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The Effectiveness of Sinking Regulation: Evidence from the Central Environmental Protection Inspection

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Abstract

This study utilizes data from listed companies and their subsidiaries during 2012-2020 to investigate the role of the central environmental protection inspection system in improving the environmental governance system. The findings reveal that following the deployment of inspection teams to a province, the investment stock of heavy-pollution enterprises in local subsidiaries permanently declined by approximately 8%. Further mechanism analysis identifies a substitution relationship between autonomous environmental institution building by local governments and enterprises and direct central supervision. At the macro level, the impact of inspection actions is attenuated in regions with high environmental protection priority, substantial fiscal investment in pollution control, robust legal systems, and high pollution discharge efficiency. In other words, the impact of central environmental protection inspection actions is more pronounced when listed companies engage in production transfer to regions with lax regulation. At the micro level, inspection actions have a diminished impact on state-owned enterprises and politically unconnected enterprises, as these firms exhibit higher investment intensity in environmental protection projects and superior environmental performance. The substitution relationship between self-regulation and central regulation demonstrates that centrally-dispatched regulatory actions can precisely target weak links in local and enterprise environmental governance, reflecting the important role of central environmental protection inspection in improving relevant institutional mechanisms. Additionally, central regulatory actions also promote enhanced resource utilization efficiency among pollution enterprises; the total factor productivity of pollution enterprises increases following inspection actions. Similar regulatory models also exist in multiple domains such as land resources and judiciary; consequently, the results of this paper provide evidence for the necessity and effectiveness of such institutional arrangements.

Full Text

The Effectiveness of Sinking Supervision: Evidence from the Central Environmental Protection Inspection

Abstract

This paper employs data from listed companies and their subsidiaries from 2012 to 2020 to examine the role of the Central Environmental Protection Inspection system in improving China's environmental governance framework. The findings reveal that following the arrival of an inspection team in a province, the investment stock of heavily polluting firms in their local subsidiaries permanently decreased by approximately 8%. Further mechanism analysis uncovers a substitution relationship between locally initiated environmental protection institutional development and direct central supervision. At the macro level, inspection effects are attenuated in regions that demonstrate greater environmental commitment, allocate more fiscal resources to pollution control, possess sound legal systems, and achieve higher pollution discharge efficiency. Conversely, when listed firms shift production to regions with lax regulation, the impact of Central Environmental Protection Inspections intensifies. At the micro level, state-owned enterprises (SOEs) and politically unconnected firms experience smaller effects, as these firms exhibit higher investment intensity in environmental protection projects and superior environmental performance. The substitution relationship between self-regulation and central supervision demonstrates that centrally-led sinking regulatory actions can precisely target weak links in local and corporate environmental governance, highlighting the institutional importance of Central Environmental Protection Inspections. Moreover, central regulatory actions promote improved resource utilization efficiency among polluting firms, as evidenced by increased total factor productivity following inspections. Similar regulatory models exist in land resources, judiciary, and other domains, suggesting that these findings provide broader evidence for the necessity and effectiveness of such institutional arrangements.

Keywords: polluting firms; investment; environmental governance

JEL Classification: F062.2

The Fourth Plenary Session of the 19th Central Committee of the Communist Party identified ecological civilization construction as a millennium-long project critical to the sustainable development of the Chinese nation, calling for strengthened institutional development in ecological conservation, resource efficiency, and environmental responsibility. This underscores the vital role of environmental governance in perfecting socialism with Chinese characteristics and advancing the modernization of national governance.

However, establishing an effective regulatory governance system presents considerable challenges. Environmental protection institutional development generates strong externalities, while short-term economic interests may distort incentives and cause market failures. Delegating authority to local regulators leverages informational advantages for direct problem detection but risks sys-

temic local regulatory failure—for instance, through local governments concealing pollution (Ghanem and Zhang (2014); Greenstone et al. (2022)) and strategic emissions behavior (Cai et al. (2016); Kahn et al. (2015)), or even active rent-seeking and regulatory capture by local enterprises. Centralizing power can enhance enforcement stringency (Kong and Liu (2024)), yet limited regulatory resources create inconsistent enforcement across jurisdictions (Kedia and Rajgopal (2011)). An effective regulatory mechanism must therefore combine the informational advantages of local supervision with the impartiality of centralized enforcement. Centrally-led sinking inspection actions represent a multi-advantage institutional arrangement: high-level inspections eliminate potential local favoritism, overcome regional fragmentation in enforcement, and ensure comprehensive policy implementation, while on-site inspections directly address information asymmetry across regulatory tiers, enabling precise targeting of institutional weaknesses and preventing both over-enforcement and resource misallocation.

By documenting the impact of the first round of Central Environmental Protection Inspections on corporate investment behavior, this paper analyzes the critical role of sinking inspection regulatory actions in improving environmental governance systems. Following inspection team arrivals in a province, heavily polluting listed companies permanently reduced their local subsidiary investment stock by approximately 8%. Mechanism analysis reveals a substitution relationship between routine local environmental supervision and central inspections. Building upon daily regulatory authority exercised by local environmental protection departments, central inspection actions precisely target regions or enterprises with poor environmental governance outcomes, demonstrating the informational advantages of on-site inspections.

At the macro institutional level, if localities have already established relatively comprehensive environmental governance and regulatory systems autonomously, inspection effects are offset. Specifically, when a province demonstrates greater environmental commitment, allocates more fiscal resources to pollution control, possesses more robust environmental enforcement systems and public supervision channels, and achieves higher production-emission efficiency, the negative impact of direct central regulation on local investment diminishes. At the micro firm level, inspection effects on SOEs and politically unconnected firms are smaller because these firms maintain higher investment intensity in environmental protection projects. This indicates that sinking regulatory actions precisely target pollution-prone enterprises without resorting to blunt “one-size-fits-all” enforcement for short-term results, thereby ensuring normal operations for compliant firms and reflecting the fairness of inspection actions. Firm-level analysis further shows that total factor productivity of heavily polluting enterprises increased following inspections, suggesting that effective environmental regulation promotes resource utilization efficiency. Overall, these findings demonstrate that sinking central regulation can focus on regions and enterprises with weak environmental institutional development and inadequate pollution control, evidencing the effectiveness and necessity of the Central Environmental Protection

Inspection system.

