Journal of Business Ethics
https://doi.org/10.1007/s10551-024-05622-1

ORIGINAL PAPER

How Officials' Political Incentives Influence Corporate Green Innovation

Shenggang Ren[1] · **Donghua Liu**[2,3] · **Ji Yan**[4]

Received: 1 September 2021 / Accepted: 11 January 2024

Abstract

Drawing on tournament theory, we argue that when environmental goals are incorporated into the cadre evaluation system, compared to officials who are close to retirement (i.e., retiring officials), non-retiring officials may exert more effort to foster risky green innovation. Based on a sample of publicly traded firms from heavily polluting industries in China between 2008 and 2016, we hypothesize and find that confronted with severe environmental pollution, firms in provinces with non-retiring governors have higher green innovation performance than those in provinces with retiring governors. Moreover, we find that this effect is stronger for firms in provinces whose governors have higher promotion anticipation, for local state-owned enterprises (SOEs), and for politically connected firms. Our study identifies the political incentives of government officials as an important antecedent of corporate green innovation and highlights the value of establishing a "green" cadre evaluation system to promote sustainable development.

Keywords Political incentives · Tournament theory · Green innovation

Introduction

Global climate change and environmental degradation remain two major challenges that humanity will face in the foreseeable future (Quan et al., 2021). How to address severe environmental challenges has become an important topic in the environmental ethics literature (Chen et al., 2022). Green innovation is widely acknowledged to be one of the most important strategies for addressing this challenge and achieving sustainable development through the introduction of novel or significantly improved products and processes that reduce or eliminate environmental damage (Berrone et al., 2013).[1] Thus, it is imperative to learn more about the factors that affect green innovation and how they do so.

Recent studies have investigated the antecedents of green innovation, with a focus on the influences of regulatory policies such as tradable permits, pollution taxes, and emission standards (e.g., Borghesi et al., 2015; Fabrizi et al., 2018). Borghesi et al., (2015, p. 670) noted that regulatory policy plays a particularly important role in driving green innovation, which makes green innovation more regulation-driven than general innovation. However, little is known about whether and how the political incentives of the government officials who formulate and implement regulatory policy influence green innovation. In this study, we attempt to fill this gap in the literature.

This investigation is important for two main reasons. First, political incentives shape the behavior and performance of government officials (Du & Yi, 2022). Officials with divergent political incentives may show significant differences in their formulation and implementation of

✉ Donghua Liu
csu_ldh@163.com

Shenggang Ren
renshenggang1975@csu.edu.cn

Ji Yan
ji.yan@durham.ac.uk

1 School of Business, Central South University, Changsha 410083, Hunan, China

2 School of Management, Wuhan University of Technology, Wuhan 430070, Hubei, China

3 Research Institute of Digital Governance and Management Decision Innovation, Wuhan University of Technology, Wuhan 430070, Hubei, China

4 Durham University Business School, Mill Hill Lane, Durham DH1 3LB, UK

[1] The literature has described green innovation as ecological innovation, eco-innovation, and environmental innovation (e.g., Bammens & Hünermund, 2020; Berrone et al., 2013).

regulatory policy, which then affects green innovation. Second, the government and its officials play an important role in nudging corporate behavior, especially in emerging and transitional economies with relatively weak market-oriented institutions, because they control key resources and legitimacy (Zhang et al., 2016). Environmental problems are more serious in emerging and transition economies, as their enormous economic development over the past few decades has been accompanied by enormous environmental costs (Quan et al., 2021). Thus, exploring how the political incentives of government officials influence corporate green innovation, especially in the context of emerging and transition economies, is important for mitigating global climate change and environmental degradation.

As the largest emerging economy, China provides an ideal context to investigate the impact of officials' political incentives for several reasons. First, China provides a predictable ladder for the career trajectories of its officials such that the officials are motivated by promotions (Wang & Luo, 2019). In particular, local officials are evaluated and promoted by their superiors based on performance goals rather than being elected by voters (Wang et al., 2021). Thus, local officials have strong political incentives to achieve their performance goals to be promoted. Second, in 2007, the central government adjusted the cadre evaluation system by incorporating environmental goals and implementing a one-vote veto of environmental goal evaluations (Tang et al., 2021). As a result, since 2007, environmental protection has been a high-priority goal for local officials (Wu & Cao, 2021). This context allows us to examine the impact of officials' political incentives on corporate environmental practices, such as green innovation.

Tournament theory (Lazear & Rosen, 1981) provides a useful theoretical lens to study how officials' political incentives affect corporate green innovation. According to tournament theory, the promotion process for government officials can be considered a political tournament involving relative evaluations with the result that better performers are identified and promoted to higher-level positions (Li & Lu, 2020). Under the adjusted cadre evaluation system which incorporates environmental goals, green innovation provides sustainable solutions for local officials to address serious environmental problems, but it is accompanied by risks in terms of financial returns and requires more regulatory push from government officials (Borghesi et al., 2015). Drawing on tournament theory, we propose that the extent to which governors promote green innovation depends on their career stage. Specifically, in contrast to near-retirement (retiring) officials, non-retiring officials may exert greater effort to foster risky green innovation, because they are more motivated to win the political tournament and be promoted. Thus, we predict that non-retiring officials are more likely to nudge local firms to undertake green innovation than their retiring counterparts.

Furthermore, we draw on tournament theory and propose that the tournament effect varies depending on the level of promotion motivation and the order in which contestants are ranked based on their performance evaluation. This variation exists because contestants need to be motivated to compete for promotions and need to rank higher in performance evaluations to win. We follow this logic to explore the boundary conditions of the main effect. On the one hand, we contend that the officials' promotion anticipation may strengthen their motivation for a promotion. On the other hand, we propose that firms that are more vulnerable to government officials' influences are more likely to be congruent with their goals (e.g., SOEs and politically connected firms) and conform to them; in this case, officials are more likely to obtain better performance evaluations and win. Following these rationales, we predict that the main effect will be strengthened when officials have greater promotion anticipation and be strengthened for SOEs and politically connected firms. Our predictions are supported by the results of an analysis of a sample of 4732 firm-year observations for 752 Chinese publicly listed firms during 2008–2016.

Our study contributes to the extant literature in the following ways. First, we contribute to the green innovation literature by exploring the antecedent role of officials' political incentives on firms' green innovation, about which previous research remains silent. Second, we extend tournament theory to a new empirical setting by applying it to explain how and why the cadre system could influence firms' green innovation. We propose a positive effect of political incentives on green innovation and further argue that officials' higher promotion anticipation and better goal congruency between the firm and officials can strengthen such an effect. Third, we add to the literature related to whether political incentives can decrease or increase environmental performance from the perspective of green innovation.

Literature Review, Background and Hypotheses

Government Officials and Green Innovation

Green innovation refers to "the creation of new designs, new goods, services, or processes to reduce or eliminate the use and generation of hazardous substances" (Berrone et al., 2013, p. 891). Since green innovation exhibits the attribute of an environmental public product that benefits the public by providing environment-related improvements, it is more regulation-driven than is general innovation (Borghesi et al., 2015). Unless induced (or pushed) by proper regulatory policies, firms generally have little/no incentive to

pursue green innovation (Borghesi et al., 2015). Although a growing stream of work is investigating the impact on green innovation of regulatory policies, such as tradable permits (Borghesi et al., 2015), pollution taxes (Tchórzewska et al., 2022), and government subsidies (Ren et al., 2021), few studies have focused on the role played by the government officials who formulate and implement these regulatory policies.

The government is an important source of resources and legitimacy, especially in transition economies such as China, where market institutions are relatively underdeveloped (Luo & Wang, 2021). Recently, a growing body of literature has begun to focus on how government officials' characteristics influence corporate strategic choices. For instance, Guo et al. (2021) provided evidence of how officials' hometown favoritism affects corporate investments. Wang et al. (2019a) documented that officials' political ideologies are associated with corporate political appointments. Li and Lu (2020) considered that government officials are public agents of corporate social responsibility (CSR) and explored the effect of their work experience and career horizons on CSR performance.

Political incentives are regarded as one of the main characteristics shaping government officials' behavior and performance (Du & Yi, 2022). Chang et al. (2021) showed that non-retiring governors expend more effort in pushing local firms to engage in poverty alleviation campaigns than retiring ones. Wang and Luo (2019) investigated the association between officials' political incentives and firms' diversification and found that retiring governors are more inclined to push local firms to enter unrelated industries to absorb laid-off workers from bankrupt SOEs. However, whether and how officials' political incentives influence corporate environmental behavior such as green innovation is poorly understood. Given the significance of regulatory policies for green innovation, it is important to understand the influence of the political incentives of the government officials responsible for formulating and implementing these policies.

Institutional Background

In the early 1980s, China implemented a series of administrative reforms to enhance economic growth (Wang & Luo, 2019). First, governance power is decentralized from central to regional governments, especially provincial governments (Li & Lu, 2020).[2] Provinces are relatively autonomous, and provincial leaders have considerable discretion over their resource allocations and the formulation and implementation of policies in their jurisdiction (Li & Lu, 2020; Xu, 2011). Second, China further clarified the division of labor between the party and the government. Government leaders (e.g., governors at the provincial level) are responsible for day-to-day government operations and performance, and party leaders (e.g., provincial party secretaries) are responsible for the maintenance of political principles and personnel management (Wang & Luo, 2019). Third, China canceled life-long appointments of officials and established a mandatory retirement system that, for example, requires provincial leaders to retire at the age of 65 (Wang & Luo, 2019). Fourth, economic performance (such as GDP growth) has become the most important criterion in the cadre evaluation system (Li & Zhou, 2005).

These administrative reforms have promoted China's market transformation and economic development (Wang & Luo, 2019), resulting in that China become the world's second largest economy in 2009 (Zheng et al., 2014). However, local leaders driven purely by growth-focused evaluation criteria have prioritized economic growth over the environment, which has resulted in serious environmental problems, such as environmental degradation and pollution (Economy, 2007). Aware of these serious consequences, the central government adjusted the cadre evaluation system in 2007 by incorporating environmental goals combined with one-vote veto power, which means that failure to achieve these goals results in a veto on the overall performance evaluation of local officials (Chen & Jia, 2023).[3]

The adjusted cadre evaluation system seems to be affecting the behavior of China's politicians. For example, Liu and Kong (2021) found that China's local leaders manipulate the disclosure of air pollution information as a result of political incentives. Zheng and Chen (2020) showed that after 2007, the green GDP evaluation criterion applied more pressure on provincial leaders to mitigate the side effects of economic growth. Chen and Jia (2023) found that when faced with a tradeoff between environmental and economic performance, local officials were more likely to prioritize the former. A growing body of work showed that there is a positive relationship between environmental performance and promotion opportunities for local leaders, after the adjustment of the cadre evaluation system (e.g., Wu & Cao, 2021).

Figure 1 depicts the past and adjusted cadre evaluation models. In the past model (drawn on the left), local officials focused only on GDP growth, and those in areas that showed better/worse economic performance had a higher/

[2] China's state bureaucracy consists broadly of 5 hierarchical levels—from the center at the top through provinces, prefectures, counties, and townships.

[3] In May 2007, China's State Council issued the "*Notice on Issuing a Comprehensive Work Plan for Energy Conservation and Emission Reduction*," which states clearly that energy conservation and emissions reduction goals should be included in the cadre evaluation system and that a one-vote veto related to environmental goals should be implemented.

