

Regularized Campaigns as a New Institution for Effective Governance

Shiran Victoria Shen, Qi Wang, and Bing Zhang

Abstract

The legislator primarily uses institutions and implements campaigns to achieve effective governance. Institutions foster regularized implementation, while campaigns, which are organized courses of action with some level of coercion to achieve specific goals, happen ad hoc and achieve quick but transient results. This paper fills theoretical gaps in the social sciences by systematically exploring how campaigns can enhance institutions and how regularized campaigns as a new institution creates persistent effects beyond the periods when campaigns are actively ongoing. We theorize that institutions can become ineffective when special interests capture the bureaucracy, in which case campaigns are needed to weaken the regulated entities' bargaining power. Using an original firm-level dataset, we test our theory on industrial firm responses to changes in air pollution regulation in China and find that the higher-contributing the firms, the more standard violations they committed before the central government started waging waves of campaigns but not after. This suggests that when bureaucratic capture undermines the promise of institutions, campaigns can improve compliance, and their effects can persist when regularized.

Keywords: governance, institution, campaign, regulation, environment

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1. Introduction

A core subject in the social sciences is governance, which we understand from the lens of traditional state authority, namely, the effective implementation of state policies.¹ The principal delegates policy implementation to the agents with misaligned interests and better information about actual implementation than the principal. Thus, effective governance requires solving that agency dilemma, for which the principal primarily uses institutions and implements campaigns. As broadly conceived, institutions impose constraints and foster regularized policy implementation. Conversely, implementation campaigns generally happen ad hoc and are short-lived, coercive, and intensely demanding attention, leading to sudden and momentary changes in policy outcomes. Due to the persistent nature of patterns fostered by institutions, scholars and practitioners view institutions as the focal point for fixing governance problems. While extant works offer much wisdom, how campaigns can enhance institutions in governance has yet to be systematically explored. This paper aims to fill that theoretical and empirical gap. Furthermore, regularized campaigns remain understudied as an emerging form of institution.² This paper explores their effects during and beyond when campaigns are ongoing. We theorize that when the agent, or the regulating bureaucracy, is captured by special interests, institutions alone can become ineffective and that campaigns from the principal are needed to weaken the regulated entities' bargaining power and improve their compliance. When campaigns become regularized, meaning that they are waged in waves with indeterminate time between waves, that effect can endure between campaigns.

To test our theory, we turn to the empirical case of how industrial firms in China responded to changes in air pollution regulation—from being under the restraint of institutions only to additionally having top-down inspection campaigns that, over time, became regularized. The Ministry of Environmental Protection (MEP, i.e., the principal) delegates to the prefectural environmental protection bureau (EPB, i.e., the agent) to inspect, collect pollution levies from, and choose to punish firms for verified violations.³ The EPB regulates polluting firms (i.e., regulated entities). While the MEP possesses nearly complete information about firms' pollutant emissions, an information asymmetry exists because the EPB's enforcement outcomes are reported to the MEP by the EPB themselves with limited verification.

¹ While there is no consistent understanding of governance, scholars have interpreted governance to mean three things: (a) public administration or the implementation of state policies, (b) international cooperation through non-sovereign bodies, and (c) the regulation of social behavior through nonhierarchical mechanisms (Fukuyama 2016).

² We thank Andrew Walder for pointing that out.

³ The MEP is the ministry in charge of environmental protection. It was formerly called the State Environmental Protection Administration until 2008 and has been called the Ministry of Ecology and the Environment since 2018. Since the study period is 2014–2018, the ministry is referred to as MEP throughout the paper for consistency.

The prefectural EPB has misaligned interests from the MEP because the EPB is capturable by the special interests of the local government and the firms. Here, we follow the broad definition of regulatory capture from Dal Bó (2006), which refers to “the process through which special interests affect state intervention in any of its forms” (203).⁴ We posit that the relative stature of a regulated firm can influence its bargaining power with the EPB and, by extension, the level of regulatory capture of the EPB. A firm’s relative stature is primarily determined by how much it contributes to local economic development compared to other firms in the same prefecture.

Based on regression analyses of an original and fine-grained firm-level dataset, which includes comprehensive and confidential statistics collected by the MEP, we find that the more a firm contributed to a city’s industrial outputs, the more it committed violations of environmental standards before the central environmental inspection (CEI), *ceteris paribus*. That happened despite the firms having their emissions monitored by the centrally imposed continuous emission monitoring system (CEMS) and being subject to institutional constraints in the form of rules, including pollutant concentration standards and procedures to enforce those standards. As our theory would also predict, higher-contributing firms did not commit more violations after CEIs—*when the threat of future such campaign-style inspections was still imminent*. The threat faced by local firms, officials, and the EPB of getting caught and punished by the central government deterred the higher-contributing firms from committing more violations. This suggests that campaigns can work alongside institutions to improve compliance by powerful regulated entities. When campaigns become regularized over time, they impose credible threats even when they are not ongoing, and thus their effects can become enduring.

The remainder of the paper will proceed as follows. Section 2 will provide a fuller survey of the extant literature on how institutions and campaigns have been deployed to solve the principal-agent problem, lay out the theoretical framework, and discuss implications. Section 3 will delineate the empirical setting. Section 4 will discuss the research design, followed by empirical findings in Section 5. Finally, Section 6 will conclude with implications.

⁴ This contrasts with a narrower definition, which existing literature on utility regulation uses to describe the process where regulated monopolies manipulate the state agencies that are supposed to control them.

2. Literature Review and Theoretical Perspectives

In a classic principal-agent setup, the legislator is the principal, while the bureaucracy is the agent. Regulation occurs between the regulating bureaucracy and the regulated entities. We make three similar assumptions about regulation as those in Konisky and Teodoro (2016). Namely, we assume that the regulation is command-and-control rather than market-based, that the regulated entities generate identical goods, and that the regulating bureaucracy has complete information about the regulated entities' compliance.

The principal generally uses institutions or a combination of institutions and campaigns to control the regulating bureaucracies' enforcement behaviors and the regulated entities' compliance behaviors. According to Douglass North, institutions establish a set of constraints on behavior through rules. These rules represent a set of procedures to detect deviations from compliance and a means to enforce the rules (North 1981, 18). Institutions impose constraints, foster regularity over time, and provide instructiveness when functioning correctly, leading an enormous wealth of established literature to argue that institutions are the bedrock of and the default option in governance (North and Weingast 1989; Rodrik et al. 2004; Acemoglu et al. 2002; Keefer 2004; Tsai 2007; Olken 2010; Putnam 1993; Boix and Posner 1998; Banerjee and Iyer 2005; Ostrom 1990).

Another source of established wisdom holds that campaigns can temporarily improve governance outcomes. A campaign is an organized course of action to achieve a particular goal. In implementing policies, campaigns are usually short-lived, disruptive of regular bureaucratic activities, intensive in resource mobilization, and fierce in punishing noncompliance. Nevertheless, governments usually deploy and sponsor them to address highly urgent policy issues within a specified time. The types of policies span from crime crackdown to family planning. Campaigns have been deployed in both democracies and autocracies, although those in the latter generally involve a more significant population segment and exercise more coercion than those in the former (Weiss and Tschirhart 1994; van Rooij 2016).

For instance, campaigns have been central to implementing state policies in China. Their popularity has been amplified by the country's top-down political structure and the lack of the rule of law (Zhou 2012). Ideological campaigns were rife during the Maoist years (Bernstein 1967; Bennett 1976; Cell 1976; Oksenberg 1969; Teiwes 1979; Shapiro 2001). Since then, campaigns have become much less ideological and have remained a critical means of promoting the one-child policy, cracking down on crimes, and attacking "counter-revolutionary" forces like Falun Gong, among others (White 2006; Tanner 2000; Noakes and Ford 2015; Perry 2007).

In recent years, some centrally sponsored campaigns have differed drastically from previous efforts; they have been implemented in multiple waves over the years, with longer duration and farther reach. A prime example is in the realm of anticorruption. By 2012, the central government had spent more than three decades of intermittent efforts to crack down on anticorruption, with more anticorruption campaigns waged than any other country worldwide (Manion 2016). However, China was still a comparably corrupt country, ranked 75 among 182 countries in perceived levels of public sector corruption by Transparency International in 2011 (Transparency International 2011). Following the Eighteenth Party Congress in 2012, President Xi Jinping initiated the first wave of anticorruption campaigns and vowed to crack down on “tigers and flies” or high-level officials and low-level civil servants. Subsequent waves of inspections followed. As of 2022, more than 4 million government officials had been prosecuted since 2012. Moreover, the anticorruption campaigns have substantially altered the party and government structures to limit capture and structural barriers to enforcement, including, for instance, subnational political appointment patterns (Qian and Tang, 2023). Another policy realm where regularized campaigns have been deployed is environmental supervision, which will be discussed in detail in the empirical section.