This paper makes several contributions. First, it provides evidence on constructing effective environmental governance systems. Existing literature primarily focuses on direct impacts of environmental regulatory actions—unsurprisingly, any enforcement yields some emission reduction effects. However, less attention has been paid to the underlying mechanisms: whether regulatory outcomes represent long-term effectiveness through improved governance systems or short-term disruptions through crude measures. This paper documents the substitution relationship between Central Environmental Protection Inspections and local/corporate environmental investments, enriching mechanism discussions. At the macro level, centrally-organized sinking regulation helps identify weak links in local environmental governance systems and prompts targeted reforms. At the micro level, inspections precisely target poorly performing firms, generating more pronounced effects. These results demonstrate that Central Environmental Protection Inspections contribute significantly to China's environmental governance system as an important institutional innovation. Using inspections as a quasi-natural experiment, this paper provides empirical evidence for the effectiveness and necessity of this regulatory model, supplementing institutional discussions (Chen Haisong (2017); Liu Qi and Zhang Jinchi (2018); Guo Shihong (2019)). More broadly, centrally-led sinking regulation also exists in land resources, judiciary, and other critical domains, making understanding its role in institutional development essential. Second, this paper adds to evidence on climate change risk impacts on firms. As China increasingly prioritizes environmental protection, institutional changes inevitably affect corporate decisions. Specifically, stricter environmental regulation raises compliance costs and limits evasion opportunities, forcing heavily polluting firms to reduce subsidiary investments nationwide when unable to circumvent oversight. Third, by examining listed companies and their subsidiaries, this paper comprehensively captures group-level responses to environmental regulation. Facing fragmented, temporary local regulation, affiliated enterprises may be used to shift production and evade oversight (Chen et al. (2021)). Focusing solely on individual firms cannot reveal large group companies' evasion strategies, such as production transfers or temporary subsidiary closures. Group-level data can capture these potential strategic avoidance behaviors, thereby validating the effectiveness and necessity of the Central Environmental Protection Inspection system.

The remainder of the paper is organized as follows: Section 2 introduces the institutional background and reviews relevant literature; Section 3 presents hypotheses; Section 4 describes sample construction and descriptive statistics; Sections 5 and 6 conduct empirical analysis; and Section 7 concludes.

Institutional Background and Literature Review

Institutional Background: Central Environmental Protection Inspection

China's 2015 Environmental Protection Law, 2016 Paris Agreement accession, and 2018 constitutional inclusion of ecological civilization demonstrate the government's determination to achieve environmental protection and sustainable development. To thoroughly assess local environmental policy implementation, the Central Environmental Protection Inspection was officially launched in 2016 with central party and state council approval. The first round occurred from January 2016 to September 2017, deploying five batches of inspection teams across 31 provinces (detailed schedule in Appendix Table A1). Each team conducted month-long on-site inspections through public complaints and field examinations. Multiple institutional designs ensure effectiveness: (1) inspection teams meet with provincial party secretaries upon arrival, requiring local officials and departments to cooperate; (2) dedicated phone lines, mailboxes, and offices receive direct public environmental complaints during inspections; (3) post-inspection "look-back" operations verify resolution of identified problems and publicly report outcomes; (4) the Ministry of Ecology and Environment publicizes cases of inadequate rectification, while disciplinary inspection agencies impose sanctions on negligent officials; and (5) following the first round and look-backs, a second round was approved, establishing regular inspections as a normalized governance tool, with three rounds completed by end-2023.

The Central Environmental Protection Inspection offers several institutional advantages. First, relying on public reports through dedicated channels prevents local governments and enterprises from concealing pollution. Second, each verified pollution case must be rectified and verified, ensuring thoroughness—failure results in public criticism and official accountability. Third, centrally-dispatched teams ensure consistent regulatory standards and enforcement intensity, eliminating resource and information constraints that cause enforcement variation. Fourth, multi-round normalized national inspections and look-backs enable long-term, comprehensive policy implementation, replacing previous regionalized, fragmented enforcement and compressing space for window-dressing and strategic emissions.

Literature Review

Environmental protection has gained unprecedented global attention. Rapid economic development has historically come at the cost of environmental degradation, with severe pollution causing adverse consequences. Physiologically, pollutants significantly affect infant and elderly mortality, cardiovascular disease incidence, and obesity rates (Knittel et al. (2016); Deryugina et al. (2019); Schlenker and Walker (2016); Deschenes et al. (2020)). Productivity-wise, pollution damages individual and firm-level productivity (Graff Zivin and Neidell (2012); Chang et al. (2016); Chang et al. (2019); He et al. (2019); Fu et

al. (2021)), potentially affecting macroeconomic growth (Chen Shiyi and Chen Dengke (2018)) and causing societal welfare losses.

Recognizing these negative impacts, many countries have enacted stricter environmental laws and policies. According to Krueger et al. (2020), such policy emergence and tightening constitute regulatory risk within climate change risks. Direct regulatory approaches include on-site inspections and pollution taxes/fees, which effectively reduce emissions (Hanna and Oliva (2010); Zhang et al. (2018); Wang and Wheeler (2005); Dasgupta et al. (2001)) and increase pollution control expenditures (Becker (2005); Ryan (2012)). Climate change risks alter firm behavior, affecting financial leverage (Nguyen and Phan (2020)), cash holdings (Tan et al. (2021)), M&A decisions (Bose et al. (2021)), and dividend payments (Balachandran and Nguyen (2018)). Regulatory policy uncertainty also matters—Trump’s and Biden’s elections represented climate policy shocks, with markets reacting to this uncertainty (Ilhan et al. (2021); Ramelli et al. (2021)).