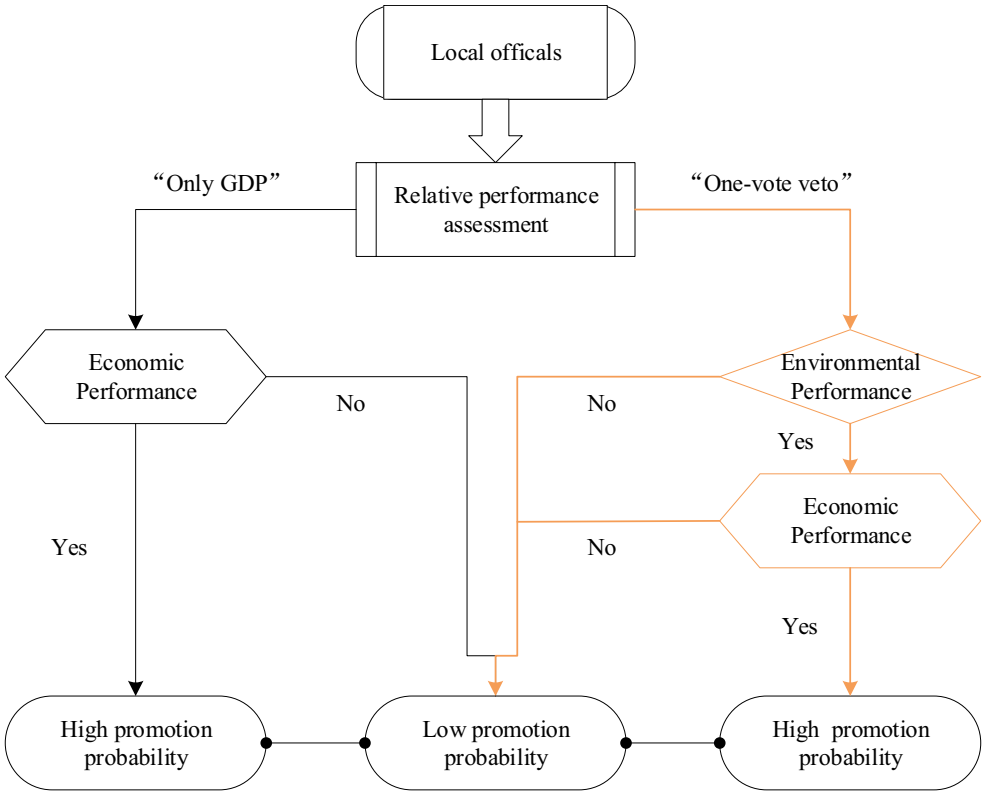

Fig. 1 The past and adjusted cadre evaluation models in China. Source: Tang et al. (2021)

lower probability of promotion. In the adjusted model (drawn on the right), environmental protection is a priority, and officials in only those areas that meet the environmental performance evaluation criteria (one-vote veto evaluation) and have good economic growth are likely to be promoted (Tang et al., 2021).

Theoretical Background

In this study, we draw on tournament theory to understand the influence of officials' political incentives on green innovation. The core idea of tournament theory is that contestants compete for a prize (e.g., promotion, wage increase), which is awarded based on their relative rather than absolute performance in the contest (Lazear & Rosen, 1981). Tournament theory holds that only when the prize spreads are large enough are contestants incentivized to participate in the tournament (Connelly et al., 2014). Given that the prize can be awarded to only one or a few contestants, the winner's gain usually equals other contestants' losses, which makes the contest a zero-sum game (Pruijssers et al., 2020). In order to increase the chances of winning the tournament, contestants will put in more effort to perform better than their competitors. In addition to triggering greater effort, contestants have a strong incentive to increase the likelihood of winning by taking greater risks (Kini & Williams, 2012). Tournament theory thus predicts that contestants will put in more effort and take more risks to achieve greater performance when faced with tournament incentives (Connelly et al., 2014; Pruijssers et al., 2020).

Tournament theory has been used by some studies to explain politicians' behavior or decisions driven by promotion incentives (Li & Lu, 2020; Xu, 2011). Political tournaments are formed when many officials at the same level compete for limited promotions and are evaluated relatively, resulting in better performers being identified and promoted to higher-level offices (Li & Zhou, 2005; Wang et al., 2021). The power and status gains that come with officials' promotions are typically substantial, especially in countries with high power distance, such as China (Wang et al., 2013). As a result, the large differential in the benefits between post and pre-promotion drives government officials to devote to political tournaments. Political tournaments have been found to take place among officials at all levels and across different countries worldwide (Li & Lu, 2020).

From a tournament perspective, the behavior of local leaders in China is driven by a cadre evaluation system in which those who achieve high-priority goals are more likely than others to be promoted (Li & Zhou, 2005). For example, when economic growth is a high priority, local leaders need

to exert greater effort and take more risks than their counterparts to promote local economic development (Wang et al., 2021). This may involve endeavors such as attracting investments and constructing infrastructure, aimed at maximizing their prospects for career advancement. Poor performance triggers local officials to seek solutions (Wang et al., 2021). Prior research has provided evidence that because of the importance that government officials place on GDP growth, shortfalls related to this goal trigger officials to promote the local economy in a variety of ways. For instance, Yue et al. (2019) found that a decline in the GDP growth rate caused local officials to charge entrance fees to religious temples in their jurisdictions to develop tourism and catch up with other regions.

Therefore, tournament theory provides a theoretical foundation on which we can explore how officials' political incentives affect local firms' green innovation when environmental protection becomes a high-priority goal. In addition, we discuss the boundary conditions of political incentives–green innovation relationship based on the two key elements of the tournament effect—promotion incentives and performance goal evaluation. We elaborate on our hypotheses in the following section.

Hypotheses Development

Officials' Political Incentives and Corporate Green Innovation

Economic growth was once the most critical goal in China's cadre evaluation system (Li & Zhou, 2005); however, since 2007, the central government has incorporated environmental goals into this system and has implemented a one-vote veto of environmental goal evaluations. As a result, environmental goals are viewed as one of governors' top priorities, driving them to reduce pollution. In particular, governors whose jurisdictions have serious environmental pollution face greater pressure to achieve environmental goals and, thus, are driven to search for solutions. Green innovation can give these governors better environmental solutions.

On the one hand, green innovation is aimed at fundamental changes to products, systems, and production processes to reduce resource use and/or pollution emissions at the source (Berrone & Gomez-Mejia, 2009). Compared to other environmental solutions that "are often off-the-shelf alternatives oriented toward meeting minimal environmental standards and that can be obtained in the open market" (Berrone et al., 2013, p. 891), green innovation emphasizes pollution prevention and provides greater environmental benefits (Berrone et al., 2013). On the other hand, green innovation can create competitive advantages while reducing pollution, thus resulting in "win−win" outcomes for both environmental and economic performance (Zeng et al., 2022). While environmental goals have been incorporated into the cadre system, economic growth remains a high priority. Green innovation is an essential turnaround for high-quality economic development (Zeng et al., 2022), and fostering green innovation can provide governors with better career opportunities.

However, while green innovation has greater environmental and economic benefits, it is risky in terms of financial returns and requires more regulatory push from government officials (Borghesi et al., 2015). Given that the motivation to engage in a political tournament depends largely on the official's career stage (Li & Lu, 2020), officials at different career stages may differ in their emphasis on green innovation. According to tournament theory, non-retiring governors in their career advancement stages may expend greater effort to promote risky green innovation due to their stronger motivation to compete in political tournaments for promotion and their need to achieve a higher performance evaluation ranking to win the tournament. In contrast, retiring governors who lack promotion prospects need only meet the minimal requirements of performance evaluations to ensure a smooth transition to retirement; thus, they may lack a strong incentive to work hard and perform better.

In addition, differences in political incentives result in non-retiring and retiring officials having different career horizons, which is manifested in the former having longer career horizons and the latter having shorter horizons (Li & Lu, 2020). Non-retiring governors might prefer green innovation for that it is the best solution in the long-term with the least harm for economic growth while reducing pollution. In contrast, retiring governors might prefer more quick steps, such as directly reducing or stopping pollution production, because they care more about the current pollution level rather than the future pollution level—at which time they may have retired.

Non-retiring governors who are more motivated by political tournament may make more effort to nudge local firms to increase green innovation than their retiring counterparts by exerting regulatory pressure and providing economic incentives. On the one hand, they may increase the frequency of environmental inspections, issue more environmental violations, and impose tougher penalty penalties, such as mandatory treatment, fines, production suspensions, and shutdowns, to force local firms to invest more in green innovation (Marquis & Bird, 2018). Berrone et al. (2013) confirmed that greater environmental regulatory pressure drives firms to undertake more green innovation. This finding is consistent with the Porter hypothesis that states that stricter environmental regulation can trigger firms' innovation (Porter & Van der Linde, 1995). On the other hand, non-retiring governors may provide more economic incentives (e.g., government subsidies, tax incentives, state-owned bank loans) to encourage local firms to engage in more green innovation

(Ren et al., 2021). For example, the green loans—loans provided at a low interest rate with the purpose of encouraging firms to engage in emission-reducing activities such as green innovation—dispensed by China's state-owned banks amounted to 640.3 billion RMB (approximately US$95.1 billion) in 2017.[4]

In summary, under the adjusted cadre evaluation system, green innovation provides sustainable solutions to serious environmental problems; however, the promotion of green innovation by governors may vary depending on their career stage. Specifically, compared to retiring governors, non-retiring governors may exert more effort to foster risky green innovation because they have a stronger motivation to win political tournaments. To achieve higher green innovation performance, non-retiring governors will exert greater regulatory pressure on and provide economic incentives to local firms. Thus, we propose the following:

H1: Confronted with severe environmental pollution, non-retiring governors will promote local firm to engage more in green innovation compared to retiring governors.

Drawing on tournament theory, we consider the boundary conditions that might change the tournament effect from two perspectives: promotion motivation and performance evaluations. On the one hand, promotion anticipation may enhance the motivation for a promotion. If non-retiring governors promote the green innovation of firms for promotion, this effect should be more prominent for governors with greater promotion anticipation. On the other hand, non-retiring governors who place high importance on tournament incentives are more likely to pressure local firms that are aligned with officials' goals or are more susceptible to their influence, such as SOEs and politically connected firms, to achieve better performance. Thus, we examine the contingent roles of officials' promotion anticipation, state ownership, and political connections.

Moderating Effect of Officials' Promotion Anticipation

Referring to previous work (Li & Lu, 2020; Li & Zhou, 2005), we define governors who held important positions in the central government prior to taking up their current position as governors who have greater promotion anticipation. Work experience in the central government may indicates that the provincial leader has closer ties to the central government and a better understanding of how the central appointment and promotion process works, which leads to better promotion prospects (Li & Zhou, 2005). Li and Zhou (2005) confirmed that the experience of working in the central government significantly increases the likelihood that the provincial leader is promoted. Moreover, previous research has pointed out that such experience allows provincial leaders to develop informal links with members of the central government who are able to influence officials' evaluation process, which is one of the important factors that influences promotion (Landry et al., 2018). Previous research has suggested that work effort increases with promotion anticipation (Frenkel & Bednall, 2016); hence, officials with greater promotion anticipations will increase their efforts to improve their performance to stand out in performance appraisals. Thus, non-retiring governors who previously held an important position in the central government may have greater promotion anticipation, which in turn is more likely to promote local firms' green innovation. Accordingly, we propose the following:

H2: The positive interaction effect between severe environmental pollution in a province and a non-retiring provincial governor on corporate green innovation will be stronger for governors with greater promotion anticipation.