While this paper concurs with the received wisdom that institutions are critical to effective long-term governance, it seeks to fill theoretical and empirical gaps in the social sciences by exploring the conditions under which institutions need campaigns to improve compliance by regulated entities. We argue institutions can become ineffective when special interests capture the regulating bureaucracy. The regulating bureaucracy can be captured by special interests that contradict its official duties. Under such a scenario, the regulated entities can fall out of compliance, anticipating that the regulating bureaucracy would look the other way. In other words, the regulating bureaucracy colludes with the regulated entities. The intuition, in line with Tirole (1986), implies that information received by the principal may be concealed or distorted by the agent due to collusion, imposing a barrier to effective regulation.

How can the principal weaken bureaucratic capture and improve the regulated entities' compliance? We posit that campaigns organized by the principal can work with institutions to improve compliance. Campaigns, or their threat, can deter special interests from capturing the bureaucracy and the regulated entities from committing violations. The perceived threat of campaigns during periods when campaigns are not actively ongoing stems from the regulating and the regulated entities' beliefs that future campaigns are imminent. Regularized campaigns—waging campaigns in waves over several years—provide a credible threat and the foundation for such belief about future campaigns. Regularized campaigns constitute a new institution in systematically shaping implementation over time.

In summary, we theorize that the bureaucracy may not properly function for effective governance due to capture by special interests, which would render institutions ineffective in fostering compliance by regulated parties. Instead, campaigns from the principal, or the perceived threat of them, can work alongside institutions to improve compliance. The two main theoretical implications are as follows.

1. Under institutions, the more bargaining power a regulated entity has with the bureaucracy, the more violations it commits, *ceteris paribus*. We call this a “bureaucratic capture effect.”
2. Under institutions and campaigns, the bureaucratic capture effect vanishes, *ceteris paribus*. When regularized, campaigns constitute a new form of institution. The absence of a bureaucratic capture effect lasts beyond the period when campaigns are actively underway.

3. Empirical Setting: Regulating Industrial Pollution in China

Evaluating those theoretical implications requires an empirical context where the following conditions hold: a) an information asymmetry exists between the legislator and the bureaucracy; b) the bureaucracy is capturable by special interests to deviate from its official duties (i.e., the preferences of the legislator); and c) institutions are consistently in place, and campaigns with real deterrence effects are implemented from time to time. Regulating industrial pollution in China provides an appropriate testing ground. In the following subsections, we will briefly summarize the structure of environmental governance in China, the means of governance in regulating industrial emissions, and the principal-supervisor-agent relationship in practice.

3.1 Structure of Environmental Governance

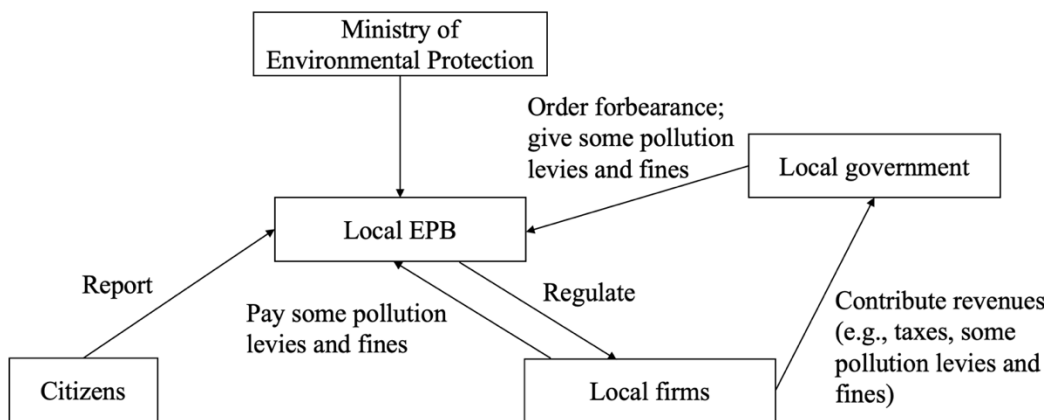
In China, environmental policies are made by the MEP and implemented by local EPBs. For a long time, the EPB had been under the dual leadership of the immediately higher level in the vertical environmental management system and the government at the same level. Here, we use the prefectural EPB as an example. The prefectural EPB is supervised by the provincial EPB and, at the same time, financially and administratively managed by the prefectural government. The prefectural government can order the prefectural EPB to apply laxer regulation of specific firms to promote the region's economic prosperity. The prefectural EPB being under the dual leadership of the provincial EPB and the prefectural government, continued well into the 13th Five-Year Plan (FYP; 2016–2020), during which time reforms to verticalize the system—meaning that the prefectural EPB would become more answerable to the provincial EPB than to the prefectural government—were gradually rolled out.⁵ The rollout happened after the end of the study period.

The broader dynamics are laid out in Figure 1. “Local” refers to administrative levels below the center, including, in hierarchical order, the province, the prefecture, and the county. The relationship between the government, EPB, and firms is very similar at each administrative level. However, the responsibilities and the amount of *de facto* power at each local level are different, which we will discuss further in Section 3.2. Local firms wield a certain level of bargaining power, which refers to their comparative capacity to negotiate or dispute to secure favorable terms with the local EPB. Local firms contribute

⁵ In September 2016, the General Office of the Central Committee and the General Office of the State Council released the *Guidelines on the Pilot Program for the Vertical Management Reform of Environmental Monitoring, Inspection, and Law Enforcement below the Provincial Level*. The guidelines made the provincial EPB the primary manager of the prefectural EPB, including allocating budgets for the latter. Nevertheless, the prefectural EPB would still be managed by the prefectural government, though less so than before the reform.

revenues to the local government. A significant part of the submitted levies and fines are then transferred to the local EPB for the official purpose of improving the EPB's regulatory capacity. In some localities, part of the pollution levies and fines are paid directly to the local EPB. Since many local EPBs are strapped for funds, they harbor perverse incentives to allow firms to keep polluting for more fees and fines to be paid to swell the EPBs' coffer, and that trend has continued well into the 2010s (Shen 2022, 35). That is to say, the interests of the local EPB have shifted away from those of the MEP and towards those of the firms.

Figure 1. Structure of local environmental governance in China (before verticalization reform under the 13th FYP)

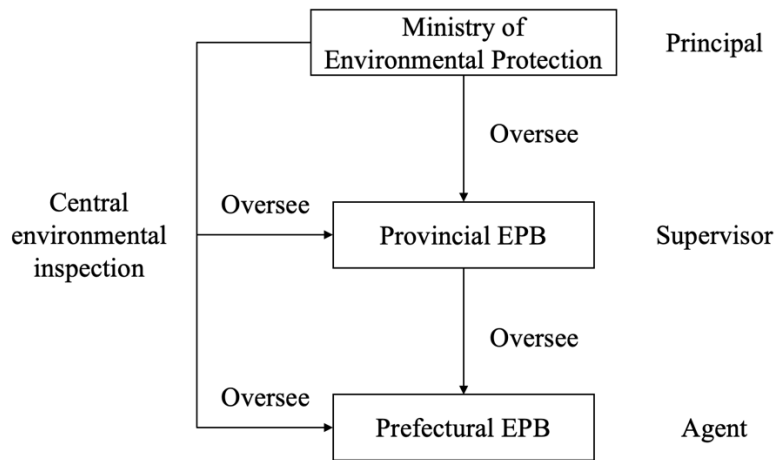


3.2 The Principal, the Supervisor, and the Agent

Our empirical analysis centers on environmental management at the prefectural level because it is mainly responsible for local environmental governance for two reasons (Shen 2022, 35–36). First, prefectural leaders oversee almost all vital production elements, from subsidies to labor policy; in other words, they define the structure and size of local economies. Second, prefectural leaders wield *de facto* authority over local pollution control.

In our empirical setup, different levels of the environmental management system represent the principal, the supervisor, and the agent, respectively (Figure 2). The MEP is the principal that establishes fundamental environmental institutions, including enacting environmental laws, policies, and regulations and organizing for their implementation (Ministry of Ecology and Environment n.d.). The prefectural EPB is the agent—the bureaucracy regulating polluting firms in cities. Finally, the supervisor is the provincial EPB—nestled between the MEP and the prefectural EPB—in the vertical system. Each level oversees the work performed by the immediately lower level.

Figure 2. The principal-supervisor-agent relationships in environmental management



Collusion between different local levels of government and bureaus has been widely documented (Kung and Chen 2011; Pan and Chen 2018). In the environmental realm, the media has detailed telling tales of how provinces, in collusion with lower levels, put local interests first in (blunt) defiance of the preferences of the center. For instance, when the central government decentralized the authority to approve environmental impact assessments of new coal projects from March 2015 onwards, provincial governments across the country went on a spree of approvals to generate power cheaply and boost their local economies, despite the national pledge to cut carbon emissions following the Paris Agreement (Hao 2016). That further exacerbated power overcapacity and worsened environmental quality. In response, the central government issued new coal policies to halt new projects and suspend ongoing projects.

In the principal-supervisor-agent setup, the supervisor colludes with the agent. That is, the province receives regular reports about the work of the prefecture and has discretion in how they treat that information. This allows the agent to pay no heed to higher-contributing firms violating standards more than their lower-contributing counterparts to suit local interests. The collusion between the supervisor and the agent and between the agent and regulated entities happened even under institutions imposed by the principal. However, after the principal kicked off campaign-style inspections, the supervisor and the agent came under direct and intense scrutiny by the MEP. That undermined the collusion, and as a result, higher-contributing firms' bargaining power diminished to a comparable level as their lower-contributing counterparts.