Existing literature documents that environmental inspections suppress emissions and improve environmental quality (Liu Zhangli and Wu Jiannan (2019); Wang Ling et al. (2019); Li Zhichao et al. (2021); Pan and Hong (2022); Li et al. (2022)), promote green innovation (Qi et al. (2022)), enhance profitability (Chen Renjun et al. (2019)), and improve environmental disclosure quality (Pan and Yao (2021)). Regarding institutional design, studies examine cross-regional environmental inspection centers’ impacts (Chen Xiaohong et al. (2020); Zhao Yang et al. (2021); Chen et al. (2022)). This paper contributes by evaluating the Central Environmental Protection Inspection’s role in environmental governance systems, providing evidence for its necessity and effectiveness. Results show inspections target problems precisely, focusing on regions with underdeveloped ecological governance systems and poorly performing firms, demonstrating that central inspections are essential for improving environmental governance by prompting stakeholders to address weaknesses.

Research Hypotheses

The General Secretary stated: “Building a beautiful China is an important goal of comprehensively building a modern socialist country.” Central policies demonstrate China’s determination to address environmental issues. The 2015 Environmental Protection Law clarified local regulators’ enforcement authority and held local officials accountable for ecological outcomes. However, some regions still prioritize GDP growth over ecological civilization strategy, attracting polluting firms through lax regulation for economic development. Under weak oversight, polluting enterprises avoid costly environmental investments. This regulatory arbitrage attracts non-compliant firms, perpetuating local pollution problems. Central inspection teams filling these gaps effectively address local regulatory failures. For each identified environmental problem, teams verify and transfer cases to local environmental departments with supervised rectification—non-compliant firms and officials face accountability. Rectification requires

polluting firms to install waste treatment facilities or upgrade production processes to meet emission standards before resuming operations. Consequently, strict environmental requirements eliminate the appeal of lax local regulation, increasing marginal costs for polluting firms and potentially reducing local investment. Based on this reasoning, we propose:

Hypothesis H1: Heavily polluting firms reduce local investment following inspection team arrivals in a province.

The General Secretary noted: “Environmental problems are fundamentally problems of development and lifestyle models.” Regional variations in economic development and industrial structure may lead to differential implementation of central environmental decisions, reflected in environmental institutional development outcomes. Regions strictly implementing national ecological civilization strategy can advance environmental protection through infrastructure investment, effective enforcement systems, and improved emission efficiency. Therefore, if local governments have fulfilled environmental regulatory duties and established sound governance systems autonomously, centralized inspections should have minimal impact. Conversely, regions dependent on high-pollution, high-energy industries may exhibit superficial rectification and lagging institutional development, experiencing greater inspection impacts. In other words, a substitution relationship exists between local self-regulation and central direct supervision: sinking inspections focus on weak links in environmental protection, with stronger (weaker) effects in regions with poor (good) institutional development. Accordingly, we propose:

Hypothesis H2: Inspection effects are stronger in regions with weak environmental protection institutional development.

SOEs are pillars of socialism with Chinese characteristics, making significant historical contributions to economic and social development. On one hand, SOEs play crucial roles in stabilizing growth and employment, serving as national economic pillars. However, they may leverage strategic positions to evade environmental regulation, with governments potentially relaxing requirements to protect profitability. On the other hand, accelerating ecological civilization reform and building a beautiful China represent long-term strategic goals. SOEs are critical platforms for implementing central decisions. Environmental protection carries strong social externalities, and SOEs may prioritize environmental strategy over financial interests, increasing pollution control investments and voluntarily adopting stricter standards. In both scenarios, centrally-led inspections have relatively smaller effects on SOEs, though the implications differ completely. In the first case, SOEs avoid supervision without actively participating in environmental protection. In the second, SOEs already invest heavily in environmental protection and achieve good performance. Based on these arguments, we propose:

Hypothesis H3: SOEs are less affected by inspection actions.

Hypothesis H3a: SOEs are less affected because they can evade environmen-

tal supervision.

Hypothesis H3b: SOEs are less affected because they have higher environmental protection investment intensity.

According to the Environmental Protection Law, firms' waste treatment facilities must be constructed simultaneously with production facilities, otherwise acceptance is denied. This raises upfront investment costs, forcing firms with limited funding to cut investment plans. Additionally, regulators can order non-compliant operating firms to install additional waste treatment facilities until emissions meet standards. Both new and existing polluting firms must increase investment to meet strict environmental standards, raising establishment and operational costs. Enhanced enforcement and environmental investment requirements create greater financial pressure. Firms unable to quickly obtain additional financing to cover unexpected cost increases may be forced to reduce investment further. Accordingly, we propose:

Hypothesis H4: Inspection effects are larger for firms with higher financing constraints.

As an emerging market, China continues exploring and improving institutional development in law enactment and enforcement. Although local environmental regulators have authority to fine, restrict, or shut down non-compliant polluting firms, they possess substantial discretion in enforcement intensity and frequency. When government agencies and officials have greater regulatory discretion, political connections may provide polluting firms with protection, ultimately causing local self-regulation failure. Environmentally poor-performing firms can use political connections to evade regulation and cut corners on industrial waste treatment facilities to save costs. Under strong central direct supervision, long-accumulated environmental problems become exposed, creating larger impacts. However, politically connected officials may also use their influence to require firms to strictly implement national environmental policies and increase environmental facility investment, resulting in better environmental performance and smaller central inspection impacts. Therefore, politically connected firms' reactions to central inspections constitute an empirical question. We propose:

Hypothesis H5: Politically connected firms are more affected by inspection actions.

Sample Construction and Descriptive Statistics

Data Sources and Sample Construction

The sample includes all A-share listed companies from 2012-2020, excluding financial firms and STAR Market companies. Financial statement data and basic company information come from CSMAR and CNRDS databases. A key research question concerns how sinking inspection actions affect group companies' regional investment behavior. Since inspection teams are deployed at the provincial level, measuring investment behavior changes across regions is crucial

for evaluating inspection effectiveness, posing an empirical challenge due to data availability.