Moderating Effect of State Ownership

SOEs' performance tends to be aligned with government demands/goals since their operations are directly influenced by the government through ownership control and executive appointments (Yang et al., 2019; Zhou et al., 2017). On the one hand, by definition, SOEs are government assets since their ultimate owner is the government or a government-controlled institution (Wang et al., 2019b). This means that SOEs' activities are heavily influenced by national policies, and they are required to work to achieve the governments goals (Zhang et al., 2020). On the other hand, Chinese SOE executives are regarded as quasi-government officials because they are appointed by the central and local governments and have corresponding administrative levels (Chen et al., 2022). More critically, these quasi-government officials are evaluated by a bureaucratic system whose focus is more on the enforcement of government policies and not necessarily firm profitability (Wang et al., 2019b). In China, SOE executives are subject to "a revolving door," which means that they can be transferred to a government agency (Chen et al., 2022). For example, in 2014, Chaoliang Jiang, chairman of Agricultural Bank of China, a state-owned commercial bank, was appointed governor of Jilin Province. This institutional design provides strong incentives for SOE executives to achieve government goals (Chen et al., 2022).

Thus, in contrast to non-SOEs, which maximize economic profits, SOEs may prioritize the allocation of corporate resources to satisfy government demands and goals (Yang et al., 2019; Zhou et al., 2017). Chen et al. (2022) found

[4] The data are available at https://www.01caijing.com/article/310133.htm.

that SOEs are more likely than non-SOEs to actively engage in reducing carbon emissions to help government officials achieve the performance evaluation goal of carbon emissions reductions. Therefore, we argue that SOEs are aligned with the goals of government officials and more likely than non-SOEs to respond to the government request to engage in green innovation. We hypothesize the following:

H3a: The positive interaction effect between severe environmental pollution in a province and a non-retiring provincial governor on corporate green innovation will be stronger for SOEs.

SOE affiliation may affect an SOE's response to government demands (Genin et al., 2021). We categorize SOEs as central or local SOEs depending on whether the ultimate controller of the SOE is the central or local government (Chen et al., 2022). Because central SOEs play an important strategic role in advancing the national economic development agenda, the central government assigns them state affiliation status (Genin et al., 2021). Although central SOEs operate in various provinces, the performance evaluation of these SOE executives is carried out by the central government or its agency, i.e., the State-owned Assets Supervision and Administration Commission of the State Council, with local governments having no jurisdiction over these central enterprises (Chen et al., 2022). Chen et al. (2022) observed that due to their affiliation with the central government, central SOEs may have access to the best resources and privileges and, thus, are less likely to respond to local government requirements, such as carbon reduction targets.

In contrast, the appointment and performance evaluation of local SOE executives is the responsibility of the local government, which can exert direct pressure on these firms to meet its demands. Research has suggested that local SOE executives can be promoted to senior local government officials—to achieve this promotion, they need to respond actively to the requirements of the local government (Chen et al., 2022). Therefore, we argue that local SOEs are more likely than central SOEs to undertake green innovation in response to requests from local governors. We hypothesize the following:

H3b: The positive interaction effect between severe environmental pollution in a province and a non-retiring provincial governor on corporate green innovation will be stronger for local SOEs than central SOEs.

Moderating Effect of Political Connections

Firms have political connections if their executives have a position in a government agency, such as the People's Congress (PC) or the People's Political Consultative Conference (PPCC) (Luo & Wang, 2021).[5] Building good connections with the government is crucial for firms operating in countries with weak institutions since the government maintains a strong influence over the economy (Zhang et al., 2020). There is broad consensus in the literature that political connections can help firms secure favorable regulatory treatment and facilitate access to critical resources controlled by the government. For example, firms with political connections find it easier to obtain bank loans (Yu et al., 2022) and government subsidies (Tao et al., 2017), and may be subject to lower tax rates (Adhikari et al., 2006). Reciprocity in social relationships implies that political connections bind firms to the government; i.e., firms rely on the government for legitimacy and critical resources, and in exchange, the government expects firms to conform to its expectations and requirements (Marquis & Qian, 2014; Zhang et al., 2016). Luo et al. (2017) suggested that firms with political connections have a higher risk of losing their independence due to their dependence on the government for resources.

Moreover, political connections provide a channel through which firms can interact intensively with the government, allowing them to gain a better understanding of the government's serious concerns (Zhang et al., 2016). These interactions also allow a more direct transfer of government expectations and pressure (Luo & Wang, 2021). Previous studies have found that politically connected firms are more likely than other firms to pursue goals encouraged by governments or officials, such as making charitable donations (Luo & Wang, 2021) and adopting environmental responsibility (Zhang, 2017). Thus, because politically connected firms are highly dependent on the government for resources or interact intensively with the government, they tend to align with government goals and, thus, engage in more green innovation than do other firms. We hypothesize the following:

H4: The positive interaction effect between severe environmental pollution in a province and a non-retiring provincial governor on corporate green innovation will be stronger for firms with political connections.

Methodology

Sample and Data Collection

We test our hypotheses using a sample of Chinese firms in heavily polluting industries listed on the Shanghai and Shenzhen Stock Exchanges between 2008 and 2016. By

[5] PC and PPCC are the only major agencies in China that are open to firm executives.

definition, heavily polluting industries are those whose production activities cause severe environmental pollution and, for this reason, are more likely than other industries to engage in green innovation activities.[6] Our sample begins in 2008 following the central government's adjustment to the cadre evaluation system by 2007. We choose 2016 as the ending year for two reasons. First, in 2016, the National Bureau of Statistics changed its method for measuring environmental pollution, resulting in substantial differences in pollution data before and after 2016.[7] Second, on July 19, 2016, the Central Environmental Protection Inspection (CEPI) launched by the central government propelled both retiring and non-retiring provincial officials to increase environmental protection measures or face severe punishment and accountability—this emphasis on environmental protection likely had an impact on officials' political incentives. As a result, we choose 2015 as the ending year for environmental pollution and political incentives and forward the dependent variable (i.e., green innovation) one year to account for the lagged effect (Rong et al., 2017), with the result that the end year for green innovation is 2016.[8]

Referring to previous studies (e.g., Quan et al., 2021), we apply the following criteria to screen the sample: (1) we identify the A-share firms in the heavily polluting industries that are listed on the Shanghai and Shenzhen stock exchanges, for a total of 5832 firm-year observations; (2) we exclude the 4 municipalities of Beijing, Tianjin, Shanghai, and Chongqing (corresponding to 781 firm-year observations) because municipality leaders are more likely than provincial governors to be promoted (Yao & Zhang, 2015); (3) we exclude 254 observations with special treatment (ST/*ST) that face the risk of delisting due to losses in two or three consecutive fiscal years (Zhang et al., 2020); and (4) we exclude 65 observations with missing data for key variables. After screening, we obtain a final sample of 4732 firm-year observations from 752 firms.

Our data are obtained from multiple sources: (1) information on provincial governors, including age, gender, homeland, education, and past appointments, is collected manually from http://cpc.people.com.cn, a website maintained by the *People's Daily*; (2) provincial information on environmental pollution is obtained from the *China Environmental Yearbook*; (3) patent and financial information on listed firms are collected from the China Stock Market and Accounting Research (CSMAR) database, which has been used extensively in previous studies (e.g., Li & Lu, 2020); and (4) provincial information on the economy and industrial structure is collected from the *China Statistical Yearbook*.

For several reasons, we measure officials' political incentives based on provincial officials. First, due to the availability of corporate financial and patent data, our sample is based on Chinese listed firms, which is consistent with the samples in extensive studies (e.g., Li & Lu, 2020; Quan et al., 2021). Provincial governments play an important role in the activities of these firms. For example, Wang and Luo (2019, p. 786) pointed out that "recommendations for Initial public offerings (IPOs) used to made by the provincial government." Second, Chinese listed firms are concentrated mainly in provincial capital cities, with few listed firms in non-provincial capitals.[9] Listed firms in a provincial capital tend to have close links with the provincial government in that city and, thus, are subject to greater influence from provincial leaders. Third, provincial leaders are an important link for the central government to implement its social, economic and political policies (Li & Lu, 2020). Some studies have pointed out that the adjustment to the cadre evaluation system was originally proposed for provincial leaders (Tang et al., 2021).

Variable Measures

Dependent Variable

Green Innovation Green patents provide an objective measure of green innovation (Amore & Bennedsen, 2016), because the China Patent Office conducts a thorough investigation of the novelty, creativity, and practicality of patents (Tan et al., 2020). All patents contain at least one International Patent Classification (IPC) related to their technological category, allowing us to distinguish green patents from other patents (Quan et al., 2021). Following prior work (e.g., Quan et al., 2021), we identify green patents using the IPC

[6] Following the categories of China's Ministry of Environmental Protection (Zhang et al., 2019), heavily polluting industries include electricity, heat production and supply, textiles, non-metallic mineral products, ferrous metal mining, ferrous metal smelting and rolling processing, chemical fiber manufacturing, chemical raw materials and chemical products manufacturing, fabricated metal products, wine, beverages and refined tea manufacturing, coal mining and washing, leather, fur, feathers and their products and footwear, oil and gas extraction, petroleum processing, coking and nuclear fuel processing, building decoration and other construction, gas production and supply, rubber and plastic products, pharmaceutical manufacturing, non-ferrous metal mining, non-ferrous metal smelting and rolling processing, and paper and paper products.

[7] For example, industrial SO_2 emissions in Beijing were 71,172 tons in 2015 compared to 14,989 tons in 2016, and industrial SO_2 emissions in Inner Mongolia were 12,309,046 tons in 2015 compared to 569,521 tons in 2016.

[8] We also extend the sample to 2020, the latest year for which we can collect data on the dependent variable, and find a same (positive) sign but with a coefficient with a reduced magnitude and significance.

[9] For example, in 2015, more than 50% of listed firms in most provinces were located in the provincial capital.

Green Inventory.[10] Although Chinese Patent Law categorizes patents as invention patents, utility model patents, or design patents (Tan et al., 2020), green patents identified by IPC searches include only invention and utility model patents, which represent significant technological improvements (Ren et al., 2022). Therefore, green patents are as a good measure to use to capture firms' real progress toward controlling pollution.

In our study, patent counts are based on the patent application rather than patent grant year because the former better captures the actual timing of the innovation (Ren et al., 2022). By doing so, the application year can capture the efforts made by government officials to promote corporate green innovation in a timely manner. We follow previous works (Quan et al., 2021; Rong et al., 2017) and measure green innovation as the natural logarithm of 1 plus the number of green patent applications.[11]

By using green innovation to measure the level of effort made by local leaders, we might underestimate the influence of political incentives on environmental protection because it is an output indicator and not all inputs can be converted into outputs. In other words, the estimated effect in our study should be considered conservative. However, given that not all efforts lead to direct improvements in environmental performance and that many efforts cannot be measured directly, green innovation is a good measure of overall efforts.

Independent Variable

The coefficient of the interaction term between non-retiring governors and environmental pollution is our key interest.

