.333	0	7	1.261	0	0	0
CRE2_D	4663	0.077	0	1	0.267	0	0	0
IP	4663	1.222	1	4	0.525	1	1	1
IP_R	4663	11.64	1	31	7.894	4	11	17
SOE	4663	0.395	0	1	0.489	0	0	1
GDPgrowth	4663	0.071	0.000	0.129	0.023	0.064	0.077	0.085
Area	4663	0.694	0	1	0.461	0	1	1
INDD	4663	0.551	0	1	0.498	0	1	1
Export	4663	7.391	0	82.27	16.54	0	0	4.925
Marketshare	4663	0.015	0	0.235	0.035	0.001	0.004	0.011
Invest	4663	0.014	-0.105	0.175	0.036	-0.002	0.006	0.023
II	4663	1.750	0	32.94	4.690	0	0	1.332
F1	4663	34.83	8.540	75.25	15.03	22.95	32.90	44.98
Director	4663	8.611	5	15	1.711	7	9	9
BTM	4663	0.729	0.054	4.189	0.746	0.269	0.476	0.867
Size	4663	22.14	19.48	25.97	1.271	21.26	21.98	22.85
Lev	4663	0.441	0.052	0.938	0.214	0.267	0.429	0.607
ROA	4663	0.032	-0.199	0.188	0.055	0.010	0.030	0.060
Loanstate	4663	0.376	0	1	0.484	0	0	1
Subsidies	4663	0.149	0	3.507	0.459	0	0.006	0.087
TOA	4663	0.637	0.196	0.938	0.162	0.531	0.650	0.759
CFO	4663	0.006	-0.131	0.192	0.047	-0.015	0.002	0.022
Age	4663	17.09	6	29	5.248	14	17	22
Htax	4663	0.439	0	1	0.496	0	0	1
ET	4663	0.093	0	1	0.290	0	0	0
LSubsidies	4663	0.165	0	4.178	0.546	0	0.002	0.081

Table 4 The impact of institutional pressure on corporate carbon reduction engagement