3.3 Means of Governance in Regulating Industrial Pollutant Emissions

The MEP has put in place institutions such as pollutant emissions standards and procedures to monitor firm-level emissions and for EPBs to respond to detected cases of violations. However, while the MEP has (near-)complete information about emissions at monitored firms, an information asymmetry exists between the MEP's knowledge of EPBs' enforcement activities, submitted by the EPBs upward to the MEP, and actual enforcement. Therefore, in 2016, centrally sponsored inspection campaigns were initiated to supervise the local EPBs, governments, and firms directly. This subsection will detail the specifics of those institutions and campaigns.

In 2013, the MEP launched the CEMS program, under which automatic monitors were installed at around thirty thousand key polluting plants across the country, measuring the stack-level concentrations of three air pollutants—total suspended particles (TSP), sulfur dioxide (SO₂), and nitrogen oxides (NO_x). Those plants are responsible for over 75 percent of China's industrial emissions. To guarantee the veracity of collected data, the MEP implemented various measures to prevent tampering with the CEMS monitoring equipment. For instance, the MEP required third-party installation of CEMS equipment, and polluting firms were required to install and operate CCTVs close to the monitoring equipment 24/7 to deter potential interference. In addition, the MEP used algorithms to detect irregularities in the CEMS data and hosted monthly supervisory sessions with local EPBs to discuss detected anomalies. Furthermore, the MEP requires on-site inspections once a month at a minimum to check the proper functioning of the automated monitoring equipment. Each plant's hourly emissions data must be posted to provincial government websites in real time. That marked the first time data from an automatic monitoring system was made public.⁶ Following detected cases of violations, EPBs must verify and, if confirmed, follow official rules to collect levies and require firms to rectify them lest they face shutdowns. However, EPBs can exercise discretion in enforcement.

Not long after the launch of the CEMS program, the central government began to formulate plans to send the CEI team down to localities for surprise inspections, which would be a form of campaign-style regulation. Such actions were spurred by the “airpocalypse” in Beijing in January 2013, during which the city was besieged by haze so severe that the maximum daily PM_{2.5} concentration exceeded the WHO guideline by nearly 22-fold, and several more air pollution “red alert” days in 2015.

⁶ Back in 2004, the MEP launched a nationwide automated monitoring system for key polluting enterprises, where a flow meter was installed on site to measure pollutant concentrations at discharge. That data would be transmitted to each local EPB's monitoring center in real time. However, those were only shared internally with the government and the monitored firms.

As a result, on July 1, 2015, the Central Commission on Comprehensively Deepening Reforms announced the formation of CEI teams to be directly supervised by the MEP. The CEI teams would conduct rotating inspections of provinces (or autonomous regions or cities with an equivalent administrative rank but not the special administrative regions), staying in each province for about a month. As of this writing, two rounds of CEI have been organized and executed. This paper studies the first round (2016–2017), during which CEI inspection kicked off inspection activities with a pilot in Hebei Province in early 2016, followed by four batches later in 2016 and 2017 (Figure 3). By September 2017, all 31 provincial-level regions in mainland China had been inspected. The second round involved six batches of inspections between 2019 and 2022.

Figure 3. Map for the pilot and four batches of CEI, 2016–2017



The planning and execution of a CEI took place according to the following three stages. First, about one month before a CEI inspection, the central government appointed officials, primarily from the MEP and the General Office of the Chinese Communist Party, to form the CEI inspection team. Second, when a CEI team was stationed in each province during a roughly month-long inspection, it would secretly visit city and county levels to uncover potential problems in environmental governance. The CEI team followed a consistent inspection protocol when conducting unannounced inspections of prefectural EPBs' enforcement of and industrial plants' compliance with national pollution standards. In addition, the CEI team also provided a channel for citizens to report suspected cases of environmental violations to the CEI team. Firms verified for noncompliance were typically required to shut down operations or treat pollution in addition to paying fines. Third, after the month-long onsite inspection, the team would provide an evaluation of local environmental management, summarize the discovered problems, and share the report detailing those items with the provincial government. The inspection results must also be publicly available on provincial EPB websites and covered in the news. In response to the points raised in the report, the provincial government needed to draft and submit a rectification and carry out the rectification action plan soon following the onsite inspection.

The CEI campaign was much more than direct monitoring and auditing to uncover malfeasance—it also brought about substantial punishments and a fundamental change in behavioral patterns that lasted beyond the campaign periods. According to official statistics published by the state-sanctioned China News, the first wave of CEI (2016–2017) received about 135,000 citizen complaints, punished about 29,000 enterprises, fined a total of about RMB 1.43 billion (about USD 224 million), detained 1,527 individuals, and interviewed 18,448 government and party leaders, 18,199 of whom were held accountable (China News 2018). Of those 18,199 held accountable, 875 were leading cadres at the department level (i.e., top leaders at the county level) or above. Moreover, after the first wave of CEI, the central government declared that the CEI would be carried out routinely and regularly—that is, the threat of impending CEIs is still present between waves of CEIs.

The CEIs posed a direct deterrence even to the formerly “untouchable.” A case in point is Laoganma, a company producing a wildly popular sauce. It is the face of and a significant tax contributor to Guiyang Prefecture. For a long time, greasy fumes from Laoganma's plants negatively affected the surrounding environment, and people repeatedly complained. However, Laoganma received preferential treatment from the local government. To attract Laoganma to set up their plant in their jurisdiction, the local government took over the pollution control responsibility of the firm, funded pollution control from local finance, and signed a contract with the firm to restrict environmental enforcement activities by the local EPB. As a result, Laoganma's pollution problems remained largely unresolved as of 2017.

The CEI campaign drastically undermined the capture of the EPB and made the formerly untouchable accountable. In April 2017, when the CEI team entered Guizhou Province, it received 19 complaints about greasy fumes from Laoganma in just three days. The CEI team interviewed Laoganma a total of four times that year. On May 22, the Guiyang prefectural government convened a special meeting on Laoganma’s oil fume pollution control. After several hours of discussion, the meeting proposed the short- and medium-term rectification goals for Laoganma. In early September, the Guiyang prefectural government held another interview with Laoganma, urging the latter to act quickly to address its pollution. Finally, in early November, the Guizhou Provincial Department of Environmental Protection conducted a provincial-level interview with Laoganma, mandating the latter complete rectification within a given deadline. It is reported that Laoganma has finally completed thorough rectification through technological innovation and factory relocation.

3.4 Theoretical Expectations

Applying our theory to the empirical context, we develop the following three sets of hypotheses. The first set relates to the overall aggregate relationship between a firm’s relative level of bargaining power with the prefectural EPB and the number of violations it commits. We call the phenomenon described in H1a a “bureaucratic capture effect.”

H1: Overall compliance

H1a. Before CEI, the higher the relative contribution of a firm, the more violations it committed, *ceteris paribus*.

H1b. After CEI, when the threat of future CEIs was imminent, the relative contribution of a firm did not significantly affect the number of violations committed, *ceteris paribus*.

The second and third sets of hypotheses are related to the first but shift the focus to the conditions of the city and the prefectural party secretary’s time in office, under which the bureaucratic capture effect is expected to be stronger. When the dispersion in firms’ relative contributions to the city’s total industrial outputs is significant, we would expect the high-contributing firms to be more dominant, thus wielding more de facto bargaining power than in a city whose dispersion in firms’ relative contributions is small. Furthermore, building upon the findings of Shen (2022), top local leaders implement critical policies more vigorously later in their tenure as they come closer to being considered for promotion. By top local leader, we mean the prefectural party secretary, who is the first-in-command of a prefecture and controls a wide range of matters—from loans to air quality.

During the period studied, environmental protection was critical. As such, we would expect the bureaucratic capture effect to be more substantial earlier in a prefectural party secretary's tenure, which, according to the statistics on tenure lengths in Shen (2022), would be the first two years in the office.

H2: Variation in a city's dispersion in firm outputs

H2a. Before CEI, the bureaucratic capture effect was stronger in cities with large firm output dispersion than in small ones, *ceteris paribus*.

H2b. After CEI, when the threat of future CEIs is imminent, the bureaucratic capture effect is about the same regardless of the degree of dispersion in a city's firm outputs, *ceteris paribus*.

H3: Variation in the prefectural party secretary's time in office

H3a. Before CEI, the bureaucratic capture effect was stronger early in a prefectural party secretary's tenure (1–2 years) than later in the tenure (≥ 3 years), *ceteris paribus*.

H3b. After CEI, when the threat of future CEIs is imminent, the bureaucratic capture effect was similar across firms regardless of their level of relative contributions to the city's industrial outputs later in tenure (≥ 3 years) when implementing environmental policies rigorously was crucial, *ceteris paribus*.