Existing literature shows that establishing subsidiaries is an important channel for business groups to leverage political networks, access environmental havens, and obtain tax benefits (Zeume (2017); Dam and Scholtens (2008); Cooper and Nguyen (2020)). Chinese listed companies establish local subsidiaries to support local officials' promotion and receive tax benefits and subsidies (Chen et al. (2020)). Chen et al. (2021) find Chinese business groups adjust production allocation among subsidiaries to evade regulation and maximize profits. Based on this research, this paper uses subsidiaries and grandson companies invested by listed companies nationwide as proxies for investment behavior. Subsidiary data from CNRDS are restricted as follows: (1) only subsidiaries with >50% ownership are included, excluding associates and joint ventures, to ensure listed companies have full autonomy over establishment or closure decisions; (2) only subsidiaries with RMB registered capital are included to avoid exchange rate fluctuations; (3) subsidiaries in Hong Kong, Macau, Taiwan, and overseas are excluded. All subsidiary data are cross-verified through Tianyancha.com and Aiqicha.baidu.com platforms.

The final subsidiary information forms a subsidiary-level panel dataset including company name, registered capital, location, registration date, operating status, affiliated listed company, and ownership percentage. Since most subsidiaries are unlisted without financial data, registered capital serves as the investment proxy. To study dynamic investment adjustments, this paper aggregates all subsidiaries' registered capital within each province for each listed company annually (or counts subsidiary numbers for robustness), creating a listed firm-year-province level sample. This aggregated sample records each listed company's overall subsidiary investment situation in each province annually, constructing a dynamic national investment panel at the group level. This sample offers several advantages. First, Chen et al. (2021) find Chinese business groups transfer production to unregulated affiliates when facing energy conservation policies. This sample can capture potential evasion behaviors, such as temporarily closing subsidiaries or cross-regional investment transfers, which geographic panel data can detect. Second, the expanded sample accurately characterizes inspection features: environmental inspections are geographically province-based rather than firm-specific. If a Zhejiang-registered listed company invests in a Beijing subsidiary, the group's inspection impact begins when the team arrives in Beijing (2016), not when inspecting Zhejiang (2017). The listed firm-year-province dimension helps evaluate real-time inspection effects. Using only listed firm-level panel data may fail to accurately reflect firms' inspection exposure or capture group-level immediate responses to environmental regulation.

Descriptive Statistics

The sample contains approximately 110,000 subsidiaries established by Chinese listed companies. Table 1 shows the subsidiary panel: average listed company

ownership is 89.27% (median 100%), reflecting the >50% ownership requirement to ensure autonomy. Subsidiary registered capital is the key investment indicator, averaging 155.8 million RMB (median 20 million RMB), with right-skewed distribution indicating some large subsidiaries. Geographically, Guangdong, Jiangsu, Zhejiang, Shanghai, and Beijing are preferred subsidiary locations, while Qinghai, Ningxia, Tibet, and Gansu attract fewer subsidiaries, indicating preference for economically developed regions and major cities.

Table 1 Partial Descriptive Statistics of Key Variables

Figure 1 [Figure 1: see original paper] shows annual new subsidiary establishment numbers and registered capital amounts. Before 2000, few subsidiaries were established annually, likely due to China's nascent stock market. As the market developed, more listed companies and subsidiaries entered the sample. Approximately 60% of the 110,000 subsidiaries were newly established during the sample period (2012-2020), accounting for about 50% of total registered capital. The peak occurred in 2017, when listed companies established over 10,000 new subsidiaries. Subsidiary establishment carries substantial economic significance: average annual registered capital of newly established subsidiaries reached 814.3 billion RMB, confirming that subsidiary establishment is a widely used investment method that can proxy for corporate investment behavior.

Since inspections target pollution, heavily polluting industries are the regulatory focus. Following the Ministry of Ecology and Environment's 2008 "Listed Company Environmental Verification Industry Classification Management Catalogue," polluting firms are classified and marked as heavily polluting (*Treat*). Firms switching registration from polluting to non-polluting industries are excluded to avoid selection issues. As hypothesized in H1, heavily polluting industries should experience greater inspection impacts. Table 1's firm-year panel shows approximately one-quarter of sample firms belong to heavily polluting industries, indicating representative coverage. Control variables include firm financial characteristics: log of total assets (*logAsset*), leverage (*Leverage*), log of cash (*logCash*), log of sales (*logSales*), return on assets (*ROA*), SOE dummy (*SOE*), book-to-market ratio (*B/M*), log of staff (*logStaff*), institutional ownership (*InstiHold*), asset tangibility (*Tangibility*), and loss dummy (*Loss*). Descriptive statistics show right-skewed distributions for assets, sales, and employment. Approximately one-third of listed companies are SOEs, highlighting their economic importance. Average profitability is relatively low, with median and mean ROA around 4%. All financial variables are measured at prior year-end, with continuous variables winsorized at 1% and 99% to prevent outliers from affecting results.

Identification Strategy and Empirical Results

Baseline Regression

The Central Environmental Protection Inspection provides an exogenous policy shock creating a quasi-natural experiment. The first round represented the first

high-level environmental inspection and enforcement action organized by the central government, unpredictable for local governments and enterprises. The “one case, one resolution” requirement and “look-back” operations ensure long-lasting regulatory effects. Inspection teams entered provinces at different times, establishing a normalized regulatory mechanism, enabling causal identification through difference-in-differences methodology.

$$\log(1+inv\ or\ \#)_{itp} = \beta_0 + \beta_1 Treat_i \times Post_{tp} + \beta_2 Controls_{it-1} + FirmFE_i + YearFE_t + Prov_YearFE_{tp} + FProv$$

This paper uses model (1) to verify inspection effects on corporate investment behavior. As described, this is a listed firm-year-province level regression. The dependent variable is the log of one plus the sum of registered capital (or count) of subsidiaries that listed firm i invests in province p in year t . Since the dependent variable contains zeros, the inverse hyperbolic sine (IHS) transformation is also applied for robustness. The treatment variable $Treat_i$ equals 1 if the listed firm belongs to a heavily polluting industry per the Catalogue, and 0 otherwise. $Post_{tp}$ equals 1 in the year when inspection teams enter province p and thereafter. Controls include all firm financial and accounting indicators listed previously. The model includes firm $FirmFE_i$ and year $YearFE_t$ fixed effects, plus province-year $Prov_YearFE_{tp}$ fixed effects to capture geographic, economic, and industrial policy factors that attract investment. To account for geographic distance effects, listed firm registration province-province fixed effects $FProv_ProvFE_{ip}$ are also included.