	Carbon Reduction Engagement							
	Reporting (*CRE1*)				Performance (*CRE2*)			
	Model(1) 4-1	Model(1) 4-2	Model(1) 4-3	Model(1) 4-4	Model(1) 4-5	Model(1) 4-6	Model(1) 4-7	Model(1) 4-8
IP	0.036**	0.030**	0.038***	0.031**	0.212***	0.210***	0.206***	0.203***
	(2.679)	(2.145)	(2.756)	(2.220)	(4.198)	(3.995)	(4.088)	(3.869)
SOE	0.126***	0.114***	0.126***	0.114***	0.107*	0.127**	0.108*	0.126**
	(5.937)	(5.503)	(5.937)	(5.527)	(1.992)	(2.269)	(2.007)	(2.242)
GDPgrowth	0.218	0.337	-0.021	0.127	-0.031	0.206	0.864	1.074
	(0.402)	(0.598)	(-0.038)	(0.223)	(-0.032)	(0.209)	(0.863)	(1.059)
Area	0.034*	0.046**	0.035*	0.047**	0.061	0.071	0.058	0.068
	(1.683)	(2.087)	(1.724)	(2.113)	(1.321)	(1.534)	(1.255)	(1.489)
INDD	0.088***	0.031	0.089***	0.033	0.091*	-0.062	0.088*	-0.070
	(3.651)	(0.878)	(3.692)	(0.898)	(1.985)	(-0.648)	(1.903)	(-0.768)
Export	0.000	0.001	0.000	0.000	0.001	0.001	0.002	0.002
	(1.005)	(1.335)	(0.664)	(0.991)	(0.907)	(0.826)	(1.253)	(1.186)
Marketshare	1.318**	1.590**	1.305**	1.570**	1.243	-0.322	1.292	-0.239
	(2.644)	(2.570)	(2.627)	(2.542)	(1.357)	(-0.314)	(1.406)	(-0.230)
Invest	-0.107	-0.325	-0.122	-0.336	-0.405	-0.574	-0.350	-0.527
	(-0.428)	(-1.285)	(-0.487)	(-1.329)	(-0.769)	(-1.137)	(-0.658)	(-1.037)
II	0.003	0.002	0.001	0.001	-0.012***	-0.012***	-0.007**	-0.008**
	(0.888)	(0.830)	(0.509)	(0.506)	(-3.485)	(-3.531)	(-2.081)	(-2.177)
F1	0.000	0.000	0.000	0.000	-0.004***	-0.004***	-0.004***	-0.004***
	(0.645)	(0.911)	(0.537)	(0.822)	(-3.089)	(-2.867)	(-2.942)	(-2.742)
Director	0.021***	0.020***	0.020***	0.020***	-0.017	-0.012	-0.015	-0.010
	(3.316)	(3.269)	(3.294)	(3.261)	(-1.179)	(-0.860)	(-1.033)	(-0.734)
BTM	-0.016	-0.014	-0.024	-0.022	-0.130**	-0.133***	-0.098*	-0.101*
	(-0.600)	(-0.513)	(-0.833)	(-0.719)	(-2.647)	(-2.999)	(-1.783)	(-1.986)
Size	0.179***	0.173***	0.184***	0.177***	0.222***	0.248***	0.205***	0.230***
	(13.501)	(12.599)	(13.472)	(12.318)	(5.852)	(6.142)	(5.018)	(5.264)
Lev	-0.198**	-0.143*	-0.196**	-0.142*	-0.117	-0.091	-0.125	-0.097
	(-2.609)	(-1.817)	(-2.554)	(-1.783)	(-1.101)	(-0.878)	(-1.182)	(-0.938)
ROA	-0.288	-0.291	-0.307	-0.310	1.096**	1.144**	1.170***	1.224***
	(-1.182)	(-1.333)	(-1.287)	(-1.453)	(2.565)	(2.560)	(2.740)	(2.736)
Constant	-3.996***	-3.904***	-4.050***	-3.962***	-4.569***	-5.291***	-4.366***	-5.053***
	(-14.071)	(-13.349)	(-13.883)	(-12.980)	(-5.808)	(-6.222)	(-5.350)	(-5.675)
Industry	No	Yes	No	Yes	No	Yes	No	Yes
Year	No	No	Yes	Yes	No	No	Yes	Yes
Observations	4663	4663	4663	4663	4663	4663	4663	4663
Adj. R^2	0.194	0.203	0.194	0.203	0.044	0.052	0.046	0.054

Note: Two-tailed robust t-statistics in parentheses are clustered at the industry level; *, **, and *** denote statistically significant at 0.10, 0.05, and 0.01 levels, respectively.

Table 5 The moderating role of ultimate ownership on the relationship between institutional pressure and corporate carbon reduction engagement