Non-retiring Governor (Non-retiring) Since provincial governors are responsible for local economic and environmental performance (Kahn et al., 2015), we focus on governors' political incentives.[12] Under China's mandatory retirement system, governors are required to retire at the age of 65. The governor's political career is structured according to the number of political terms, and political cycles coincide with the National Congress of the Communist Party of China (CPC), which is held every five years (Wang & Luo, 2019). Following Wang and Luo (2019), non-retiring provincial governors are defined as governors who will be younger than 65 years of age at the time of the next Congress, which means that they could still serve one or more political terms. Retiring governors are defined as governors who will be aged 65 years or older at the time of the next Congress, which means that they are serving their last political term.

Environmental Pollution (Pollution) Air pollution has become the most urgent environmental problem in China (Feng et al., 2019). Compared with water and solid waste pollution, air pollution is attracting unprecedented public attention, and China's central government has put the prevention of air pollution at the top of its list of environmental goals (Feng et al., 2019). Thus, we use air pollution as a proxy for environmental pollution and create the variable *Pollution*, which is measured as the natural logarithm of industrial waste gas emissions.[13]

Moderators

Promotion Anticipation We create a dummy variable, *Promotion anticipation*, which takes the value of 1 if the provincial governor has held the position of vice minister or higher in a central ministry and 0 otherwise.

SOE An SOE is defined as an enterprise whose ultimate controller is the government or one of its agencies. Following prior studies (e.g., Zhang et al., 2020; Zhou et al., 2017), *SOE* equals 1 if the enterprise is an SOE and 0 otherwise.

Central SOE and Local SOE *Central SOE* is a dummy variable that equals 1 if the firm's ultimate owner is the central government and 0 otherwise. Similarly, *Local SOE* equals 1 if the firm's ultimate owner is the local government and 0 otherwise (Chen et al., 2022).

Political Connection Following Zhang et al. (2020), *Political connection* takes the value of 1 if the firm's chairman or CEO served as or is currently a member of the PC or PPCC at various levels (from national to subprovincial level), and 0 otherwise.

Control Variables

We include a range of control variables that the literature shows might affect corporate green innovation (Arena et al., 2018; Quan et al., 2021). First, we include firm-level factors, including R&D expenditure, size, age, return on equity (ROE), debt, board independence, ownership concentration,

[10] The IPC Green Inventory was developed by the World Intellectual Property Office (WIPO) and is available at http://www.wipo.int/classifications/ipc/en/green_inventory/.

[11] The green patent applications in our study were eventually granted.

[12] Past environmental incidents in China, such as the cadmium contamination in Longjiang, Guangxi (February 2012) and the aniline spill in Changzhi, Shanxi (December 2012), reveal that the central government punished only governors (Kahn et al., 2015).

[13] Industrial waste gas is the general term for pollutant gases resulting from industrial production activities and includes sulfur dioxide, nitrogen oxides, soot, carbon monoxide, carbon dioxide, ozone, total suspended particles (TSP), etc.

institutional shareholder, and environmental report. Second, we include province-level factors, including regional economic development (GDP per capita) and industrial structure. Finally, we control for provincial governors' personal characteristics, which might affect political incentives. We include governors' gender, homeland, ethnicity, education, and prior work experience. All continuous variables are winsorized at the top and bottom 1% to alleviate the influence of outliers (Chang et al., 2021). Appendix A in online Supplementary Information shows detailed variable definitions.

Estimation Model

Following the innovation literature (Quan et al., 2021; Ren et al., 2022), we employ ordinary least square (OLS) regression to test our hypotheses. We handle potential endogeneity by (1) forwarding the dependent variable one year to mitigate possible reverse causality (Xu et al., 2019), (2) including year, industry, and province fixed effects to control for within-group variations over time and limit the potential bias caused by omitted variables (Xu et al., 2019), and (3) clustering standard errors at the province and year levels to correct for possible heteroskedasticity. We test the coefficient of the interaction term *Non-retiring*Pollution*, which provides the estimates for the main effect hypothesis (H1). We construct three-way interaction terms to test our hypotheses on the moderating effects (H2 to H4) and mean-center the continuous variables in the interaction terms to reduce concerns over possible multicollinearity (Wang & Luo, 2019).

Results

Descriptive Statistics

Table 1 reports the summary statistics of the variables. On average, the firms in our sample filed 1.75 green patents per year.[14] Non-retiring governors account for 77% of our sample, SOEs account for 48%, of which 35% are local SOEs and 13% are central SOEs, and executives with political connections account for 18.9%. On average, governors have a postgraduate education, and 25.7% have experience in a central government position.

Table 1 also presents that the magnitude of the pairwise correlation coefficients among the variables is not high. We further check for multicollinearity problems by computing the variance inflation factor (VIF). The VIF values range from 1.02 to 2.11, with a mean value of 1.48. These VIF values fall well below the typical threshold of 10, indicating that multicollinearity is not a major concern in our study.

Officials' Political Incentives and Green Innovation

Table 2 presents the test results for the main effect hypothesis (H1), which predicts a positive interaction effect between serious environmental pollution and non-retiring provincial governors on green innovation. Model 1 regresses green innovation on the control and interaction variables (*Non-retiring* and *Pollution*), and the interaction term *Non-retiring*Pollution* is added to Model 2 to test H1. For Model 2, the coefficient of the interaction term is positive and statistically significant (β_{model2}=0.066, $p < 0.01$), which suggests that when non-retiring governors motivated by political tournaments are confronted with severe environmental pollution, they are more inclined to mobilize local firms to undertake green innovation to improve their political evaluations than are their retiring counterparts. Thus, H1 is supported.

The coefficients of *Non-retiring* and *Pollution* are both insignificant; however, their interaction term is significantly positive, which highlights the importance of the co-presence of serious environmental pollution and non-retiring governors in promoting corporate green innovation. The insignificant coefficient of *Pollution* suggests that the impact of environmental pollution on corporate green innovation is mainly from the presence of governors with strong incentives to solve this problem. The insignificant coefficient of *Non-retiring* suggests that in the absence of serious pollution, there is no significant difference between non-retiring and retiring governors in promoting local firms' green innovation.

We follow prior studies (e.g., Zhang et al., 2020) to calculate economic significance. The coefficient of 0.066 in Model 2 suggests that a one standard deviation increase in pollution (0.819, see Table 1) increases green innovation by 0.05 (0.066*0.819) for firms in provinces with non-retiring governors. Taking the mean value of green innovation in our sample as the benchmark (0.562), the magnitude of this increase is 9.6% (0.05/0.562). That is, a one standard deviation increase in pollution is correlated with firms in provinces with non-retiring governors having 9.6% more green patents that that of firms in provinces with retiring governors, which is economically significant.

Moderating Effects

Table 3 reports the results of the moderating effects. For brevity, we do not report the coefficients of the control variables. H2 theorizes that the interaction effect between environmental pollution and non-retiring governor on green innovation is reinforced by governors' promotion anticipation. Model 1 shows a positive and statistically significant coefficient of the three-way interaction

[14] Since this measure is the natural logarithm of (green patents + 1), the raw number is 1.75 ($=e^{0.5662}-1$).

Table 1 Summary statistics

Variables	Mean	SD	1	2	3	4	5	6	7
1. Green innovation (log)	0.562	0.849	1						
2. Non-retiring	0.773	0.419	0.006	1					
3. Pollution (log)	10.036	0.819	0.104*	−0.107*	1				
4. Promotion anticipation	0.257	0.437	0.034*	−0.158*	0.142*	1			
5. SOE	0.483	0.500	0.071*	0.144*	−0.091*	0.000	1		
6. Central SOE	0.131	0.338	0.098*	0.101*	−0.023	−0.011	0.402*	1	
7. Local SOE	0.352	0.478	0.004	0.078*	−0.079*	0.008	0.762*	−0.287*	1
8. Political connection	0.189	0.391	0.006	−0.037*	0.075*	−0.074*	−0.216*	−0.124*	−0.139*
9. R&D expenditure	0.011	0.015	0.092*	−0.074*	0.142*	0.036*	−0.236*	−0.066*	−0.200*
10. Firm size (log)	7.846	1.142	0.296*	0.093*	0.086*	0.019	0.347*	0.102*	0.291*
11. Firm age	14.406	4.844	0.033*	0.089*	0.098*	0.036*	0.131*	0.085*	0.076*
12. ROE	0.049	0.340	0.017	−0.036*	−0.011	−0.042*	−0.065*	−0.068*	−0.020
13. Debt	0.445	0.214	0.135*	0.108*	−0.008	0.011	0.364*	0.188*	0.248*
14. Board independence	0.367	0.049	−0.005	0.031*	−0.022	0.021	−0.035*	−0.065*	0.009
15. Insti_holder	0.481	0.232	0.100*	0.072*	−0.056*	−0.015	0.354*	0.124*	0.283*
16. Concentration	0.533	0.156	0.087*	−0.052*	0.050*	−0.003	−0.036*	−0.039*	−0.010
17. Environmental report	0.016	0.127	0.098*	−0.006	−0.001	−0.037*	0.003	−0.015	0.014
18. GDP per capita (log)	10.592	0.457	0.110*	−0.264*	0.498*	0.059*	−0.339*	−0.128*	−0.265*
19. Industrial structure	49.385	4.841	−0.027*	−0.045*	0.436*	−0.031*	0.030*	−0.003	0.033*
20. Governor education	1.949	0.596	0.018	0.263*	0.073*	−0.283*	0.006	0.009	0.000
21. Governor gender	0.021	0.144	−0.004	0.080*	−0.041*	0.136*	0.034*	0.043*	0.006
22. Governor homeland	0.329	0.470	−0.041*	−0.170*	0.019	−0.320*	−0.038*	−0.007	−0.035*
23. Governor ethnicity	0.090	0.286	−0.054*	0.149*	−0.311*	−0.080*	0.059*	0.114*	−0.019
24.Governor source	0.561	0.496	−0.048*	0.004	−0.222*	−0.512*	−0.044*	−0.024*	−0.028*

Variable	8	9	10	11	12	13	14	15	16
8. Political connection	1								
9. R&D expenditure	0.126*	1							
10. Firm size (log)	−0.028*	−0.123*	1						
11. Firm age	−0.106*	−0.057*	0.091*	1					
12. ROE	0.065*	0.045*	0.015	−0.063*	1				
13. Debt	−0.155*	−0.258*	0.384*	0.178*	−0.250*	1			
14. Board independence	−0.005	0.014	−0.041*	0.044*	−0.026	−0.023	1		
15. Insti_holder	−0.099*	−0.125*	0.364*	0.024	0.069*	0.145*	−0.061*	1	
16. Concentration	0.037*	0.072*	0.157*	−0.251*	0.107*	−0.125*	0.030*	0.551*	1
17. Environmental report	−0.002	−0.002	0.094*	−0.033*	−0.008	0.056*	−0.025	−0.008	0.009
18. GDP per capita (log)	0.075*	0.276*	−0.094*	0.197*	−0.003	−0.162*	0.010	−0.152*	0.057*
19. Industrial structure	0.089*	−0.060*	0.105*	−0.123*	0.024	0.057*	−0.033*	0.037*	0.037*
20. Governor education	0.031*	0.039*	0.058*	0.034*	−0.016	0.015	0.001	−0.020	−0.054*
21. Governor gender	−0.003	0.021	0.026	−0.011	−0.026	0.022	−0.005	0.007	−0.031*
22. Governor homeland	0.046*	−0.065*	0.016	−0.122*	0.024	0.000	−0.036*	0.024	0.028
23. Governor ethnicity	−0.065*	−0.105*	−0.027	−0.017	−0.031*	0.076*	0.010	0.029*	−0.053*
24. Governor source	0.021	−0.074*	−0.067*	−0.042*	0.013	−0.036*	−0.005	0.028	0.022

Variable	17	18	19	20	21	22	23	24
17. Environmental report	1							
18. GDP per capita (log)	0.035*	1						
19. Industrial structure	−0.020	0.064*	1					
20. Governor education	0.033*	0.020	0.088*	1				
21. Governor gender	−0.019	−0.074*	0.110*	0.156*	1			
22. Governor homeland	−0.040*	0.149*	0.170*	0.096*	−0.103*	1		
23. Governor ethnicity	−0.040*	−0.055*	−0.097*	−0.012	0.087*	0.334*	1	
24. Governor source	0.040*	0.021	0.003	−0.028	−0.066*	0.457*	0.249*	1

Table 1 (continued)

This table presents summary statistics for all the variables and their pairwise Pearson correlation coefficients. $N = 4732$. Significance at the 0.05 level.

term *Non-retiring*Pollution*Promotion anticipation* (β_{model1}=0.228, $p < 0.01$), indicating that the interaction effect is stronger for firms in provinces with governors who have greater promotion anticipation. As such, this result supports H2. The economic significance of the main effect is 6.8% for non-retiring governors with a low level of promotion anticipation and 40.1% for non-retiring governors with a high level of promotion anticipation. Obviously, the moderating effect of promotion anticipation is economically significant.