4. Research Design

4.1 Data and Variable Description

Variables

We use the *percentage of output*, which is the output of an industrial firm as a percentage of all outputs by industrial firms in a city, to measure the relative importance of a given firm in contributing to the city's total industrial outputs and, by extension, that firm's bargaining power. That is a commonly used and appropriate proxy because local economic development is a critical policy goal, and bargaining power derives from the ability to contribute to that critical policy goal. In addition to GDP figures, tax collection, usually the leading source of local revenues, is crucial to city leader promotion (Guo 2009). Hence, we use the *percentage of tax*, which refers to the amount of tax a firm pays as a percentage of the total industrial taxes collected in a given city as an alternative measure for firm environmental bargaining power. Following Lorentzen et al. (2014), we also use the *percentage of employees*—the number of employees a firm employs as a percentage of the city population—as another alternative measure.

The key dependent variable is a firm's environmental compliance. A direct measure of the degree of compliance—or the lack thereof—is the *number of standards violations* (Gray and Deily 1996). Thus, we measure the total annual number of violations of daily average concentrations in the categories of TSPs, SO₂, and NO_x. In addition, we use the annual violations of daily average concentrations for each of those three air pollutants in our regression analyses.⁷

In a robustness check, we also use the punishments the prefectural EPB imposes on a firm for violating environmental standards as the dependent variable. In gauging punishments, we use three different measures. First, we create a binary variable, *whether punished*, to measure whether a firm was punished in a given year. Second, we use the *number of penalties* to measure the volume. Third, we use *amount of penalties* in monetary terms to measure the extent.

We control for a battery of variables that are plausibly correlated with a firm's output percentage and affect its environmental compliance. At the firm level, we control for firm output value because it directly affects its pollutant emissions and compliance with standards. Since cities are at different levels of economic development and have varying

⁷ We believe the number of standards violations is a more direct and accurate measure of environmental compliance than the amount of pollutant discharge fees collected. While the amount of pollution discharge fees has sometimes been used as a measure for firm environmental compliance, the enforcement of official policy is influenced by a firm's bargaining power and official relief policies in China (H. Wang et al. 2003).

levels of dependency on industries for economic growth, which could affect how much bargaining power a particular firm wields, it is necessary to control for relevant city characteristics. At the city level, we control GDP per capita, population density, the proportion of city GDP that comes from the industrial sector, the proportion of employees in the industrial sector, and the number of unemployed.

In a robustness check, we will also control for the potential influence of poor air days on firms' compliance behaviors. We do so because it is possible that EPB regulators would be more inclined to enforce standards on heavily polluted days so that bad air would not lead to social unrest. Therefore, polluting firms would more likely to comply with environmental standards on highly polluted days. We measure lousy air days using the number of days in a year a city has an AQI of 200 or above (i.e., heavily polluted).

Data Sources

The China Environmental Statistics Database (CESD) and the CEMS Database provide statistics on firm characteristics and pollutant concentrations. The CESD is widely regarded to be the most extensive national environmental dataset of China, encompassing companies whose cumulative emissions account for about 85 percent of total national industrial emissions. CESD contains annual environmental statistics in China since 1985 and covers 31 provinces, 113 cities, and 42 industrial sectors. It is compiled and verified by the MEP and remains confidential.

Nevertheless, we obtained statistics on six industries: paper, chemicals, nonmetallic minerals, ferrous metal, non-ferrous metal, and heating and electricity industries. These industries are known to be among the most significant contributors to criteria air pollutants mandated for control. In addition, we obtain firm-level tax and employment data from the Chinese Industrial Enterprise Database, which covers more than 300,000 firms from over 60 major industries; cumulatively, they account for about 90 percent of China's total industrial output. Unfortunately, limited availability means we can only access firm-level tax and employment statistics for 2014.

Statistics on hourly firm-level pollutant concentrations come from the CEMS Database. As of 2018, it covers nearly 30,000 key polluting firms in 30 provincial-level units. According to a study that compares CEMS data with onsite supervisory monitoring data, it does not observe significant firm manipulation of CEMS data. However, that does not rule out the possibility that some firms may have turned off monitors when their emissions concentration increased (X. Wang et al. 2022). We used the official CEMS data provided by the MEP rather than from the provincial government websites to identify violations. The official data from the MEP are comparatively more complete and have corrected basic errors that occasionally appear in the real-time concentration readings.

In addition, since high monitored values can be caused by mechanical errors or production suspensions as opposed to actual standard violations, we excluded observations with values above the 99th percentile for each pollutant concentration. We also dropped negative values, zeros, and too-small values (i.e., below the 1st percentile for each pollutant concentration). Finally, we aggregated the hourly readings to the annual level.

Furthermore, we obtained the administrative penalty dataset (APD) from the MEP for 2015–2018.⁸ The dataset includes information on environmental violations, including the time, type, reason, and amount of the punishment, if monetary. While such statistics are not confidential, and some environmental NGOs have publicized some data, we obtained more comprehensive data directly from the MEP.

Statistics on city characteristics mostly come from City Statistical Yearbooks, published by the National Bureau of Statistics and covering 656 cities nationwide. Such features include city industrial output value, GDP per capita, population density, percentage GDP from the industrial sector, the percentage employed in the industrial sector, and the number of unemployed residents. In addition, we obtained city-level AQI data from the China National Environmental Monitoring Centre (CNEMC).

Finally, we obtained statistics on citizen complaints made through the 12369 platforms for 2016 and 2017 from the MEP, including the dates of the complaints. Such data remains confidential; we acquired a comprehensive dataset directly from the MEP.

Descriptive Statistics

After matching the CESD and the CEMS datasets, our sample contains 16,870 firm-year observations. The statistics on the variables used in the analyses are summarized in Table 1. We can see a significant variation in the absolute output value and the percentage of output.

⁸ According to the *2010 Measures for Environmental Administrative Penalties* passed by the MEP, the local EPBs were required to establish statistical systems to record administrative punishment cases and report to the upper levels, up to the MEP.

Table 1. Summary statistics of key variables

Variable	Data sources	Data years	Min	Max	Mean	Std. dev.	Num. obs.	
Overall			0	7507	108.88	331.13	16,870	
Violations	TSP		0	2608	39.36	125.70	16,179	
	SO ₂	CEMS	2014–18	0	2450	31.54	118.18	16,517
	NO _x		0	3604	42.07	168.26	16,143	
	Whether punished		0	1	0.29	0.45	13,658	
Penalties	Number of penalties	APD	2015–18	1	53	1.98	2.39	3,958
	Amount of penalties (10,000 yuan)			1	2810	35.38	128.82	3,865
Percentage of firm output (%)	CESD + CSY	2014–18	0.000016	86.62	0.66	2.35	16,870	
Firm output value (10,000 yuan)	CESD	2013–18	14	23069764.4	165213.90	548994.80	16,870	
GDP per capita (yuan)	CSY		10171	215488	64606.47	35833.31	16,846	
Population density (people/km ²)	CSY		4.08	2648.11	495.07	346.74	16,846	
% GDP from the industrial sector	CSY	2014–18	12.19	75.53	46.35	8.86	16,846	
% employed in the industrial sector	CSY		7.53	83.43	46.70	13.84	16,844	
Unemployed (people)	CSY		775	403054	36086.46	40171.22	16,660	
Number of heavily polluted days	CNEMC	2014–18	0	76	12.30	14.13	15,854	

Note on abbreviations: continuous emission monitoring system (CEMS), administrative penalty database (APD), China environmental statistics database (CESD), city statistical yearbook (CSY), China National Environmental Monitoring Centre (CNEMC)

4.2 Identification Strategy

Differing from a large and burgeoning stream of literature that assesses the immediate- and long-term effects of CEIs on various *air quality indicators* in China, we ask a very different question of how firm bargaining power influences compliance with environmental standards before and after the CEIs. We seek to compare firms with the same level of industrial output but different levels of bargaining power in the same province. Our identification leverages that the timing of the announcement of city inspections is plausibly exogenous.⁹

⁹ This is likely because the MEP intended to carry out CEIs in all provinces, so it did not matter which provinces were inspected in any batch. Another paper has documented that while some firms may have sought to muddle through to look compliant in anticipation of CEIs since production stoppages on aggregate increased starting in the first week of CEI (compared to the counterfactual of no CEI), that increase did not become significant until the third week of CEI in a given province (Q. Wang et al. 2023). In other words, while there would be some opportunity for firms to anticipate and muddle through, the CEIs were quite surprising to the inspected.

We conduct our analysis at the annual level for two reasons. First, we seek to understand longer trends less affected by short-term fluctuations. Second, firm bargaining power measurements are at the annual level. We use the following model specification for firm i in industry ind with ownership type own in city c within province p in year t . We have considered but decided not to use the difference-in-differences method.¹⁰

$$Compliance_{i,t} = \alpha + \beta_1 \frac{FirmOutput_{i,t}}{CityOutput_{c,t}} \times 100\% + \beta_2 FirmOutput_{i,t} + \beta_c City_{c,t} + \theta_{ind,t} + \zeta_{own,t} + \eta_{p,t} + \varepsilon_{i,t}$$

where $Compliance_{i,t}$ denotes the inverse hyperbolic sine (IHS) transformation of firm i 's number of violations of daily average concentration standards for TSP, SO₂, and NO_x in year t .¹¹ $FirmOutput_{i,t}$ refers to firm i 's industrial output value in year t . $CityOutput_{c,t}$ represents city c 's total industrial output value in year t . $City_{c,t}$ denotes a vector of characteristics for city c in year t .