	Carbon Reduction Engagement					
	Reporting (*CRE1*)			Performance (*CRE2*)		
	SOEs	NSOEs	Full sample	SOEs	NSOEs	Full sample
	Model(1)	Model(1)	Model(2)	Model(1)	Model(1)	Model(2)
	5-1	5-2	5-3	5-4	5-5	5-6
IP	0.003	0.076***	0.043**	0.164**	0.278***	0.222***
	(0.126)	(3.162)	(2.669)	(2.513)	(4.055)	(4.238)
SOE			0.116***			0.129**
			(5.575)			(2.328)
*IP*SOE*			-0.082**			-0.139*
			(-2.554)			(-1.765)
GDPgrowth	0.679	-0.497	0.139	2.477	0.122	1.095
	(0.712)	(-0.764)	(0.242)	(1.244)	(0.111)	(1.075)
Area	0.038	0.053*	0.049**	0.066	0.087	0.071
	(0.924)	(1.906)	(2.178)	(0.848)	(1.606)	(1.582)
INDD	0.017	0.150**	0.035	-0.014	-0.006	-0.068
	(0.234)	(2.389)	(0.874)	(-0.141)	(-0.034)	(-0.690)
Export	0.003**	-0.000	0.000	0.004	0.001	0.002
	(2.116)	(-0.788)	(1.003)	(1.353)	(0.608)	(1.195)
Marketshare	0.838	1.744	1.531**	-1.129	0.378	-0.305
	(1.227)	(1.642)	(2.498)	(-1.205)	(0.199)	(-0.299)
Invest	-0.074	-0.315	-0.331	-0.385	-0.450	-0.519
	(-0.160)	(-1.277)	(-1.310)	(-0.425)	(-0.734)	(-1.017)
II	0.000	0.003	0.001	-0.010*	-0.006	-0.008**
	(0.006)	(0.792)	(0.504)	(-1.686)	(-1.323)	(-2.190)
F1	0.002*	-0.001	0.000	-0.004	-0.003	-0.004***
	(1.845)	(-1.208)	(0.881)	(-1.357)	(-1.428)	(-2.703)
Director	0.017	0.021**	0.020***	-0.004	-0.012	-0.011
	(1.675)	(2.682)	(3.229)	(-0.171)	(-0.623)	(-0.745)
BTM	-0.019	-0.067*	-0.020	-0.060	-0.080	-0.097*
	(-0.417)	(-1.821)	(-0.635)	(-0.986)	(-0.681)	(-1.907)
Size	0.230***	0.135***	0.176***	0.230***	0.207***	0.228***
	(9.108)	(7.666)	(12.299)	(3.125)	(3.645)	(5.188)
Lev	-0.293**	-0.024	-0.138*	-0.458**	0.078	-0.090
	(-2.239)	(-0.350)	(-1.765)	(-2.142)	(0.600)	(-0.853)
ROA	-0.738*	0.014	-0.309	1.339	1.256**	1.227***
	(-1.930)	(0.071)	(-1.483)	(1.590)	(2.404)	(2.772)
Constant	-5.094***	-2.977***	-3.945***	-5.086***	-4.571***	-5.026***
	(-9.212)	(-8.165)	(-12.995)	(-3.421)	(-3.847)	(-5.679)
Industry/Year	Yes	Yes	Yes	Yes	Yes	Yes
Diff. on *IP*	5.54**		-	1.84		-
Observations	4663	4663	4663	4663	4663	4663
Adj. R^2	0.179	0.131	0.204	0.055	0.056	0.054

Note: Two-tailed robust t-statistics in parentheses are clustered at the industry level; *, **, and *** denote statistically significant at 0.10, 0.05, and 0.01 levels, respectively.

Table 6 Effect of corporate carbon reduction engagement on firms' access to state-owned bank loans and government subsidies varying in SOEs and NSOEs