H3a posits that the interaction effect is stronger for SOEs. It can be seen from the results of Model 2, the coefficient of the three-way interaction term *Non-retiring *Pollution*SOE* is significantly positive (β_{model2}=0.082, $p < 0.05$), suggesting that SOEs are more likely than non-SOEs to comply with government requirements and engage in more green innovation. H3a thus is supported. The economic significance of the main effect is 5.4% for non-SOEs and 17.3% for SOEs.

We proposed in H3b that the interaction effect is stronger for local than central SOEs. Model 3 shows that the coefficient of the three-way interaction term *Non-retiring*Pollution*Local SOE* is significantly positive (β_{model3}=0.095, $p < 0.05$), whereas the coefficient of *Non-retiring*Pollution*Central SOE* is positive and insignificant (β_{model3}=0.042, $p > 0.1$). These results demonstrate that local SOEs are more likely than central SOEs to respond to local government requirements and engage in more green innovation, which supports H3b. The economic significance of the main effect is 5.1% for non-local SOEs and 18.9% for local SOEs.

H4 predicts a stronger interaction effect for firms with political connections. Model 4 shows that the coefficient of the three-way interaction *Non-retiring*Pollution*political connection* is significantly positive (β_{model4}=0.203, $p < 0.1$), suggesting that H4 is supported. The economic significance of the main effect is 9% for firms with political connections and 38.6% for firms without political connections.

Following the methods of Murphy and Aguinis (2022) and Li et al. (2023), we depict those moderating effects in Figs. 2, 3 and 4. Specifically, we plot the simple-slope coefficients of the interaction of environmental pollution and non-retiring governor (*Non-retiring*Pollution*) and its 95% confidence region against green innovation to assess the strength of the moderating effect. For example, Fig. 2 plots the moderating effect of promotion anticipation. Given that promotion anticipation is a categorical variable, Fig. 2 plots the relationship between *Non-retiring*Pollution* and green innovation for variable values of 0 and 1, respectively. The slope is much steeper when the variable equals 1, suggesting that the positive interaction effect between *Non-retiring*Pollution* on green innovation is stronger for governors with greater anticipation of a promotion. Similarly, Figs. 3 and 4 plot the moderating effects of state ownership and political connections.

Endogeneity and Robustness Checks

Addressing Endogeneity Related to Officials' Appointments

One possible concern is that appointments of non-retiring and retiring officials may not be exogenous. For example, a non-retiring governor may be assigned to a province with characteristics associated with the development of green innovation. In other words, the estimated effect may be driven by omitted provincial characteristics. To address this concern, we compare the distribution of provinces with non-retiring and retiring governors during 2008–2020 and find a high level (67%) of overlap between the two groups of provinces. As such, the appointment of non-retiring and retiring governors in China is exogenous, which suggests that the process is unlikely correlated with provincial characteristics.

Our baseline model includes province fixed effects to control for time-invariant provincial characteristics. To further mitigate concerns over omitted time-varying provincial characteristics, we follow previous studies and include the interaction of province fixed effects and year trends (*Province FEs*Trend*) (Chakraborty & Chatterjee, 2017). We obtain consistent results after including *Province FEs*Trend*, indicating that our results are robust after controlling for time-invariant and time-varying provincial characteristics.[15] Therefore, our estimated effect is unlikely driven by omitted provincial characteristics.

Excluding the Alternative Explanation of Officials' Age

Some might be concerned that political incentives are contingent on the official's age rather than career stage (i.e., whether close to retirement). To address this concern, we conduct the following analysis. First, we create a continuous variable for governor age (*Governor age*) and reverse-code it by multiplying the values by − 1. We perform a correlation analysis of *Non-retiring* and *Governor age* and find that the correlation coefficient is 0.65 and significant. This

[15] The results are available on request.

Table 2 Regression results for the main effect

Variables	Model 1	Model 2
Non – retiring*pollution		0.066***
		(0.019)
Non-retiring	0.036	0.035
	(0.022)	(0.022)
Pollution	0.001	−0.014
	(0.048)	(0.043)
Promotion anticipation	−0.027	−0.026
	(0.032)	(0.032)
SOE	0.032	0.035
	(0.027)	(0.028)
Political connection	0.019	0.020
	(0.026)	(0.026)
R&D expenditure	3.124***	3.132***
	(1.126)	(1.131)
Firm size	0.242***	0.242***
	(0.015)	(0.015)
Firm age	−0.007**	−0.007**
	(0.003)	(0.003)
ROE	0.071***	0.072***
	(0.022)	(0.022)
Debt	0.093	0.093
	(0.068)	(0.068)
Board independence	−0.088	−0.083
	(0.235)	(0.235)
Insti_holder	0.144*	0.144*
	(0.079)	(0.079)
Concentration	−0.093	−0.093
	(0.112)	(0.112)
Environmental report	0.273***	0.272***
	(0.102)	(0.102)
GDP per capita	0.189	0.109
	(0.274)	(0.270)
Industrial structure	0.001	0.003
	(0.006)	(0.006)
Governor education	0.004	0.004
	(0.016)	(0.016)
Governor gender	−0.087*	−0.097**
	(0.047)	(0.045)
Governor homeland	0.049**	0.050**
	(0.024)	(0.023)
Governor ethnicity	−0.063	−0.068
	(0.084)	(0.082)
Governor source	−0.067**	−0.074**
	(0.029)	(0.029)
Constant	−3.923	−3.109
	(2.469)	(2.442)
Province, Industry, and Year FEs	Yes	Yes
Observations	4732	4732
R-squared	0.220	0.221

This table reports the results for the main effect (H1). H1 predicts a positive interaction effect between serious environmental pollution and non-retiring provincial governors on green innovation. Standard errors clustered at the province and year level are reported in parentheses. ***, ** and * denote the statistical significance of a two-tailed test at the 1%, 5% and 10% levels, respectively

result indicates that career stage as measured by political tenure is correlated with governor age but does not depend exclusively on governor age. We also add *Governor age* as a control variable to our baseline regression. The results of Model 1 in Table 4 show that the coefficient of *Non-retiring*Pollution* remains significantly positive.

Second, we use *Governor age* as a proxy for political incentives and replace the interaction term *Non-retiring*Pollution* with *Governor age*Pollution*. Model 2 shows that the coefficient of *Governor age*Pollution* is 0.011, which is much smaller than the coefficient in the baseline regression (0.066). This finding confirms that political incentives are more closely related to officials' career stage than to their age. As Wang and Luo (2019, p. 798) noted, "the categorical measurement may better capture the difference in political incentives at different career stages."

Third, if officials' political incentives depend on their career stage, then political incentives among retiring officials do not differ with age. To verify this, we retain only the sample of retiring governors and regress green innovation on the interaction term *Governor age*Pollution*. Model 3 shows that the coefficient of the interaction term is insignificant, which supports our prediction.

Fourth, we conduct a counterfactual test by defining retiring governors as those who will retire in 7 years (8 years) and non-retiring governors otherwise. In this case, we expect non-retiring and retiring governors to show fewer (or no) differences in political incentives, because more non-retiring governors are included in the retiring governor group. Models 4 and 5 show that the significance levels of the interaction term are smaller or insignificant, which is consistent with our argument. Overall, we confirm that political incentives depend closely on officials' career stage rather than vary over time (Wang & Luo, 2019).

Other Robustness Checks

We conduct several other robustness checks using instrumental variable approach, alternative measures of environmental pollution and green innovation, alternative estimation methods, and the impact threshold of the confounding variables, and find that our main results are not driven by potential endogeneity. Appendix B in online Supplementary Information provides details of the robustness checks.

Mechanism Analysis

As mentioned in the hypothesis development of the main effect, we propose that non-retiring governors may exert

Table 3 Regression results for the moderating effects

Variables	Model 1	Model 2	Model 3	Model 4
Non-retiring*Pollution	0.047***	0.037*	0.035*	0.062***
	(0.018)	(0.020)	(0.019)	(0.019)
Non-retiring*Pollution*Promotion anticipation (H2)	0.228***			
	(0.078)			
Pollution*Promotion anticipation	−0.240***			
	(0.073)			
Non-retiring*Promotion anticipation	−0.084			
	(0.060)			
Non-retiring*Pollution*SOE (H3a)		0.082**		
		(0.041)		
Pollution*SOE		0.051*		
		(0.029)		
Non-retiring*SOE		−0.002		
		(0.044)		
Non-retiring*Pollution*Central SOE (H3b)			0.042	
			(0.172)	
Non-retiring*Pollution*Local SOE (H3b)			0.095**	
			(0.043)	
Pollution*Central SOE			0.092	
			(0.162)	
Non-retiring*Central SOE			−0.107	
			(0.107)	
Pollution*Local SOE			0.035	
			(0.032)	
Non-retiring*Local SOE			0.010	
			(0.053)	
Non-retiring*Pollution*Political connection (H4)				0.203*
				(0.121)
Pollution*Political connection				−0.291**
				(0.115)
Non-retiring*Political connection				−0.041
				(0.063)
Non-retiring	0.021	0.032	0.035	0.041*
	(0.029)	(0.031)	(0.031)	(0.024)
Pollution	0.013	−0.056	−0.051	−0.009
	(0.043)	(0.043)	(0.043)	(0.043)
Constant	−3.423	−1.683	−1.734	−2.765
	(2.424)	(2.410)	(2.424)	(2.405)
Control variables	Yes	Yes	Yes	Yes
Province, Industry, and Year FEs	Yes	Yes	Yes	Yes
Observations	4732	4732	4732	4732
R-squared	0.221	0.223	0.227	0.222

This table reports the test results for the moderating effects (H2-H4). Standard errors clustered at the province and year level are reported in parentheses. ***, ** and * denote the statistical significance of a two-tailed test at the 1%, 5% and 10% levels, respectively

a greater effort to pressure local firms to increase green innovation than their retiring counterparts by exerting regulatory pressure and providing economic incentives. To test the potential mechanisms, we adopt a step-by-step method (Baron & Kenny, 1986; He & Shen, 2019) to conduct the following analysis.