Table 2 Baseline Regression Results

Table 2 presents baseline results. Column (1) includes no controls or fixed effects, providing limited information. Columns (2) and (3) add controls and fixed effects, where the interaction term remains negative and statistically significant, indicating heavily polluting firms reduced investment after inspection team arrivals. Economically, column (2) suggests listed companies in heavily polluting industries reduced provincial investment stock by about 9% post-inspection. Using column (3) ‘s most conservative estimate, inspections reduced heavily polluting firms’ provincial investment stock by approximately 8%. Column (4) applies IHS transformation to registered capital, with interaction coefficients remaining robust in magnitude and significance. Columns (5)-(8) replace the dependent variable with subsidiary counts. Across all specifications, interaction coefficients remain significantly negative, meaning heavily polluting firms reduced subsidiary numbers post-inspection. The smaller coefficients in count specifications suggest that eliminated subsidiaries tend to be larger. Overall, heavily polluting companies reduced local subsidiary investments following inspection arrivals, initially supporting H1. This echoes Chen et al. (2021): establishing subsidiaries is a channel for group companies to evade regulation. The Central Environmental Protection Inspection, as a comprehensive national environmental governance system, significantly compresses space for cross-regional production and emission transfers through subsidiaries.

Dynamic Model

To test the parallel trends assumption in difference-in-differences, the following dynamic model (2) is estimated:

$$\log(1+inv\ or\ \#)_{itp} = \sum \beta_l Treat_{itp}^l + \delta_1 Controls_{it-1} + FirmFE_i + YearFE_t + Prov_YearFE_{tp} + FProv_Prov$$

The year before inspection arrival serves as the baseline. The model includes full controls and fixed effects as in Table 2 column (3). Figures 2 [Figure 2: see original paper] and 3 [Figure 3: see original paper] show the parallel trends assumption is satisfied: before inspection arrival, heavily polluting and non-polluting listed companies exhibited identical tendencies to establish subsidiaries nationwide. Post-arrival, heavily polluting firms began reducing investments nationwide, with significant decreases in both investment amounts and subsidiary numbers. The parallel trends figures show heavily polluting firms continued cutting investments for three years following inspections, indicating they cannot use temporary shutdowns or window-dressing to 应付检查, highlighting the effectiveness of sinking central regulation.

Moderation Analysis

In developing countries, lacking effective regulatory mechanisms may render environmental laws merely symbolic, perpetuating pollution problems. Literature emphasizes gaps between environmental legislation and enforcement (Greenstone and Hanna (2014); Shimshack (2014)). Historically, local official performance evaluation focused primarily on economic growth, potentially hindering timely integration of ecological civilization into policy objectives and creating regional disparities in environmental protection investment and outcomes. China's national legislature handles environmental legislation, providing uniform legal basis across governments, making central supervision focus on local implementation rather than standard-setting. An intuitive inference suggests that if local governments have implemented strict environmental regulation, central inspection impacts should diminish.

This section analyzes the relationship between local self-regulation and central inspection through model (3) with a triple interaction term. Specifically, it calculates environmental protection institutional development differences between each province p and listed firm i 's registration province. Literature shows polluting firms transfer production and investment from stricter to laxer regulatory regions (Becker and Henderson (2000); Wu et al. (2017)), so relative measures capture institutional differences. Variable $(Dest_p - Reg_{it})$ records these differences, positive when investment destinations have stricter environmental regulation than registration locations. Under H2, if local governments have established relatively complete environmental regulatory mechanisms with strict local environmental performance requirements, inspection effects should

weaken. When firms invest in regions with better environmental systems, these investments already face stricter local regulation, requiring no additional adjustment under central oversight. Thus, triple interaction coefficient β_1 should have opposite sign to double interaction coefficient β_2 .

$$\log(1+inv\ or\ \#)_{itp} = \beta_0 + \beta_1 Treat_i \times Post_{tp} \times (Dest_p - Reg_{it}) + \beta_2 Treat_i \times Post_{tp} + \beta_3 (Dest_p - Reg_{it}) + \beta_4 Treat_i \times$$

(1) Local Government Environmental Commitment. Following Chen et al. (2018), provincial government annual work report environmental keyword frequency measures local environmental commitment. The keyword list appears in Table A3. Keyword counts are standardized by text length to calculate frequency—higher values indicate greater ecological protection emphasis. The ratio difference between investment destination and firm registration provinces is calculated, naming $(Dest_p - Reg_{it})$ as $govr_{pt}$. With triple interaction, Table 3 columns (1)-(2) show the double interaction coefficient remains significantly negative while the triple interaction coefficient is significantly positive. This indicates that when local governments themselves emphasize environmental protection, direct central regulation’s impact on local investment is offset, consistent with H2. Conversely, if firms intend to evade regulation by investing in regions with low environmental commitment (negative $govr_{pt}$), they must cut more local investment under central oversight. This pattern aligns with Zhao Haifeng and Zhang Ying (2023), who find government attention improves local environmental governance efficiency. Economically, column (1) shows that if the investment destination province’s government mentions environmental terms 0.29% more frequently in annual work reports than the registration province’s government, the central inspection’s impact is completely offset ($0.3190 \times 0.2900 = 0.0925$).