	Loanstate SOEs Model(3) 6-1	*Loanstate* NSOEs Model(3) 6-2	*Subsidy* SOEs Model(4) 6-3	*Subsidy* NSOEs Model(4) 6-4	*Loanstate* SOEs Model(3) 6-5	*Loanstate* NSOEs Model(3) 6-6	*Subsidy* SOEs Model(4) 6-7	*Subsidy* NSOEs Model(4) 6-8
CRE1	0.018	0.180***	0.008	0.006				
	(0.40)	(3.09)	(0.65)	(0.39)				
CRE2					-0.036	0.044*	0.002	0.010
					(-1.56)	(1.93)	(0.30)	(1.61)
Area	0.053	0.122**	0.002	-0.023	0.056	0.127**	0.002	-0.022
	(0.78)	(2.01)	(0.11)	(-1.32)	(0.82)	(2.10)	(0.13)	(-1.31)
INDD	-0.217	-0.216	0.014	-0.293***	-0.218	-0.191	0.014	-0.292***
	(-1.42)	(-0.58)	(0.31)	(-3.00)	(-1.42)	(-0.51)	(0.32)	(-2.99)
BTM	0.072	0.142*	0.013	0.010	0.070	0.133	0.013	0.010
	(1.21)	(1.76)	(0.80)	(0.42)	(1.18)	(1.64)	(0.79)	(0.44)
Size	-0.067*	0.061*	-0.019*	-0.009	-0.056	0.081**	-0.017	-0.010
	(-1.71)	(1.66)	(-1.72)	(-0.91)	(-1.48)	(2.27)	(-1.62)	(-1.04)
Lev	0.860***	0.735***	0.067	0.025	0.841***	0.727***	0.066	0.024
	(3.94)	(4.48)	(1.10)	(0.53)	(3.85)	(4.44)	(1.08)	(0.52)
ROA	-1.280*	-0.078	0.238	-0.147	-1.259*	-0.127	0.229	-0.160
	(-1.80)	(-0.15)	(1.18)	(-0.98)	(-1.77)	(-0.24)	(1.14)	(-1.07)
F1	0.001	-0.000	0.000	-0.000	0.001	-0.000	0.000	-0.000
	(0.25)	(-0.00)	(0.20)	(-0.46)	(0.25)	(-0.03)	(0.24)	(-0.41)
TOA	-0.806***	-0.336*			-0.812***	-0.310*		
	(-3.54)	(-1.91)			(-3.56)	(-1.76)		
CFO	2.007**	-0.216			2.030**	-0.245		
	(2.38)	(-0.44)			(2.41)	(-0.50)		
Age	-0.004	-0.015***			-0.004	-0.015***		
	(-0.58)	(-3.10)			(-0.58)	(-2.95)		
Htax			0.011	-0.011			0.011	-0.012
			(0.50)	(-0.61)			(0.51)	(-0.64)
ET			0.000	-0.004			-0.000	-0.004
			(0.00)	(-0.15)			(-0.01)	(-0.16)
LSubsidy			0.547***	0.401***			0.546***	0.401***
			(35.97)	(28.55)			(35.96)	(28.50)
Constant	1.519*	-1.727**	(2.35)	(1.38)	1.292	-2.166***	0.512**	0.323
	(1.77)	(-2.14)	0.549**	0.300	(1.56)	(-2.75)	(2.27)	(1.51)
Industry/ Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Diff. on *CRE*	5.01**		0.01		6.40**		0.74	
Observations	1832	2803	1840	2823	1832	2803	1840	2823
Pseudo/Adj.R^2	0.048	0.047	0.454	0.259	0.049	0.046	0.454	0.260

Note: Two-tailed robust z/t-statistics in parentheses are clustered at the industry level; *, **, and *** denote statistically significant at 0.10, 0.05, and 0.01 levels, respectively.

Table 7 Corporate carbon reduction engagement before and after the evaluation launched

	CRE1	*CRE1*	*CRE2*	*CRE2*
Post	0.205***	0.167***	0.369***	0.139*
	(7.267)	(4.469)	(8.398)	(1.743)
*Post*IP*		0.063**		0.379***
		(2.038)		(3.653)
SOE	0.061***	0.060***	0.061**	0.059**
	(5.381)	(5.327)	(2.166)	(2.053)
GDPgrowth	-0.116	-0.101	0.574	0.664
	(-0.392)	(-0.343)	(1.262)	(1.461)
Area	0.013	0.020*	0.001	0.040*
	(1.044)	(1.726)	(0.060)	(1.884)
INDD	0.025	0.026	-0.043	-0.041
	(1.024)	(1.059)	(-0.786)	(-0.791)
Export	0.000	0.000*	0.001	0.001
	(1.680)	(1.682)	(1.393)	(1.424)
Marketshare	0.709**	0.711**	-0.119	-0.105
	(2.591)	(2.598)	(-0.250)	(-0.222)
Invest	-0.125	-0.119	-0.294	-0.259
	(-0.980)	(-0.936)	(-1.190)	(-1.051)
II	-0.001	-0.001	-0.002**	-0.003**
	(-0.598)	(-0.633)	(-2.031)	(-2.201)
F1	0.000	0.000	-0.002***	-0.002***
	(0.542)	(0.544)	(-2.868)	(-2.863)
Director	0.009**	0.009**	-0.007	-0.006
	(2.502)	(2.516)	(-0.900)	(-0.828)
BTM	-0.035***	-0.035***	-0.052***	-0.055***
	(-2.777)	(-2.802)	(-2.741)	(-2.836)
Size	0.099***	0.099***	0.121***	0.123***
	(13.506)	(13.615)	(5.119)	(5.351)
Lev	-0.055	-0.055	-0.042	-0.041
	(-1.443)	(-1.440)	(-0.822)	(-0.791)
ROA	-0.230**	-0.227**	0.536**	0.555**
	(-2.114)	(-2.104)	(2.388)	(2.533)
Constant	-2.242***	-2.262***	-2.555***	-2.678***
	(-13.600)	(-13.751)	(-5.670)	(-5.974)
Industry/Year	Yes	Yes	Yes	Yes
Observations	9246	9246	9246	9246
Adj. R^2	0.176	0.176	0.060	0.065