In addition, we apply three sets of fixed effects. First, there are likely drastic differences in environmental compliance across years, industries, and firm ownership types (Pearson 2005). Hence, we include industry-year fixed effects, denoted $\theta_{ind,t}$, and ownership-year fixed effects, denoted $\zeta_{own,t}$, in the model specification. Furthermore, since many prefectural policies, including those for emissions, are formulated at the provincial level, it is important to account for that by including the province-year fixed effects, denoted $\eta_{p,t}$. $\varepsilon_{i,t}$ represents the error term.

¹⁰ We believe that the difference-in-differences (DiD) method is inappropriate for our analysis for the following reasons. First, our cross-sectional analysis compares firms with the same output level but different contribution percentages to the city's total outputs within the same province. That is necessary because provinces may differ drastically in terms of their policies and conditions that would influence the outcome. However, CEIs were carried out at the provincial level, so if DiD is applied, it would no longer be possible to make comparisons between firms within the same province. Second, since ample skepticism has been cast over multi-period DiD, a single-period DiD is comparatively more encouraged. If we were to pursue a single-period DiD, we would designate the first and second batches of CEI as the treatment and the third and fourth batches as the control. However, that would make it impossible to discuss trends after 2016. Furthermore, the first and second batches were carried out in the second half of 2016, but our analysis is at the annual level. Even if CEI brought about changes, that might be difficult to detect at the annual level. Third, DiD would require applying firm fixed effects, meaning that firm-level time-invariant factors are being controlled for. However, since a firm's contribution percentage to the city's total industrial outputs does not change much across years, its effects would be absorbed by the firm fixed effects, making it difficult to know the real effect of a firm's percentage contribution to the city's total outputs on compliance.

¹¹ We take the IHS because the number of violations can be 0. The transformation equation is

$$\tilde{x} = \operatorname{arcsinh}(x) = \ln(x + \sqrt{x^2 + 1}).$$

5. Empirical Results

5.1 Primary Results

In the first set of regressions, we use the total number of violations of environmental standards as the dependent variable to explore the relationship between the firm's bargaining power and its environmental compliance. In Table 2, columns (1) to (4) show the results during the pre-CEI period, while columns (5) to (8) exhibit the results during the post-CEI period. Overall, the results suggest that firms that contributed more to the city's industrial outputs and, by extension, wielded more bargaining power with the prefectural EPB violated the standards more before the CEI. When all the reasonable control variables and fixed effects are included in the model, a 1 percent increase in output is associated with a 0.07 percent increase in the total number of violations before the CEI, *ceteris paribus*. As our theory would also predict, firms committed violations statistically similarly regardless of their relative contribution to the city's industrial outputs after the CEI when the threat of future CEIs was imminent. Results using alternative measures for firm bargaining power can be found in Table A1. Due to limited statistics on firm-level taxes and employment figures, we were able to run the regression analyses for the year 2014. The results are like those in column (3) of Table 2.

Table 2. Relationships between the percentage of output and the total number of violations

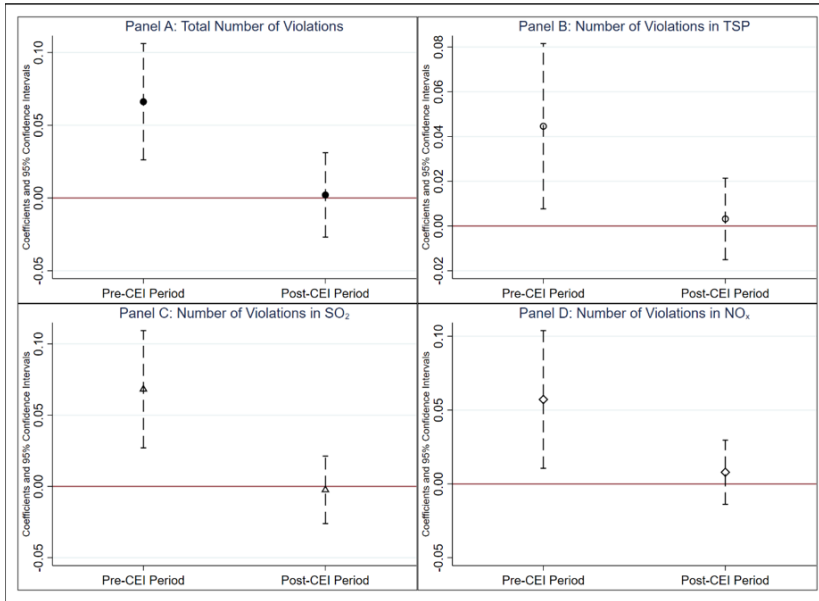
	Pre-CEI period (2014–2016)				Post-CEI period (2017–2018)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Perc. of output	0.0415*	0.0549**	0.0662***	0.0679**	-0.00235	0.000441	0.00210	-0.0157*
	(0.0215)	(0.0214)	(0.0203)	(0.0299)	(0.0151)	(0.0141)	(0.0147)	(0.00852)
Firm output	0.0483	0.0881	0.0538	-0.129	0.187**	0.150*	0.143*	0.0912
	(0.0727)	(0.0647)	(0.0609)	(0.182)	(0.0772)	(0.0789)	(0.0780)	(0.0857)
Unemployed			0.0199	-0.0239			-0.297***	-0.415
			(0.0776)	(0.205)			(0.107)	(0.591)
Employees prop. from ind.			0.00658	-0.00539			0.00686	0.00454
			(0.00708)	(0.0203)			(0.00627)	(0.0191)
GDP per capita			-0.0242	0.379			0.131	-2.628
			(0.160)	(1.136)			(0.162)	(2.812)
GDP prop. from ind.			0.0186*	-0.0234			0.0000288	0.0170
			(0.00981)	(0.0374)			(0.00976)	(0.0569)
Population density			-0.00161	-0.782			0.0823	3.429
			(0.0854)	(1.264)			(0.107)	(2.536)
Province-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year FE	No	Yes	Yes	No	No	Yes	Yes	No
Ownership-year FE	No	Yes	Yes	No	No	Yes	Yes	No
Firm FE	No	No	No	Yes	No	No	No	Yes
Observations	10169	10164	9998	9210	6700	6694	6648	4796
Adj. R^2	0.248	0.267	0.269	0.580	0.102	0.109	0.114	0.482

Standard errors are clustered at the province-month level and given in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

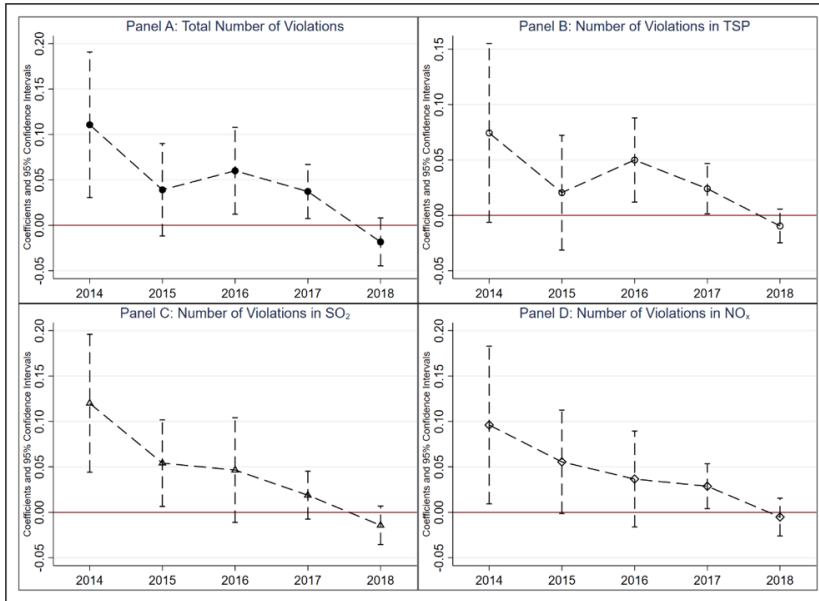
We further assess the relationship between the firm’s bargaining power and its compliance with individual pollutant concentration standards. We plot the coefficients and their 95 percent confidence intervals for the *percentage of output* variable. Suppose the estimate and its 95 percent confidence intervals cross the horizontal zero line. In that case, a firm’s percentage contribution to the city’s total industrial output does not affect the number of violations it commits. Estimates above zero indicate that the higher-contributing the firm, the more violations it commits. We can see from Figure 4 that the results for each of the three pollutants are similar. Specifically, before the CEI with only institutions in place, if the percentage of firm output values increases by 1 unit, the number of violations of TSP, SO₂, and NO_x standards increases by 0.0446 percent, 0.0682 percent, and 0.0572 percent, respectively, *ceteris paribus*. After the CEI, when the threat of more CEIs was imminent, a firm’s relative contribution to industrial outputs did not significantly influence the number of violations it committed. Some may argue that parts of 2016 and 2017 were amid the CEI, so we reran our analysis by excluding observations from 2016 and 2017. The results remain very similar (Figure A2).