First, we use environmental penalties as a proxy for regulatory pressure. We follow previous studies (Marquis

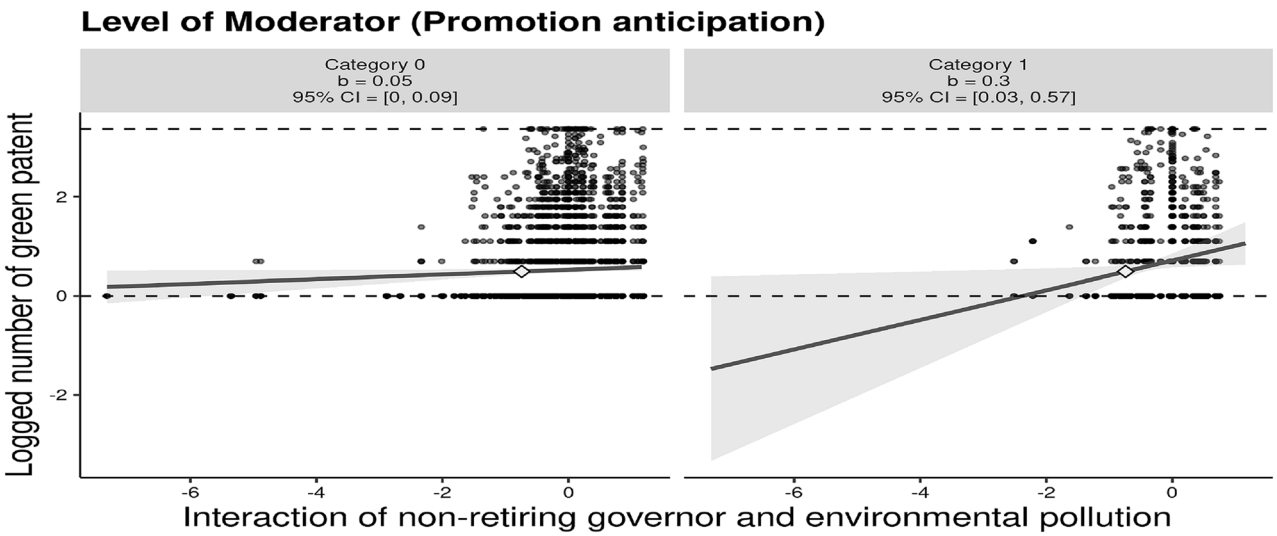

Fig. 2 Moderating effect of promotion anticipation

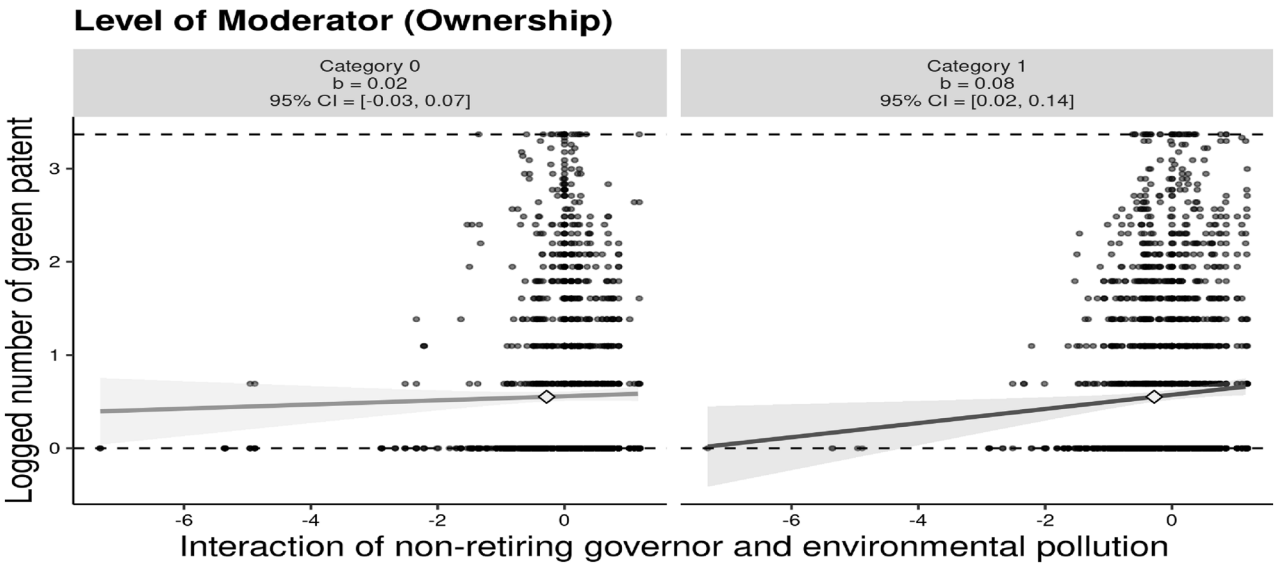

Fig. 3 Moderating effect of ownership

& Bird, 2018) and manually collect the number of firm-level environmental penalties from the Institute of Public & Environmental Affairs (IPE) website (http://www.ipe.org.cn). IPE is an environmental nonprofit organization that collects records of firm-level environmental penalties published by local governments. As shown in Table 5, Model 1 takes environmental penalties as the dependent variable and shows that the coefficient of *Non-retiring*Pollution* is significantly positive, indicating that non-retiring governors impose more environmental penalties on local firms than do their retiring counterparts. Model 2 uses green innovation as the dependent variable and shows that the coefficients of *Non-retiring*Pollution* and *Environmental penalties* are both significantly positive, suggesting that environmental penalties are one of the mechanisms used by non-retiring governors to promote green innovation.

Second, we use government R&D subsidies and state-owned bank loans as a proxy for economic incentives. On the one hand, we manually collect government R&D subsidy data from the financial statement notes under the "non-operating income" and "government subsidy details" items in firms' annual reports, following Wu et al. (2020). We identify the subsidy as an R&D subsidy if the abstract of a subsidy contained any of the following keywords:

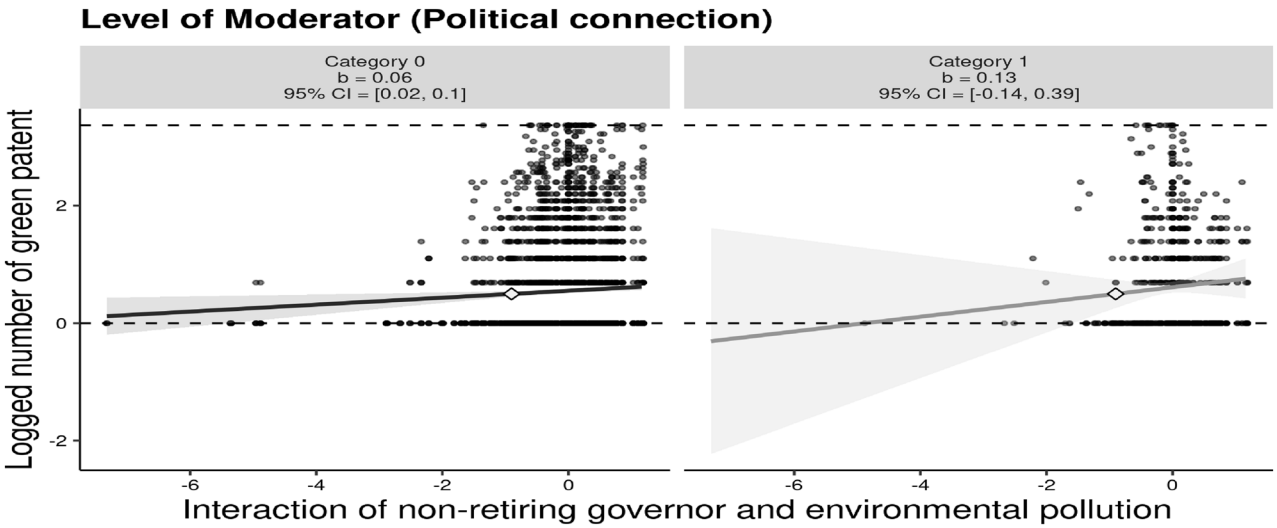

Fig. 4 Moderating effect of political connection

Table 4 Excluding the alternative explanation of officials' age

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Non-retiring*Pollution	0.062***				
	(0.018)				
Governor age*Pollution		0.011***	−0.002		
		(0.003)	(0.015)		
Non-retiring-7 years*Pollution				0.030*	
				(0.018)	
Non-retiring-8 years*Pollution					0.006
					(0.022)
Governor age	0.004	−0.003	−0.620***		
	(0.004)	(0.003)	(0.190)		
Non-retiring/Non-retiring-7	0.055*			0.012	0.002
years/Non-retiring-8 years	(0.030)			(0.022)	(0.023)
Pollution	−0.015	0.021	0.636***	0.003	0.000
	(0.042)	(0.042)	(0.205)	(0.045)	(0.049)
Constant	−3.274	−2.300	14.104	−2.764	−2.855
	(2.421)	(2.361)	(10.085)	(2.357)	(2.406)
Governor age	Yes	Yes	Yes	No	No
Control variables	Yes	Yes	Yes	Yes	Yes
Province, Industry, and Year FEs	Yes	Yes	Yes	Yes	Yes
Observations	4732	4732	1072	4732	4732
R-squared	0.221	0.221	0.229	0.220	0.220

This table reports the results of the tests conducted to exclude the alternative explanation of officials' age. Standard errors clustered at the province and year level are reported in parentheses. ***, ** and * denote the statistical significance of a two-tailed test at the 1%, 5% and 10% levels, respectively

science and technology, innovation, new product, technology innovation, patent, scientific research, research and development, and technological transformation (Wu et al., 2020). Models 3 and 4 in Table 5 shows that non-retiring governors are more likely than retiring governors to promote green innovation through government R&D subsidies.

On the other hand, we follow Chen et al. (2022) and collect data on state-owned bank loans from CSMAR. State-owned banks include Bank of China, Agricultural Bank of

Table 5 Potential mechanisms

Variables	Model 1 Environmental penalties	Model 2 Green innovation	Model 3 Government subsidies	Model 4 Green innovation	Model 5 Bank loans	Model 6 Green innovation
Non-retiring*Pollution	0.018**	0.065***	0.423**	0.063***	0.068*	0.066***
	(0.008)	(0.018)	(0.209)	(0.018)	(0.037)	(0.019)
Environmental penalties		0.066***				
		(0.021)				
Government subsidies				0.007***		
				(0.002)		
Bank loans						0.013*
						(0.007)
Non-retiring	−0.007	0.035	−0.245	0.037*	0.006	0.035
	(0.014)	(0.022)	(0.278)	(0.022)	(0.055)	(0.022)
Pollution	−0.000	−0.014	0.784	−0.019	−0.080	−0.013
	(0.029)	(0.043)	(0.476)	(0.043)	(0.096)	(0.043)
Constant	0.224	−3.124	−2.318	−3.092	−1.382	−3.091
	(1.189)	(2.419)	(26.295)	(2.414)	(4.120)	(2.436)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Province, Industry, and Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4732	4732	4732	4732	4732	4732
R-squared	0.038	0.222	0.211	0.224	0.083	0.221

This table reports the results of mechanism analysis. The variable *Environmental penalties* is measured as the number of firm-level administrative penalties related to environmental violations. The variable *Government subsidies* is measured as the natural logarithm of government R&D subsidies received by the firm plus 1. The variable *Bank loans* are measured as the number of loans received by the firm from state-owned banks. Standard errors clustered at the province and year level are reported in parentheses. ***, ** and * denote the statistical significance of a two-tailed test at the 1%, 5% and 10% levels, respectively

China, China Construction Bank, Industrial and Commercial Bank of China, China Bank of Communications, and Postal Savings Bank of China. Models 5 and 6 of Table 5 report the corresponding results and indicate that non-retiring governors are more likely than retiring governors to promote green innovation through the provision of state-owned bank loans.