Note: Two-tailed robust t-statistics in parentheses are clustered at the industry level; *, **, and *** denote statistically significant at 0.10, 0.05, and 0.01 levels, respectively.

Table 8 Impact of institutional pressure on subsequent corporate carbon reduction engagement

	CRE1	*CRE1*	*CRE2*	*CRE2*
IP_{t-1}	0.068**	0.090***	0.396***	0.465***
	(2.425)	(2.771)	(5.727)	(4.927)
IP_{t-2}	-0.051***	-0.040	-0.089	-0.137**
	(-2.966)	(-1.665)	(-1.240)	(-2.208)
IP_{t-1}*SOE		-0.059		-0.173
		(-0.746)		(-0.832)
IP_{t-2}*SOE		-0.016		0.103
		(-0.303)		(0.802)
SOE	0.227***	0.321***	0.297***	0.385**
	(6.648)	(4.264)	(3.515)	(2.118)
GDPgrowth	0.387	0.391	0.083	0.083
	(1.305)	(1.310)	(0.121)	(0.121)
Area	0.042	0.043	0.072	0.070
	(1.275)	(1.316)	(0.882)	(0.852)
INDD	-0.178	-0.173	-0.195**	-0.186**
	(-1.454)	(-1.383)	(-2.221)	(-2.163)
Export	0.002*	0.002*	0.002	0.002
	(1.903)	(1.906)	(0.988)	(0.987)
Marketshare	0.909	0.910	1.004	1.035
	(1.376)	(1.367)	(0.553)	(0.568)
Invest	-0.309***	-0.312***	-1.669***	-1.649***
	(-3.800)	(-3.885)	(-4.544)	(-4.426)
II	-0.003*	-0.003*	0.001	0.001
	(-1.882)	(-1.859)	(0.089)	(0.088)
F1	-0.001	-0.001	-0.007***	-0.007***
	(-1.591)	(-1.674)	(-3.730)	(-3.783)
Director	0.025***	0.024***	0.005	0.004
	(2.727)	(2.731)	(0.196)	(0.175)
BTM	-0.049***	-0.049***	-0.120***	-0.119***
	(-3.169)	(-3.159)	(-5.467)	(-5.417)
Size	0.197***	0.196***	0.402***	0.401***
	(10.368)	(10.271)	(10.045)	(9.884)
Lev	-0.088	-0.086	-0.316*	-0.323**
	(-1.324)	(-1.273)	(-2.011)	(-2.057)
ROA	-0.190	-0.196	0.704*	0.679
	(-1.534)	(-1.538)	(1.751)	(1.671)
Constant	-4.389***	-4.402***	-8.419***	-8.414***
	(-10.555)	(-10.522)	(-8.994)	(-9.004)
Industry	Yes	Yes	Yes	Yes
Observations	2636	2636	2636	2636
Adj. R^2	0.229	0.229	0.104	0.104

Note: Two-tailed robust t-statistics in parentheses are clustered at the industry level; *, **, and *** denote statistically significant at 0.10, 0.05, and 0.01 levels, respectively.