(2) Local Government Pollution Control Investment. Beyond commitment statements, actual local government pollution control investment represents important institutional development. Increased environmental governance investment creates better ecological conditions, reducing additional central regulatory pressure. These investments drive local environmental infrastructure construction, easing firms’ environmental investment burdens and stabilizing local investment. This paper measures local environmental investment intensity using the ratio of “completed investment in industrial pollution control” to provincial annual GDP, with data from the National Bureau of Statistics. The difference in environmental investment intensity between investment destination and registration locations is calculated as $fiscal$, measuring relative local governance investment strength. Positive values indicate greater fiscal environmental investment at the destination. Table 3 columns (3)-(4) present results. The double interaction coefficient remains significantly negative while the triple interaction coefficient is significantly positive, indicating local pollution reduction efforts offset inspection effects. Economically, column (3) shows that when the investment destination’s industrial pollution control investment exceeds the

registration province' s by 0.059% of GDP, central direct regulation' s impact is completely offset ($1.0102 \times 0.0590 = 0.0596$).

(3) Local Legal Environment. Environmental institutional development also involves regional rule-of-law environments. Local governments should regulate local polluting firms even without central supervision. However, multiple objectives of economic development (and related official promotion) and environmental protection may create incentive distortions in enforcement, causing regional differences in environmental law enforcement stringency. To measure enforcement strictness, this paper manually collects annual provincial environmental administrative penalty cases from pkulaw.com and standardizes by provincial population. The difference between investment destination and registration provinces serves as a relative measure of local environmental law enforcement intensity, denoted *enforce*. Positive values mean investment destinations already enforce environmental laws more strictly, regulating local firms under higher standards. When effective local environmental enforcement systems exist, centralized inspection effects should weaken. Table 3 columns (5)-(6) show results. Column (5) indicates that when environmental administrative penalty cases increase by 0.7 per 10,000 people relative to the registration location, central inspection impacts are completely offset ($0.1363 \times 0.6970 = 0.0950$).

Public supervision also constitutes an important environmental protection system component. Under the Environmental Protection Law, qualified environmental public interest organizations registered with civil affairs departments can file environmental public interest lawsuits in intermediate people' s courts. In regions with better legal environments, the public can supervise environmental protection through legal channels even without central on-site supervision. Thus, central supervision' s additional effects should be less pronounced in areas with sounder legal systems. To evaluate public supervision effects, this paper uses lawyers per 10,000 people to measure local legal environment, calculating the ratio difference between investment destination and registration provinces as *law*. Positive differences indicate more effective legal systems where firms already face greater local social supervision, resulting in smaller impacts from central direct regulation. Public supervision results appear in Table 3 columns (7)-(8). Column (7) shows that a relative increase of one lawyer per 10,000 people in the investment destination province reduces central direct regulation' s impact by 60% ($0.0372/0.0560 = 66.43\%$). These results indicate sound legal environments help stabilize local investment.

(4) Local Pollutant Emission Efficiency. Emission efficiency reflects local environmental governance outcomes—regions with inadequate environmental systems exhibit higher pollution levels. Some firms transfer operations to more polluted areas to exploit lax regulation. This paper uses provincial chemical oxygen demand (COD) to measure pollution levels, standardized by provincial GDP (unit: 10,000 tons/100 million yuan), with original data from the National Bureau of Statistics. The emission efficiency difference between investment destination and registration provinces is calculated as variable *COD*. Pollutant

emissions per unit of economic output reflect local environmental governance outcomes. Positive values indicate firms selected more polluted regions as investment destinations to evade regulation. Evasion-prone firms face greater negative shocks under strong central regulation. Table 3 columns (9)-(10) show results. Consistent with main findings, the double interaction coefficient is significantly negative, but now the triple interaction coefficient is also significantly negative. This indicates that if polluting firms exhibit evasion behavior by investing in relatively lax, low emission-efficiency regions, they must make larger adjustments under strict central regulation. On average, if the investment destination province's COD per 100 million yuan GDP exceeds the registration province's by 1 ton, listed companies must cut approximately 0.24% more investment (equivalent to expanding inspection impact by 4.61% ($(23.9605/10000)/0.0520 = 4.61\%$)).

Overall, results support H2, indicating a substitution relationship between local routine environmental self-regulation and central concentrated supervision. Well-developed local environmental governance systems weaken additional impacts from central direct regulation, stabilizing local investment. While inspections reduce polluting firms' investment activities, local environmental commitment, provincial fiscal pollution control investment, and sound legal environments can mitigate central supervision effects. Conversely, regions with low emission efficiency and lagging environmental governance outcomes force larger adjustments from local firms under central oversight. These results demonstrate that centrally-led sinking inspection actions can precisely target weak links in local environmental governance and regulation, representing an indispensable component of effective environmental governance systems.

Cross-Sectional Analysis

(1) Firm Ownership. SOEs attract extensive research attention. Though operationally less efficient (Chen et al. (2011)), they enjoy policy advantages in financing and judiciary (Allen et al. (2019); Firth et al. (2011); Liu et al. (2018)). SOEs' role in environmental institutional development is empirical. As corporate entities, SOEs pursue shareholder interests, with profits representing important government revenue sources. Thus, enforcement agencies may relax SOE regulation to ensure profitability (H3a). However, despite profit importance, SOEs are also critical platforms for implementing national strategic policies. Environmental protection policies require substantial upfront investment with significant externalities, potentially yielding slow or negative returns. Where market mechanisms fail, SOEs may serve as effective pathways for achieving national environmental strategy, voluntarily undertaking social responsibility (H3b).