Collectively, in contrast to firms in provinces with retiring governors, firms in provinces with non-retiring governors are more likely to suffer more environmental penalties and receive more government R&D subsidies and state-owned bank loans. This finding is consistent with our theoretical mechanism that non-retiring governors are more likely than retiring governors to promote green innovation by exerting stronger regulatory pressure (environmental penalties) and providing more economic incentives (government R&D subsidies, state-owned bank loans).

Discussion and Conclusion

Developing a refined understanding of why and when firms carry out green innovation activities is essential for not only firm competitiveness but also environmental sustainability. We confirm the positive impact of officials' political incentives on corporate green innovation when environmental performance is incorporated into the cadre evaluation system. We further reveal that this positive impact is strengthened by officials' promotion anticipation and firms' state ownership and political connections.

Theoretical Implications

Our study makes several important theoretical contributions. First, our study advances the green innovation literature by identifying officials' political incentives as a new antecedent of green innovation. Compared to the extensive literature on the relationship between regulatory policies and corporate green innovation (e.g., Borghesi et al., 2015; Ren et al., 2022), notably sparse attention has been paid to the factors influencing the behavior and performance of policy-makers and implementers. This limited attention sits uncomfortably because factors affecting the "green" motivation of officials determine the extent to which they place importance on formulating and implementing policies, which in turn affects the outcomes of these policies. Our study focuses on political incentives—one of the most important factors shaping officials' behavior and performance (Du & Yi, 2022) and

provides evidence that stronger political incentives foster corporate green innovation. We theoretically explain that this is because non-retiring governors have higher political incentives and are more likely to foster green innovation to gain further promotion, e.g., by nudging local firms by exerting regulatory pressure and providing economic incentives, than their retiring counterparts. The additional mechanism analysis also supports this explanation. It indicates that the role played by the governors is quintessential, as it determines the degree to which regulations and/or incentive plans are exercised to promote green innovation.

Second, our study contributes to tournament theory by extending it to the context of green innovation. Previous studies have mainly adopted institutional theory (Bammens & Hünermund, 2020), legitimacy theory (Ren et al., 2022), stakeholder theory (Lin et al., 2014), and upper echelons theory (Arena et al., 2018) to explain why firms engage in green innovation. They have focused on antecedents such as regulatory, market, technological, or firm-specific factors. Unlike their work, we provide a new theoretical perspective (i.e., tournament theory) and explain that due to the tournament effect, higher political incentives drive government officials to exert more effort to promote green innovation. Applying tournament theory in such a context thus helps strengthen the understanding of the antecedents of green innovation.

Moreover, the existing research has remained silent on the boundary conditions of the tournament effect (Connelly et al., 2014). Our research addresses this important gap by theorizing the boundary conditions based on two fundamental aspects of tournament theory: promotion motivation and performance evaluation. The finding indicates that the positive effect of political incentives on green innovation is stronger for firms in provinces whose governors have higher promotion anticipation, for local SOEs, and for politically connected firms. We explain that higher promotion anticipation increases the motivation to achieve a promotion and that goal congruency between officials and firms (e.g., SOEs and politically connected firms) enables officials to perform better. By doing so, our study answers the recent call for more exploration of boundary conditions when investigating the relationship between the tournament effect and firm behavior (Connelly et al., 2014; Zhong et al., 2021).

Third, our study enriches to the literature pertinent to the consequences of political incentives by providing insights that political incentives can work to decrease environmental pollution from the perspective of firms' green innovation. Our finding is different from that of previous studies that have suggested a positive effect of such incentives on pollution (e.g., Economy, 2007; Xu, 2011). We explain that this may be because those studies were set in an empirical setting in which the cadre evaluation system does not include environmental performance. While a growing number of studies have noticed that the adjusted cadre evaluation system (the one that includes environmental performance) reshapes the incentive structure of local officials (Du & Yi, 2022), few studies have explored the role of the adjusted system in environmental governance from the perspective of corporate green innovation. By revealing the positive impact of political incentives on green innovation, this study deepens our understanding of the role of the cadre evaluation system in shaping officials' political incentives and provides more comprehensive insights into the relationship between political incentives and pollution.

Ethical Implications

Our study provides important ethical implications for sustainable development. First, our attention to the political incentive system is different from that in prior ethics studies that have focused mainly on the regulatory policies that push firms to adopt more green management initiatives (e.g., He & Shen, 2019; Ren et al., 2022). Our finding goes beyond the emphasis of the policy itself and suggests that attention should also be paid to policy-makers and implementers and, subsequently, to the factors influencing their behavior and performance (i.e., political incentives). This finding advises the authority to consider establishing a cadre evaluation system that rewards local officials' green behavior because such a system can effectively motivate officials to move away from their past priority of promoting economic growth at the expense of the environment. Our evidence for China also provides useful references for emerging economies with similar political systems on how to better address global climate change and environmental degradation.

Second, our study demonstrates the short horizon problem of retiring officials in reducing pollution by showing that these officials invest less than their non-retiring counterparts do in green innovation. The negative consequence of this ethical problem highlights the importance of providing adequate incentives to alleviate the problem of retiring officials. For example, officials' retirement packages can be closely connected to the regional environmental performance during their governance. The officials who perform better in environmental performance evaluations should be prioritized for appointment to leadership positions in the PC or PPCC (the two major political bodies outside the government administration in China) after their retirement. At the same time, the central government should increase the publicity of the efforts of these retiring officials to improve local environmental performance and promulgate relevant honorary awards that enable these officials to build their good political reputations.

Third, prior ethics studies have suggested that the connection between firm managers and government officials has been criticized because it may create the potential for

collusion and the extraction of private benefits for both parties in emerging markets (Chen et al., 2011). However, our findings suggest that the government officials nudge politically connected firms to engage in more green innovation to help achieve their social and political goals. This finding indicates that political connections can increase the goal congruency between firms and the government and thus help solve environmental problems. In the case of our empirical setting, for example, when a firm contributes positively to environmental governance, its executives can be rewarded with PC or PPCC membership.

Limitations and Directions for Future Research

Our study has some limitations that suggest directions for future research. First, the political incentives characteristic of China is not unique but also apply to that of other countries. For example, it has been shown that some countries with unitary systems, such as Vietnam, Japan, and South Korea, share these characteristics, and their local officials are motivated to achieve performance goals (Wang et al., 2021). Moreover, political incentives are prevalent in countries with federal systems (Li & Lu, 2020), where local leaders face pressure from voters and electoral cycles. For example, it would seem that in the US, a governor's re-election prospects are determined largely by how his or her responses to voters' concerns (e.g., economic and environmental goals) compared to responses by governors in neighboring states (Besley & Case, 2003; Li & Lu, 2020). This is similar to the case of China's political incentives. Therefore, a fruitful direction for future research is to explore whether our findings can be replicated in other countries.

Second, due to the availability of corporate financial and patent data, our study is based on a sample of Chinese listed firms. This limitation causes us to track only the political incentives of provincial officials. Thus, we encourage future studies to extend this research by using data on non-listed firms and focusing on the political incentives of city leaders who have a direct impact on the behavior of these firms.

Third, using green innovation, an output indicator, to measure the efforts of local officials might underestimate the impact of political incentives on environmental protection since not all inputs are converted into outputs. We encourage future research to construct a measure that more accurately captures the environmental protection efforts of local officials when input indicators are available.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s10551-024-05622-1.

Acknowledgements We sincerely thank Assaad El Akremi (the editor) and three anonymous reviewers for their insightful comments and suggestions. We acknowledge the financial support from the National Natural Science Foundation of China (Grant Nos. 71974205, 72274220).

Author Contributions Conceptualization and Funding acquisition: [SR]; Formal analysis and investigation and Writing—original draft preparation: [DL]; Writing-review and editing: [DL and JY]; Supervision: [SR and JY].

Funding This work is supported by the National Natural Science Foundation of China, Grant Nos. 71974205, 72274220 to Shenggang Ren.

Data Availability All data are publicly available from sources identified in the text.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval This article does not contain any studies with human participants or animals performed by any of the authors.

References

Adhikari, A., Derashid, C., & Zhang, H. (2006). Public policy, political connections, and effective tax rates: Longitudinal evidence from Malaysia. *Journal of Accounting and Public Policy, 25*(5), 574–595.

Amore, M. D., & Bennedsen, M. (2016). Corporate governance and green innovation. *Journal of Environmental Economics and Management, 75*, 54–72.

Arena, C., Michelon, G., & Trojanowski, G. (2018). Big egos can be green: A study of CEO hubris and environmental innovation. *British Journal of Management, 29*(2), 316–336.

Bammens, Y., & Hünermund, P. (2020). Nonfinancial considerations in eco-innovation decisions: The role of family ownership and reputation concerns. *Journal of Product Innovation Management, 37*(5), 431–453.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173–1182.

Berrone, P., Fosfuri, A., Gelabert, L., & Gomez-Mejia, L. R. (2013). Necessity as the mother of 'green' inventions: Institutional pressures and environmental innovations. *Strategic Management Journal, 34*(8), 891–909.

Berrone, P., & Gomez-Mejia, L. R. (2009). Environmental performance and executive compensation: An integrated agency-institutional perspective. *Academy of Management Journal, 52*(1), 103–126.

Besley, T., & Case, A. (2003). Political institutions and policy choices: Evidence from the United States. *Journal of Economic Literature, 41*(1), 7–73.

Borghesi, S., Cainelli, G., & Mazzanti, M. (2015). Linking emission trading to environmental innovation: Evidence from the Italian manufacturing industry. *Research Policy, 44*(3), 669–683.

Chakraborty, P., & Chatterjee, C. (2017). Does environmental regulation indirectly induce upstream innovation? *New Evidence from India. Research Policy, 46*(5), 939–955.

Chang, Y., He, W., & Wang, J. (2021). Government initiated corporate social responsibility activities: Evidence from a poverty alleviation campaign in China. *Journal of Business Ethics, 173*(4), 661–685.

Chen, C. J., Li, Z., Su, X., & Sun, Z. (2011). Rent-seeking incentives, corporate political connections, and the control structure of private firms: Chinese evidence. *Journal of Corporate Finance, 17*(2), 229–243.

Chen, S., & Jia, K. (2023). How local governments prioritize multiple conflicting goals: Beyond the sole-goal perspective. *Public Administration, 101*(2), 522–538.

Chen, S., Mao, H., & Sun, J. (2022). Low-carbon city construction and corporate carbon reduction performance: Evidence from a quasi-natural experiment in China. *Journal of Business Ethics, 180*(1), 125–143.