Table 9 Effect of institutional pressure on corporate carbon reduction engagement and moderating effect of ultimate ownership: robustness checks

Panel A: Alternative regression model–negative binomial model				
	CRE1	*CRE1*	*CRE2*	*CRE2*
	Model(1)	Model(2)	Model(1)	Model(2)
IP	0.147***	0.217***	0.655***	0.709***
	(3.458)	(4.278)	(3.254)	(3.589)
*IP*SOE*		-0.272***		-0.435*
		(-2.818)		(-1.681)
Panel B：Alternative measure of key variables				
(1)Natural logarithm of *IP*				
	CRE1	*CRE1*	*CRE2*	*CRE2*
	Model(1)	Model(2)	Model(1)	Model(2)
ln(IP)	0.054**	0.068**	0.384***	0.408***
	(2.211)	(2.557)	(4.349)	(4.659)
*ln(IP)*SOE*		-0.078**		-0.126
		(-2.440)		(-1.655)
(2)Institutional pressure based on government evaluation ranking				
	CRE1	*CRE1*	*CRE2*	*CRE2*
	Model(1)	Model(2)	Model(1)	Model(2)
IP_R	0.002	0.002*	0.014***	0.014***
	(1.440)	(1.691)	(4.728)	(4.910)
*IP_R*SOE*		-0.070**		-0.085
		(-2.247)		(-1.126)
(3)Using dummy variable to measure carbon reduction engagement				
	CRE1_D	*CRE1_D*	*CRE2_D*	*CRE2_D*
	Model(1)	Model(2)	Model(1)	Model(2)
IP	0.230***	0.322***	0.525***	0.613***
	(2.603)	(3.439)	(5.130)	(5.971)
*IP*SOE*		-0.377**		-0.443**
		(-2.316)		(-2.443)
Panel C：Alternative sample-excluding NSOEs with political connections				
	CRE1	*CRE1*	*CRE2*	*CRE2*
	Model(1)	Model(2)	Model(1)	Model(2)
IP	0.022	0.034*	0.205***	0.229***
	(1.486)	(1.980)	(3.015)	(3.221)
*IP*SOE*		-0.095**		-0.195*
		(-2.193)		(-1.807)

Note: Two-tailed robust z/t-statistics in parentheses are clustered at the industry level; *, **, and *** denote statistically significant at 0.10, 0.05, and 0.01 levels, respectively. Control variables, constant, and industry and year fixed effects are included in all the columns. For the sake of brevity, the table does not report the coefficients of control variables.

Table 10 Effect of corporate carbon reduction engagement on firms' access to state-owned bank loans and government subsidies varying in SOEs and NSOEs: robustness checks

Panel A: Different measure of corporate carbon reduction engagement using dummy variable

	Loanstate SOEs Model(3)	*Loanstate* NSOEs Model(3)	*Subsidy* SOEs Model(4)	*Subsidy* NSOEs Model(4)	*Loanstate* SOEs Model(3)	*Loanstate* NSOEs Model(3)	*Subsidy* SOEs Model(4)	*Subsidy* NSOEs Model(4)
CRE1_D	0.059	0.244***	0.015	0.009				
	(0.78)	(2.79)	(0.70)	(0.38)				
CRE2_D					-0.133	0.187*	0.010	0.038
					(-1.25)	(1.71)	(0.34)	(1.24)
Diff. on *CRE*	2.63		0.03		4.53**		0.39	

Panel B: Alternative sample size–excluding NSOEs with political connections

	Loanstate SOEs Model(3)	*Loanstate* NSOEs Model(3)	*Subsidy* SOEs Model(4)	*Subsidy* NSOEs Model(4)	*Loanstate* SOEs Model(3)	*Loanstate* NSOEs Model(3)	*Subsidy* SOEs Model(4)	*Subsidy* NSOEs Model(4)
CRE1	0.018	0.219**	0.008	0.008				
	(0.40)	(2.53)	(0.65)	(0.32)				
CRE2					-0.036	0.107***	0.002	0.017*
					(-1.56)	(3.12)	(0.30)	(1.87)
Diff. on *CRE*	4.09**		0.00		12.81***		1.35	

Note: Two-tailed robust z/t-statistics in parentheses are clustered at the industry level; *, **, and *** denote statistically significant at 0.10, 0.05, and 0.01 levels, respectively. Control variables, constant, and industry and year fixed effects are included in all the columns. For the sake of brevity, the table does not report the coefficients of control variables.