First, the sample is divided by ownership, with separate regressions of model (1) for SOE and non-SOE subsamples. Table 4 columns (1)-(2) show SOE subsample results: interaction coefficients are insignificant, indicating relatively small SOE investment adjustments post-inspection. Conversely, columns (3)-(4) show significantly negative interaction coefficients for non-SOEs, indicating investment reductions after inspection arrivals. These findings support H3. To

further interpret cross-sectional results and distinguish between H3a's and H3b's competing explanations, this paper examines listed companies' environmental investment intensity. Following Zhang Qi et al. (2019), environmental investment amounts are calculated from annual report financial statement notes' "major construction in progress" and "administrative expenses" sections. Data from CSMAR identify environmental protection investment projects when project descriptions contain any keywords from Table A4' s list, aggregated to firm-year level as *EnvInv* and standardized by total assets *Asset*, sales revenue *Sales*, or owners' equity *Equity*.

Table 5 presents environmental investment intensity results. First, regardless of standardization method, Panel A shows non-polluting firms' environmental investment intensity is lower than Panel B' s polluting firms, indicating reasonable variable construction. Second, using Panel A as control, SOEs do not invest more in environmental protection than private firms among non-polluting firms—if anything, SOE environmental investment intensity is significantly lower than private firms when standardized by total assets. Third, Panel B focuses on polluting firms' environmental investment intensity. Results show SOEs invest significantly more in environmental protection than private firms under all standardization methods, consistent with Lin and Xie (2023) that environmental inspections more strongly suppress private firms' rent-seeking behavior. Private firms' lower environmental investment intensity and poorer environmental performance force larger adjustments under central direct supervision. Fourth, comparing Panels A and B reveals higher environmental investment intensity is not systematically concentrated in the state sector. Instead, higher intensity appears only among SOEs in heavily polluting industries, indicating SOEs do not blindly invest in environmental protection and waste resources. These results show heavily polluting SOEs invest more resources in environmental protection, experiencing smaller inspection impacts, consistent with H3b' s speculation.

(2) Financing Constraints. Financing constraints literature focuses on constructing reasonable proxies and examining impacts on corporate investment and financing (Fazzari et al. (1988); Kaplan and Zingales (1997); Cleary (1999); Whited and Wu (2006); Hadlock and Pierce (2010)). Environmental governance initiatives inevitably create additional financial pressure. The 2015 Environmental Protection Law requires waste treatment facilities to be designed, constructed, and operated simultaneously with main production facilities. Non-compliant operating firms can be ordered to restrict or suspend production for rectification, installing additional waste treatment facilities until emissions meet standards. Under central direct supervision pressure, environmental protection departments at all levels intensify inspections and enforcement, increasing polluting firms' compliance costs and financial pressure. Facing higher initial investment and operating costs, firms with difficult access to funds are more likely to reduce investment demand. We hypothesize that strict environmental regulation has greater impact on firms with higher financing constraints. To test H4, this paper first constructs listed companies' financing constraint levels using Kaplan and Zingales (1997)' s KZ index, then calculates each firm' s pre-treatment

period (2012-2015) average and splits the sample by median.

Table 6 presents financing constraint results. Consistent with H4, Central Environmental Protection Inspection effects concentrate in high financing constraint firms, with no significant impact on low constraint firms. Table A5 uses Hadlock and Pierce (2010)'s SA index for robustness, confirming results. These findings verify that strict environmental policy enforcement indeed creates financial pressure. For polluting firms willing to cooperate with rectification and continue operations, governments could consider providing appropriate support to help achieve environmental protection goals.

(3) Political Connections. Firm-politician connections exist worldwide, with research suggesting political relationships create positive value (Fisman (2001); Faccio (2006); Cooper et al. (2010)). Politically connected firms may receive preferential support in credit, tax benefits, procurement contracts, and litigation (Claessens et al. (2008); Schoenherr (2019); Firth et al. (2011)). Chinese listed companies also have extensive political connections (Fan et al. (2007)), which can compensate for low marketization or weak rule-of-law environments (Chen et al. (2011)). However, political connections' impacts are complex—some scholars find they add value (Calomiris et al. (2010)), while others find they correlate with poor long-term performance (Fan et al. (2007)).

To examine political connection effects, firms are divided into politically connected and unconnected subsamples. Table 7 shows grouping regression results. Inspection effects are more pronounced for politically connected firms. In magnitude, coefficients for unconnected samples decline over 60% compared to connected samples (though column (4)'s coefficient is significant at 10%). This result supports H5. To explore underlying mechanisms, Table 8 compares environmental investment intensity by political connection status using Table 5's method. First, in non-polluting industries (Panel A control), politically connected firms do not systematically underinvest in environmental protection. However, in the polluting group (Panel B), politically connected firms invest less in environmental protection than unconnected firms across all standardization methods. Politically connected polluting firms may cut environmental investment corners due to official protection, experiencing larger impacts under strong central supervision. Notably, Panel B shows low statistical significance, so Table 8 results can provide only suggestive evidence regarding political connections.

Additional Results

(1) Reducing Future Investment vs. Cutting Existing Investment. Listed companies can reduce nationwide investment by decreasing new subsidiary establishment or closing existing subsidiaries. This paper replaces dependent variables with annual newly established (or deregistered) subsidiaries' registered capital and counts to explore how polluting firms reduce investment. Table 9 shows heavily polluting firms primarily reduce investment by cutting new subsidiaries rather than closing existing ones. Theoretically, firms could

also reduce investment through capital reduction, but complex procedures and creditor rights make capital reduction rare in China. Therefore, only reductions in future investment or cuts to existing investment are examined.

(2) Baseline Regression Robustness and Placebo Tests. Subsidiary Scope. The baseline model requires >50% ownership to ensure listed companies have full discretion over subsidiary establishment/closure decisions. The first robustness test removes this restriction, including all participating subsidiaries, expanding the sample by approximately 4,000 subsidiaries. Unreported results show full-sample subsidiary registered capital averages 164.74 million RMB (median 20 million RMB), with listed group ownership slightly decreasing to 86.97%. Re-running model (1) with the new sample, Table A6 columns (1)-(2) show results highly consistent with Table 2. **Random Assignment (Placebo Test).** Previous analyses define treatment groups using the Catalogue' s heavily polluting firms. To verify that inspections precisely target heavily polluting industries, 50% of listed companies are randomly assigned to treatment ($rTreat$) and model (1) is re-estimated. Table A6 columns (3)-(4) show the double interaction coefficient is statistically zero, confirming inspections strictly supervise heavily polluting firms with minimal impact on others. **Policy Overlap.** As background describes, the first round and subsequent look-backs established a stable, long-term supervision system, suggesting effects should concentrate in the first round. The Party Central Committee and State Council approved a second round in 2019, with nine provinces completed by the 2020 sample end. To isolate first-round effects, the final two sample years are deleted. Table A6 columns (5)-(6) show results very similar to Table 2, indicating inspection effects concentrate in the first round.