Figure 4. Relationships between the percentage of output and the number of violations for TSP, SO₂, and NO_x concentrations



When we analyze the effect of the *percentage of output* across the individual years, we note that the compliance gap between firms with varying relative contribution levels generally narrowed gradually since the onset of the CEI in 2016 (Figure 5). The gap was statistically insignificant by 2018—the year between the two waves of CEIs.

Figure 5. The relationship between the percentage of firm output and the number of environmental violations, 2014–2018



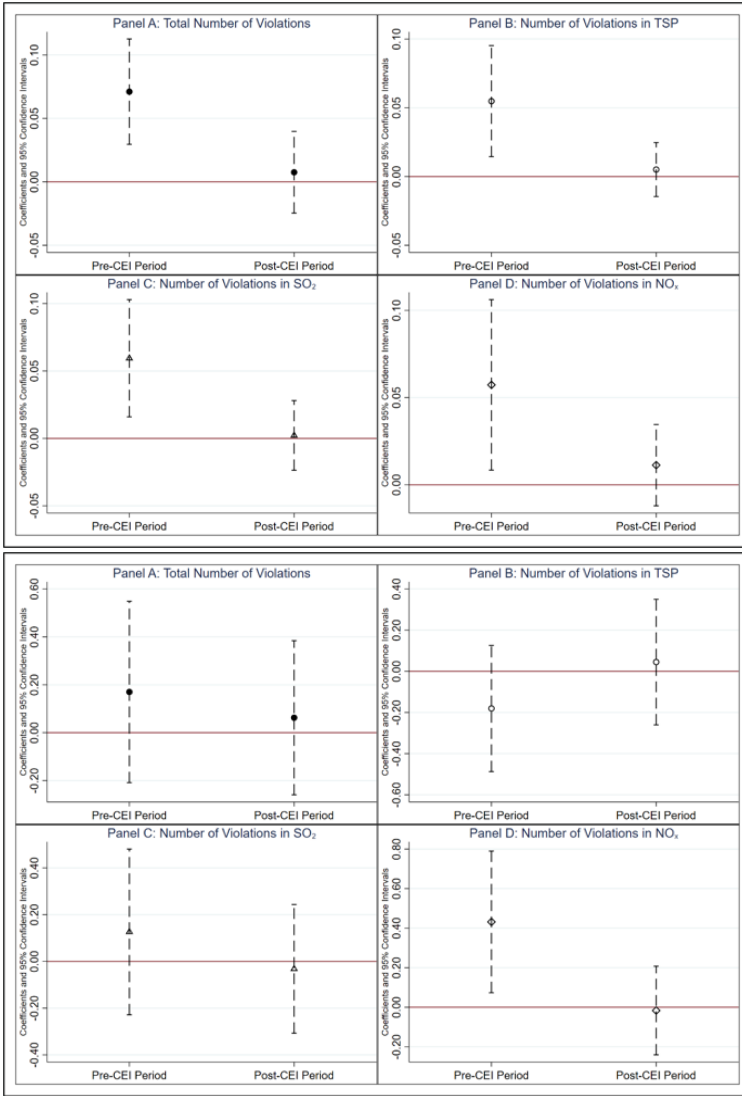
5.2 The Conditioning Effect of Dispersion in a City’s Firm Outputs

A firm’s bargaining power is likely conditioned by the level of dispersion in a city’s firm outputs. In a city with high dispersion in firm outputs, high-contributing firms have a more dominant role in the local economy, thereby wielding more bargaining power with the prefectural EPB. In such a case, we would expect higher-contributing firms violating more standards to be more severe in cities with higher levels of dispersion in firm outputs.

To assess the validity of that prediction, we divide cities into two groups based on the standard deviations in firms’ percentages of outputs in a given year and run regressions based on the two subsamples. Cities with standard deviation values at or above the median value belong to the high dispersion group, and those under the median are part of the low dispersion group.

We can see that in cities with relatively high levels of dispersion in the percentages of firm outputs, the higher contributing the firms, the more they committed violations of concentration standards for all three air pollutants in the pre-CEI period, but not more in the post-CEI period (Figure 6 left). In contrast, in cities with relatively low levels of dispersion in the percentages of firm outputs, higher-contributing firms did not commit significantly more violations of concentration standards except for NO_x in the pre-CEI period (Figure 6 right). In the post-CEI period, the violations were similar across firms regardless of their relative contributions to the city’s industrial outputs, *ceteris paribus*.

Figure 6. The relationship between the percentage of output and the number of violations in cities with high levels (top) and low levels (bottom) of dispersion in firm outputs



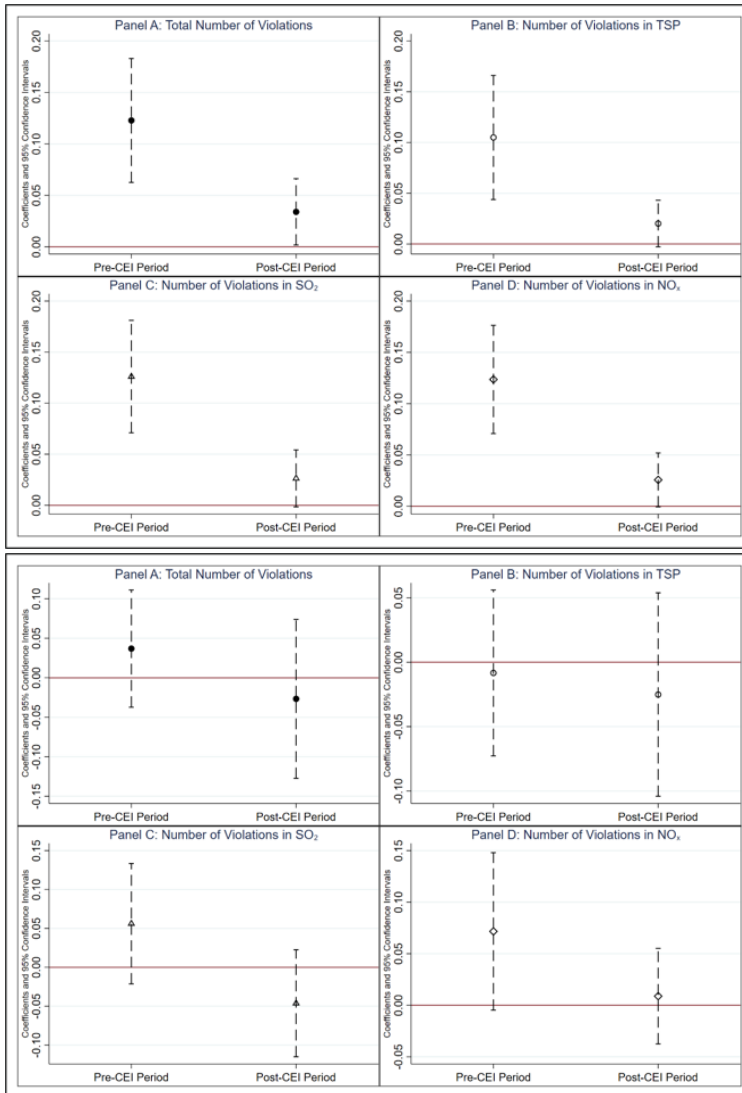
5.3 The Conditioning Effect of Time in Tenure for a City’s Prefectural Party Secretary

In addition to the level of dispersion in the percentages of firm outputs in a given city, another conditioning factor is the time in tenure for a city’s prefectural party secretary—the first in command. As Shen (2022) finds, political superiors in China generally prefer that their subordinates pursue a gradual improvement in implementing critical policies; data on economic and environmental outcomes suggest that political subordinates respond to this expectation by gradually implementing critical policies more vigorously throughout their tenure. The period under study, 2014–2018, was when the status of environmental protection was substantially elevated. Theoretically,

we would expect the bureaucratic capture effect documented in the primary analysis to be stronger earlier in a prefectural party secretary’s tenure when polluting firms can more readily exert bargaining power with the EPB.

We divide the observations into two groups based on the prefectural party secretary’s year in office to examine that theoretical expectation. Those in their first two years in office are in the “early” group, while others are in the “late” group. The results are shown in Figure 7. We can see that the compliance gap during the pre-CEI period detected in the primary analysis is primarily driven by the observations where the city’s party secretaries were early in their tenure, which holds for all three types of air pollutants.

Figure 7. The relationship between the percentage of output and the number of violations in cities whose party secretaries were early in their tenure, 1–2 years (top), and late in their tenure, ≥ 3 years (bottom)



5.4 Robustness Checks

We conducted a series of robustness checks to evaluate and rule out alternative explanations. First, we find that while reverse causality (i.e., less compliant firms contributing more to the city's industrial output) is possible, our primary results remain valid despite it (Figures A3 and A4). Second, we use an alternative specification for the dependent variable—the number of days with violations. The results remain similar to those in the primary analysis (Figures A5 and A6). Third, we assess the possibility that higher-contributing firms violate standards more due to greater affordability of fines rather than higher bargaining power. We find that higher bargaining power rather than greater affordability still holds as the primary mechanism (Figure A7). Fourth, we assess whether improved compliance after the CEIs is driven by intensified public complaints. We find that citizen complaints only increased during the month of a CEI inspection and dwindled quickly afterward; in other words, it is unlikely that citizen complaints drove the primary results (Figure A8). Fifth, we assess the potential confounding effect of high-pollution days on firms' compliance and find it insignificant (Table A2). Finally, we assess the possibility that cities with lower industrial outputs may also have lower state capacities, leading to more violations. We do so by also controlling for city industrial output, which is consistently insignificant across models (Table A3).