Connelly, B. L., Tihanyi, L., Crook, T. R., & Gangloff, K. A. (2014). Tournament theory: Thirty years of contests and competitions. *Journal of Management, 40*(1), 16–47.

Du, J., & Yi, H. (2022). Target-setting, political incentives, and the tricky trade-off between economic development and environmental protection. *Public Administration, 100*(4), 923–941.

Economy, E. C. (2007). The great leap backward? The costs of China's environmental crisis. *Foreign Affairs, 86*(5), 38–59.

Fabrizi, A., Guarini, G., & Meliciani, V. (2018). Green patents, regulatory policies and research network policies. *Research Policy, 47*(6), 1018–1031.

Feng, Y., Ning, M., Lei, Y., Sun, Y., Liu, W., & Wang, J. (2019). Defending blue sky in China: Effectiveness of the "air pollution prevention and control action plan" on air quality improvements from 2013 to 2017. *Journal of Environmental Management, 252*, 109603. https://doi.org/10.1016/j.jenvman.2019.109603

Frenkel, S. J., & Bednall, T. (2016). How training and promotion opportunities, career expectations, and two dimensions of organizational justice explain discretionary work effort. *Human Performance, 29*(1), 16–32.

Genin, A. L., Tan, J., & Song, J. (2021). State governance and technological innovation in emerging economies: State-owned enterprise restructuration and institutional logic dissonance in China's high-speed train sector. *Journal of International Business Studies, 52*(4), 621–645.

Guo, P., Shi, G., Tian, G. G., & Duan, S. (2021). Politicians' hometown favoritism and corporate investments: The role of social identity. *Journal of Banking & Finance, 125*, 106092. https://doi.org/10.1016/j.jbankfin.2021.106092

He, W., & Shen, R. (2019). ISO 14001 certification and corporate technological innovation: Evidence from Chinese firms. *Journal of Business Ethics, 158*(1), 97–117.

Kahn, M. E., Li, P., & Zhao, D. (2015). Water pollution progress at borders: The role of changes in China's political promotion incentives. *American Economic Journal: Economic Policy, 7*(4), 223–242.

Kini, O., & Williams, R. (2012). Tournament incentives, firm risk, and corporate policies. *Journal of Financial Economics, 103*(2), 350–376.

Landry, P. F., Lü, X., & Duan, H. (2018). Does performance matter? Evaluating political selection along the Chinese administrative ladder. *Comparative Political Studies, 51*(8), 1074–1105.

Lazear, E. P., & Rosen, S. (1981). Rank-order tournaments as optimum labor contracts. *Journal of Political Economy, 89*(5), 841–864.

Li, D., Jiang, J., Zhang, L., Huang, C., & Wang, D. (2023). Do CEOs with sent-down movement experience foster corporate environmental responsibility? *Journal of Business Ethics, 185*(1), 147–168.

Li, H., & Zhou, L.-A. (2005). Political turnover and economic performance: The incentive role of personnel control in China. *Journal of Public Economics, 89*(9–10), 1743–1762.

Li, S., & Lu, J. W. (2020). A dual-agency model of firm CSR in response to institutional pressure: Evidence from Chinese publicly listed firms. *Academy of Management Journal, 63*(6), 2004–2032.

Lin, H., Zeng, S., Ma, H., Qi, G., & Tam, V. W. (2014). Can political capital drive corporate green innovation? Lessons from China. *Journal of Cleaner Production, 64*, 63–72.

Liu, C., & Kong, D. (2021). Does political incentive shape governments' disclosure of air pollution information? *China Economic Review, 69*, 101659. https://doi.org/10.1016/j.chieco.2021.101659

Luo, X. R., & Wang, D. (2021). Are politically endorsed firms more socially responsible? Selective engagement in corporate social responsibility. *Journal of Business Ethics, 170*(3), 535–555.

Luo, X. R., Wang, D., & Zhang, J. (2017). Whose call to answer: Institutional complexity and firms' CSR reporting. *Academy of Management Journal, 60*(1), 321–344.

Marquis, C., & Bird, Y. (2018). The paradox of responsive authoritarianism: How civic activism spurs environmental penalties in China. *Organization Science, 29*(5), 948–968.

Marquis, C., & Qian, C. (2014). Corporate social responsibility reporting in China: Symbol or substance? *Organization Science, 25*(1), 127–148.

Murphy, K. R., & Aguinis, H. (2022). Reporting interaction effects: Visualization, effect size, and interpretation. *Journal of Management, 48*(8), 2159–2166.

Porter, M., & van der Linde, C. (1995). Green and competitive: Ending the stalemate. *Harvard Business Review, 73*(5), 120–134.

Pruijssers, J. L., Heugens, P. P., & Van Oosterhout, J. (2020). Winning at a losing game? Side-effects of perceived tournament promotion incentives in audit firms. *Journal of Business Ethics, 162*, 149–167.

Quan, X., Ke, Y., Qian, Y., & Zhang, Y. (2021). CEO foreign experience and green innovation: evidence from china. *Journal of Business Ethics*. https://doi.org/10.1007/s10551-021-04977-z

Ren, S., Huang, M., Liu, D., & Yan, J. (2022). Understanding the impact of mandatory CSR disclosure on green innovation: Evidence from Chinese listed firms. *British Journal of Management, 34*(2), 576–594.

Ren, S., Sun, H., & Zhang, T. (2021). Do environmental subsidies spur environmental innovation? Empirical evidence from Chinese listed firms. *Technological Forecasting and Social Change, 173*, 121123. https://doi.org/10.1016/j.techfore.2021.121123

Rong, Z., Wu, X., & Boeing, P. (2017). The effect of institutional ownership on firm innovation: Evidence from Chinese listed firms. *Research Policy, 46*(9), 1533–1551.

Tan, Y., Tian, X., Zhang, X., & Zhao, H. (2020). The real effect of partial privatization on corporate innovation: Evidence from China's split share structure reform. *Journal of Corporate Finance, 64*, 101661. https://doi.org/10.1016/j.jcorpfin.2020.101661

Tang, P., Jiang, Q., & Mi, L. (2021). One-vote veto: The threshold effect of environmental pollution in China's economic promotion tournament. *Ecological Economics, 185*, 107069. https://doi.org/10.1016/j.ecolecon.2021.107069

Tao, Q., Sun, Y., Zhu, Y., & Yang, X. (2017). Political connections and government subsidies: Evidence from financially distressed firms in China. *Emerging Markets Finance and Trade, 53*(8), 1854–1868.

Tchórzewska, K. B., Garcia-Quevedo, J., & Martinez-Ros, E. (2022). The heterogeneous effects of environmental taxation on green technologies. *Research Policy, 51*(7), 104541. https://doi.org/10.1016/j.respol.2022.104541

Wang, D., Du, F., & Marquis, C. (2019a). Defending Mao's dream: How politicians' ideological imprinting affects firms' political appointment in China. *Academy of Management Journal, 62*(4), 1111–1136.

Wang, D., & Luo, X. R. (2019). Retire in peace: Officials' political incentives and corporate diversification in China. *Administrative Science Quarterly, 64*(4), 773–809.

Wang, D., Zhu, Z., Chen, S., & Luo, X. R. (2021). Running out of steam? A political incentive perspective of FDI inflows in China. *Journal of International Business Studies, 52*(4), 692–717.

Wang, F., Sun, J., & Liu, Y. S. (2019b). Institutional pressure, ultimate ownership, and corporate carbon reduction engagement: Evidence from China. *Journal of Business Research, 104*, 14–26.

Wang, L., Hinrichs, K. T., Prieto, L., & Howell, J. P. (2013). Five dimensions of organizational citizenship behavior: Comparing antecedents and levels of engagement in China and the US. *Asia Pacific Journal of Management, 30*(1), 115–147.

Wu, M., & Cao, X. (2021). Greening the career incentive structure for local officials in China: Does less pollution increase the chances of promotion for Chinese local leaders? *Journal of Environmental Economics and Management, 107*, 102440. https://doi.org/10.1016/j.jeem.2021.102440

Wu, T., Yang, S., & Tan, J. (2020). Impacts of government R&D subsidies on venture capital and renewable energy investment—An empirical study in China. *Resources Policy, 68*, 101715. https://doi.org/10.1016/j.resourpol.2020.101715

Xu, C. (2011). The Fundamental Institutions of China's Reforms and Development. *Journal of Economic Literature, 49*(4), 1076–1151.

Xu, D., Zhou, K. Z., & Du, F. (2019). Deviant versus aspirational risk taking: The effects of performance feedback on bribery expenditure and R&D intensity. *Academy of Management Journal, 62*(4), 1226–1251.

Yang, D., Wang, A. X., Zhou, K. Z., & Jiang, W. (2019). Environmental strategy, institutional force, and innovation capability: A managerial cognition perspective. *Journal of Business Ethics, 159*(4), 1147–1161.

Yao, Y., & Zhang, M. (2015). Subnational leaders and economic growth: Evidence from Chinese cities. *Journal of Economic Growth, 20*(4), 405–436.

Yu, F., Zhang, H., Tan, J., & Liang, Q. (2022). Non-market strategies and credit benefits: Unpacking heterogeneous political connections in response to government anti-corruption initiatives. *Journal of Management Studies, 59*(2), 349–389.

Yue, L. Q., Wang, J., & Yang, B. (2019). Contesting commercialization: Political influence, responsive authoritarianism, and cultural resistance. *Administrative Science Quarterly, 64*(2), 435–465.

Zeng, H., Li, X., Zhou, Q., & Wang, L. (2022). Local government environmental regulatory pressures and corporate environmental strategies: Evidence from natural resource accountability audits in China. *Business Strategy and the Environment, 31*(7), 3060–3082.

Zhang, C. (2017). Political connections and corporate environmental responsibility: Adopting or escaping? *Energy Economics, 68*, 539–547.

Zhang, J., Marquis, C., & Qiao, K. (2016). Do political connections buffer firms from or bind firms to the government? A study of corporate charitable donations of Chinese firms. *Organization Science, 27*(5), 1307–1324.

Zhang, L., Ren, S., Chen, X., Li, D., & Yin, D. (2020). CEO hubris and firm pollution: State and market contingencies in a transitional economy. *Journal of Business Ethics, 161*(2), 459–478.

Zhang, Q., Yu, Z., & Kong, D. (2019). The real effect of legal institutions: Environmental courts and firm environmental protection expenditure. *Journal of Environmental Economics and Management, 98*, 102254. https://doi.org/10.1016/j.jeem.2019.102254

Zheng, S., Kahn, M. E., Sun, W., & Luo, D. (2014). Incentives for China's urban mayors to mitigate pollution externalities: The role of the central government and public environmentalism. *Regional Science and Urban Economics, 47*, 61–71.

Zheng, W., & Chen, P. (2020). The political economy of air pollution: Local development, sustainability, and political incentives in China. *Energy Research & Social Science, 69*, 101707. https://doi.org/10.1016/j.erss.2020.101707

Zhong, X., Ren, L., & Song, T. (2021). Different effects of internal and external tournament incentives on corporate financial misconduct: Evidence from China. *Journal of Business Research, 134*, 329–341.

Zhou, K. Z., Gao, G. Y., & Zhao, H. (2017). State ownership and firm innovation in China: An integrated view of institutional and efficiency logics. *Administrative Science Quarterly, 62*(2), 375–404.