Table 11 Effect of corporate carbon reduction engagement on firms' access to state-owned bank loans and government subsidies varying in SOEs and NSOEs (PSM)

	Loanstate SOEs Model(3)	*Loanstate NSOEs* Model(3)	*Subsidy SOEs* Model(4)	*Subsidy NSOEs* Model(4)	*Loanstate SOEs* Model(3)	*Loanstate NSOEs* Model(3)	*Subsidy SOEs* Model(4)	*Subsidy NSOEs* Model(4)
CRE1	0.029	0.239***	0.012	-0.019				
	(0.44)	(2.90)	(0.84)	(-0.84)				
CRE2					-0.021	0.049*	-0.000	0.016**
					(-0.78)	(1.87)	(-0.04)	(2.17)
Area	0.142	0.058	0.009	-0.061*	0.282**	0.139	0.006	-0.028
	(1.32)	(0.49)	(0.40)	(-1.94)	(2.44)	(1.23)	(0.19)	(-0.85)
INDD	0.286	-0.638	0.009	-1.010***	0.177	0.433	0.108*	-0.851***
	(1.22)	(-0.90)	(0.18)	(-5.92)	(0.74)	(0.53)	(1.75)	(-4.35)
BTM	0.024	-0.068	0.011	0.075*	-0.018	-0.223	-0.007	-0.009
	(0.27)	(-0.43)	(0.57)	(1.81)	(-0.19)	(-1.55)	(-0.26)	(-0.22)
Size	-0.053	-0.157*	-0.010	-0.015	-0.009	0.022	-0.039**	-0.014
	(-0.77)	(-1.95)	(-0.63)	(-0.72)	(-0.12)	(0.31)	(-2.01)	(-0.70)
Lev	1.236***	1.870***	0.000	-0.050	1.364***	1.293***	0.271***	0.004
	(3.49)	(5.26)	(0.00)	(-0.53)	(3.74)	(3.92)	(2.90)	(0.05)
ROA	-1.647	-0.813	0.320	0.105	-1.660	-3.667***	0.757**	-0.622*
	(-1.44)	(-0.77)	(1.28)	(0.37)	(-1.23)	(-3.05)	(2.15)	(-1.84)
F1	0.004	-0.003	0.000	-0.001	0.004	-0.000	-0.001	0.000
	(1.20)	(-0.95)	(0.12)	(-0.57)	(0.95)	(-0.13)	(-1.02)	(0.15)
TOA	-0.991***	-0.435			-1.130***	-0.449		
	(-2.84)	(-1.33)			(-3.29)	(-1.41)		
CFO	2.456*	-0.812			1.534	-1.701*		
	(1.87)	(-0.89)			(1.10)	(-1.85)		
Age	-0.006	-0.023**			0.002	-0.013		
	(-0.51)	(-2.37)			(0.18)	(-1.47)		
Htax			0.025	0.003			0.067**	0.018
			(0.92)	(0.08)			(1.99)	(0.50)
ET			0.046	-0.029			0.013	-0.002
			(1.28)	(-0.45)			(0.28)	(-0.04)
LSubsidy			0.431***	0.356***			0.428***	0.301***
			(33.14)	(17.40)			(25.44)	(15.17)
Constant	1.671	2.097	0.141	0.426	-0.254	-0.852	0.979**	0.395
	(1.05)	(1.16)	(0.41)	(0.94)	(-0.15)	(-0.55)	(2.13)	(0.90)
Industry/Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Diff. on *CRE*	4.18**		1.84		3.71*		2.41	
Observations	783	825	799	836	726	875	743	886
Pseudo/Adj.R^2	0.076	0.086	0.641	0.349	0.076	0.073	0.140	0.243

Note: Two-tailed robust z/t-statistics in parentheses are clustered at the industry level; *, **, and *** denote statistically significant at 0.10, 0.05, and 0.01 levels, respectively.