6. Conclusion and Implications

In implementing state policies, the principal (i.e., the legislator) deploys institutions and campaigns to monitor enforcement by agents (i.e., the regulating bureaucracies) and compliance by regulated entities (e.g., firms). Institutions impose rules to constrain and foster regularized behaviors over time. In contrast, campaigns mobilize resources and demand attention for intensive implementation and can achieve quick and temporary changes in policy outcomes. The persistent nature of implementation patterns promoted by institutions makes them the focal point for tackling governance challenges. While we concur with that established wisdom, we seek to fill a critical theoretical and empirical gap by exploring the conditions under which campaigns can enhance institutions in improving compliance by regulated parties. We posit that institutions can become ineffective when special interests capture the regulating bureaucracy to deviate from their official duties and the legislator does not have complete information on the enforcement activities of the regulating bureaucracy. Under such a scenario, the regulated entities can gain more bargaining power over the regulating bureaucracy and comply with standards less. In this case, campaigns from the legislator, or the threat of them, can lessen the capture of the regulating bureaucracy and deter the regulated from committing excess violations. Furthermore, we analyze the effects of an emerging institution—regularized campaigns or campaigns waged in waves—to exercise deterrence when campaigns are not actively ongoing.

We test our theory by examining how industrial firms in China responded to changes in the means of air pollution regulation—from being under institutions alone to having campaigns work jointly with institutions. In the environmental vertical management system, the MEP, the provincial EPB, and the prefectural EPB are the principal, the supervisor, and the agent, respectively. The prefectural EPB is mainly in charge of implementing environmental policies, and the provincial EPB—in protecting local interests—colluded with prefectural EPBs. Firms are the parties being regulated by the agent for their pollutant emissions. Information asymmetry exists between the MEP and the prefectural EPB. While the MEP possesses nearly complete information about firms' pollutant emissions, the EPB's enforcement outcomes are reported to the MEP by the EPB themselves with limited verification. The prefectural EPB has misaligned interests from the MEP because the EPB is capturable by special interests to relax the regulation of polluting firms. The degree of discretionary regulation depended on how much bargaining those firms had, usually determined by how much they contributed to the locality's economy relative to the other local firms. During our study period (2014–2018), the MEP consistently instituted standards and enhanced monitoring through CEMS. Between 2016–2017, the MEP dispatched campaign-style CEIs to all provincial-level units. As soon as the CEIs concluded in 2017, the central government

vowed future waves of CEIs; that is, the threat of CEIs remains imminent between different waves of CEIs.

We created an original dataset incorporating confidential firm-level data to test our hypotheses. Our access to confidential official data gives us a rare opportunity to study compliance and, to a lesser extent, due to limited data availability, enforcement behaviors in local China. As our theory would predict, we find that the higher the relative contribution of a firm to the city's total industrial outputs, the more it violated environmental standards for TSP, SO₂, and NO_x concentrations before the CEI, *ceteris paribus*. As our theory would also predict, higher-contributing firms did not commit more violations after CEIs when the threat of campaigns was imminent, *ceteris paribus*. When CEIs were taking place, or the inspected parties (i.e., local firms, officials, and EPBs) felt their impending presence, they would fear getting caught and punished by the central environmental authority and refrained, to some degree, from committing deviations from rules.

Our findings suggest that the legislator can use campaigns to enhance the effectiveness of institutions in promoting governance when special interests capture the bureaucracy, and collusion stymies the promise of institutions. Campaigns can undermine powerful regulated entities. Regularized campaigns constitute an emerging institution whose effects go beyond the periods when campaigns are actively ongoing. However, it is also essential to recognize that the duration and reach of the CEIs also substantially disrupted people's lives and production processes. These represent difficult tradeoffs for decision-makers.

With campaigns becoming regularized, we can expect the equilibrium to shift permanently; that is, the effects of regularized campaigns constitute critical steps toward new institutionalization. While the paper examines the empirical case of firm pollution regulation in China, we can expect the proposed theory to apply to other empirical contexts that satisfy the scope conditions in authoritarian regimes, where campaigns involve a more significant segment of society and impose more coercion and severe sanctions than democracies.

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Appendix for Regularized Campaigns as a New Institution for Effective Governance

List of Figures and Tables

- **Figure A1.** Descriptive statistics on the firms and their violations
- **Table A1.** Relationships between firm bargaining power, measured by three quantities, and the total number of violations in 2014
- **Figure A2.** The relationship between the percentage of firm output and the number of environmental violations, excluding 2016 and 2017 (CEIs underway) observations
- **Figure A3.** The relationship between the percentage of firm output in the previous year and the number of violations
- **Figure A4.** The relationship between the percentage of firm output in the previous year and the number of violations, 2014–2018
- **Figure A5.** The relationship between the percentage of firm output and the number of days with violations
- **Figure A6.** The relationship between the percentage of firm output and the number of days with violations, 2014–2018
- **Figure A7.** The relationship between the percentage of firm output and violations (panel A) and penalties (panels B–D)
- **Figure A8.** The relationship between the timing of the CEIs and the number of citizen complaints made through the 12369 platforms
- **Table A2.** The relationship between the percentage of firm output and the number of violations, with the number of heavily polluted days included as a control variable
- **Table A3.** The relationship between the percentage of firm output and the number of violations, with the city industrial output included as a control variable

Figure A1. Descriptive statistics on the firms and their violations

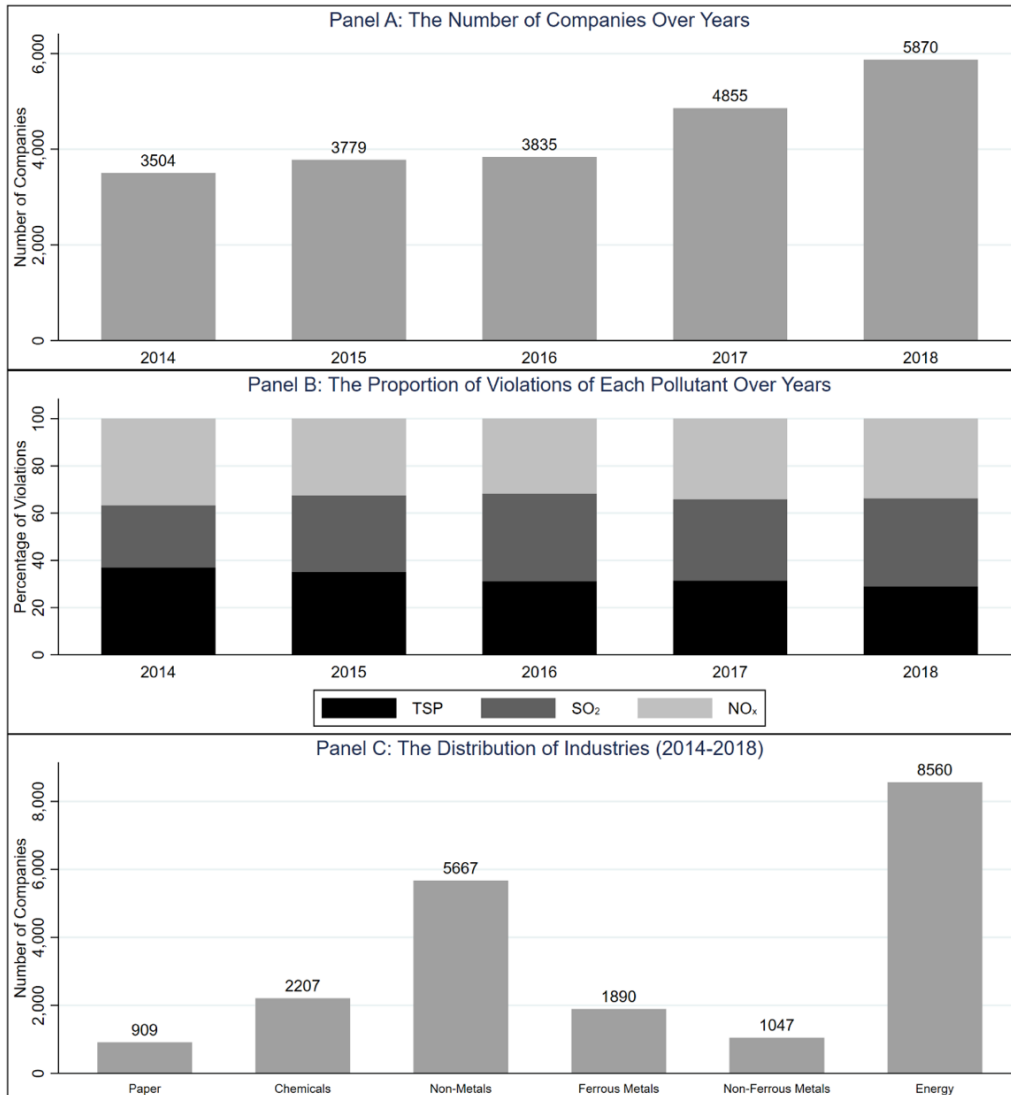


Figure A1 shows the descriptive statistics of the firms and violations. The number of companies has increased over time (panel A). The proportion of violations by pollutant type has stayed relatively stable over the years (panel B). Among the six major polluting industries for which we have data, most companies are in the nonmetallic minerals and the heating and electricity industries.