Firm-Year Level Analysis

This section tests Central Environmental Protection Inspections' overall impact on listed group companies through models (4) and (5). Specifically, this paper first calculates the proportion of listed firm i ' s investment stock in province p in year t relative to the group' s total investment stock (by registered capital), then multiplies each province' s proportion by time variable $Post_{tp}$, and sums across provinces. Parent company investment is included when calculating group total and provincial local investment because parent companies' highest importance generates large group-level impacts when regulated (results remain robust when considering only subsidiary investment stock, as shown in Tables A7.1 and A7.2). This approach compresses the firm-year-province sample to firm-year level to record what proportion of listed group company i ' s nationwide investment falls under continuous central inspection supervision. Over time, all group investment amounts gradually come under central supervision, similar to a fuzzy difference-in-differences design. The logic uses regulated investment proportions as weights to weight the arrival variable $Post_{tp}$. As in previous analysis, provincial company count proportions are also used as weights for robustness, though this implies each company (including parent and subsidiaries)

has equal regulatory impact—an assumption sometimes unreasonable, thus used only for robustness demonstration. This setting is based on inspections being province-based rather than firm-specific. Recall the earlier example: a Zhejiang-registered listed company with a Beijing subsidiary faces inspection exposure when teams arrive in Beijing (2016), not Zhejiang (2017). Therefore, based on inspection teams' nationwide provincial arrival times, models (4) and (5) are constructed with interaction terms $Treat_IPost$ and $Treat_NPost$.

$$y_{it} = \beta_0 + \beta_1 Treat_i \times \left[\sum \frac{Invest_{itp}}{Invest_{it}} \times Post_{tp} \right] + \beta_2 Controls_{it-1} + FirmFE_i + YearFE_t + \varepsilon_{it}$$

$$y_{it} = \beta_0 + \beta_1 Treat_i \times \left[\sum \frac{Count_{itp}}{Count_{it}} \times Post_{tp} \right] + \beta_2 Controls_{it-1} + FirmFE_i + YearFE_t + \varepsilon_{it}$$

Group-Level Total Capital Expenditure

Subsidiary registered capital stock has served as the investment proxy. One might worry that listed companies' investment behavior involves more than establishing subsidiaries. To verify investment reduction conclusions, this paper uses firm-level capital expenditure to capture overall investment levels, standardized by total assets, sales revenue, or owners' equity for robustness. Table 10 confirms heavily polluting firms significantly reduced investment post-inspection, robust for group-level total capital expenditure.

Firm Total Factor Productivity

Firm production efficiency also warrants examination. On one hand, strict environmental regulation forces polluting firms to reduce investment scale, potentially preventing full capital utilization and reducing productivity. On the other hand, strict regulation may require abandoning high-pollution production models, upgrading industries to improve resource efficiency and reduce emissions. Following Lu Xiaodong and Lian Yujun (2012), this paper calculates firm total factor productivity through multiple methods as dependent variables to test comprehensive inspection effects on productivity. Table 11 shows interaction coefficients are significantly positive across all specifications regardless of calculation method, indicating inspections promote productivity improvements in heavily polluting firms.

Conclusion

This paper investigates Chinese listed companies' responses to Central Environmental Protection Inspections. Results show heavily polluting firms reduced local investment scale by approximately 8% after inspection team arrivals. Mechanism analysis reveals a substitution relationship between local environmental

self-regulation and central direct supervision. At the macro level, when regions autonomously emphasize environmental strategy, increase environmental governance investment, enforce environmental laws strictly, and establish effective social supervision systems, central regulation effects weaken. However, central regulation has stronger effects in provinces with poor environmental governance and low emission efficiency. In other words, if heavily polluting firms engage in evasion by transferring production to environmentally lax regions, Central Environmental Protection Inspections have greater impact. At the micro level, SOEs and politically unconnected firms experience smaller inspection effects due to higher environmental project investment intensity and better environmental performance. Strict environmental regulation raises compliance costs and operational financial pressure, forcing firms with higher financing constraints to cut more investment. Finally, Central Environmental Protection Inspections help promote productivity improvements in heavily polluting firms.

These results demonstrate the effectiveness and necessity of the Central Environmental Protection Inspection system in environmental governance from multiple perspectives. The substitution relationship between local environmental institutional development and central supervision shows inspections precisely target weak links in local ecological governance systems, prompting improvements in daily environmental regulation. Inspections have more pronounced effects on firms with lower environmental project investment intensity, confirming they identify environmentally risky firms. Heterogeneous impacts at macro institutional and micro firm levels indicate that central requirements prohibiting local regulators from using crude “one-size-fits-all” or “total shutdown” approaches are basically implemented, ensuring environmental governance does not affect compliant firms’ normal operations. Finally, comprehensive, continuous central regulatory actions compress firms’ evasion space and promote productivity improvements.

Appendices

Table A1 First Round Central Environmental Protection Inspection Schedule

Table A2 Geographic Distribution of Sample Subsidiaries

Table A3 Environmental Keywords in Government Work Reports

Table A4 Listed Company Environmental Protection Investment Project Vocabulary

Table A5 Cross-Sectional Analysis: Financing Constraints (SA Index)

Table A6 Baseline Regression Robustness Tests

Table A7.1 Robustness Tests for Models (4) and (5)

Table A7.2 Robustness Tests for Models (4) and (5)

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