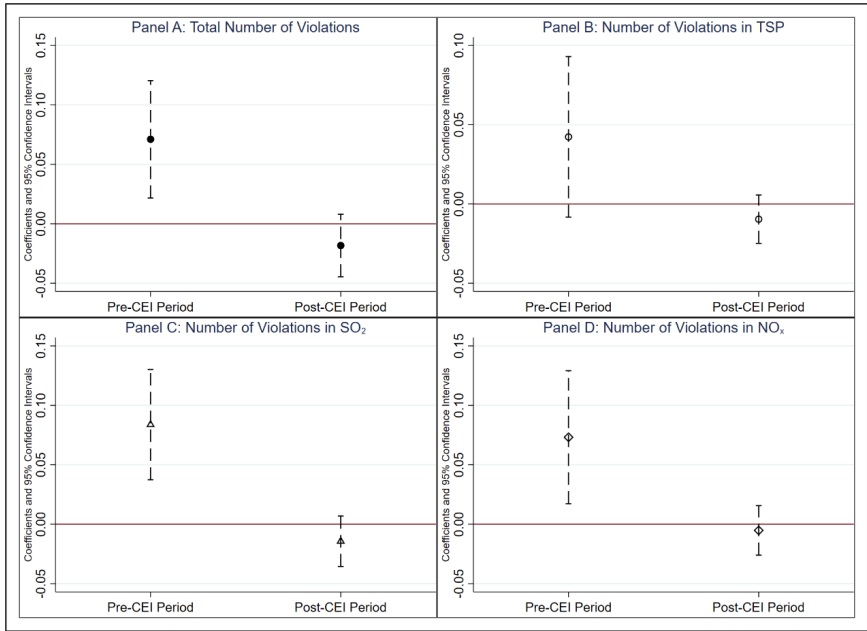
Table A1. Relationships between firm bargaining power, measured by three quantities, and the total number of violations in 2014

	Total number of violations			
	(1)	(2)	(3)	(4)
Percentage of output	0.111*** (0.0407)			
Output	0.181 (0.113)			
Percentage of tax		0.0377* (0.0204)		
Tax		-0.277 (0.199)		
Percentage of employee			0.127** (0.0578)	-0.0291 (0.0313)
Employee				0.000109*** (0.0000209)
Unemployed	0.184 (0.121)	0.0447 (0.135)	0.0581 (0.136)	0.0114 (0.136)
Employees prop. from ind.	0.00682 (0.00829)	0.00835 (0.00901)	0.00918 (0.00881)	0.00836 (0.00873)
GDP per capita	-0.204 (0.245)	-0.0198 (0.252)	-0.0518 (0.257)	-0.0273 (0.254)
GDP prop. from ind.	0.0382*** (0.0120)	0.0264** (0.0126)	0.0216* (0.0127)	0.0212* (0.0127)
Population density	0.0971 (0.121)	0.212 (0.143)	0.201 (0.140)	0.208 (0.138)
Province-year FE	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes
Ownership-year FE	Yes	Yes	Yes	Yes
Observations	3197	2371	2467	2467
Adj. R^2	0.180	0.163	0.163	0.169

Standard errors are clustered at the month-province level and given in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

When a firm's bargaining power is measured by the *percentage of tax*, the results remain very similar to when it is measured by the *percentage of outputs*. There is some caveat when measured by the *percentage of employees*. When the number of employees of a firm is controlled for, the relationship between the *percentage of employees* and the total number of violations becomes statistically insignificant. When it is not controlled for, as is the case in Lorentzen et al. (2014), the percentage of employees is significant, consistent with Lorentzen et al. (2014). Since the punishment data are available from 2015 to 2018, we are unable to conduct a similar analysis using punishments as the outcome.

Figure A2. The relationship between the percentage of firm output and the number of environmental violations, excluding 2016 and 2017 (CEIs underway) observations



Reverse Causality

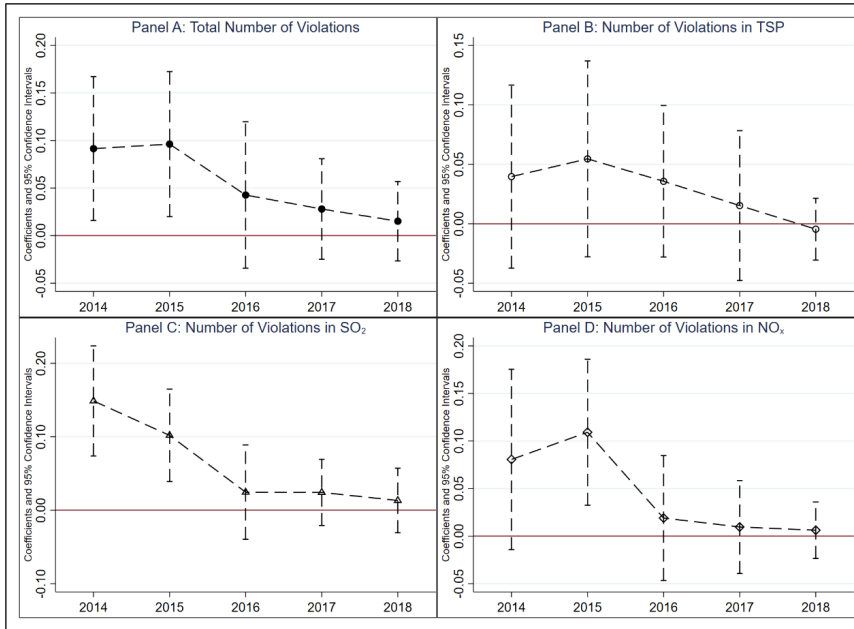
A reasonable concern is that a firm’s environmental compliance can reversely affect its contribution to the city’s industrial output. The rationale is that when a firm violates standards more, it tends to invest less in pollution abatement, leading to lower costs per unit of production and possibly more outputs. That would drive up that firm’s output value and its (relative) contribution to the city’s industrial outputs compared to a more compliant firm. To alleviate this concern, we use the percentage of output in the previous year as the independent variable, which is highly unlikely to be affected by environmental compliance status in the current year. In addition, we control for the firm output value in the previous year accordingly. As we can see from the results in Figure A3, the patterns are quite similar to those in the primary analysis (Figure 4). All the coefficients in the pre-CEI period, except for TSP compliance, are significantly positive. Specifically, as the percentage of firm output value increases by 1 unit, the total number of violations and the number of violations for SO₂ and NO_x will increase significantly, by 0.0818 percent, 0.0991 percent, and 0.0753 percent, respectively, *ceteris paribus*.

After CEI, when the threat of future CEIs was imminent, none of the coefficients remained significant. We also assess the effects of the percentage of firm output value in the previous year over the years 2014–2018. From Figure A3, we can see that the patterns are similar to those in Figure 5. With the exception of TSP compliance, the effect of the percentage of firm output value exhibits an overall downward trend over the years. It has lost statistical significance since the onset of the CEIs in 2016. These results indicate that our primary results remain largely valid despite the possible interference of reverse causality.

Figure A3. The relationship between the percentage of firm output in the previous year and the number of violations



Figure A4. The relationship between the percentage of firm output in the previous year and the number of environmental violations, 2014–2018



Alternative Specification for the Dependent Variable

In our primary analysis, we use the number of violations during a given year as the dependent variable, which can be affected by the number of plants and outlets a given firm has. Higher-contributing firms are generally larger in scale, having more plants and outlets and, by extension, a higher incidence of standard violations. To alleviate this concern, we use the number of days of violations as the dependent variable. We code a day as a violation day for a firm as long as there is at least one violation, regardless of which plant or outlet of the firm committed the breach and how many violations took place. As seen from the results exhibited in Figure A5, the patterns are very similar to those in the primary analysis shown in Figure 4. The effects of the percentage of firm output value are significant pre-CEI but insignificant afterward when the threat of future CEIs is imminent. Specifically, as the percentage of firm output value increases by 1, the days of violations of TSP, SO₂, and NO_x standards increase significantly by 0.0382 percent, 0.0604 percent, and 0.0490 percent, respectively. With the violations of all three pollutants combined, that percentage increase would be 0.0498 percent, *ceteris paribus*. In addition, the effects of a firm’s relative contribution to the city’s industrial outputs on the number of days with any type of environmental violations over the years exhibit an overall downward trend, similar to the primary results that the bargaining power of higher-contributing firms dwindled over time (Figure A6).

Figure A5. The relationship between the percentage of firm output and the number of days with violations

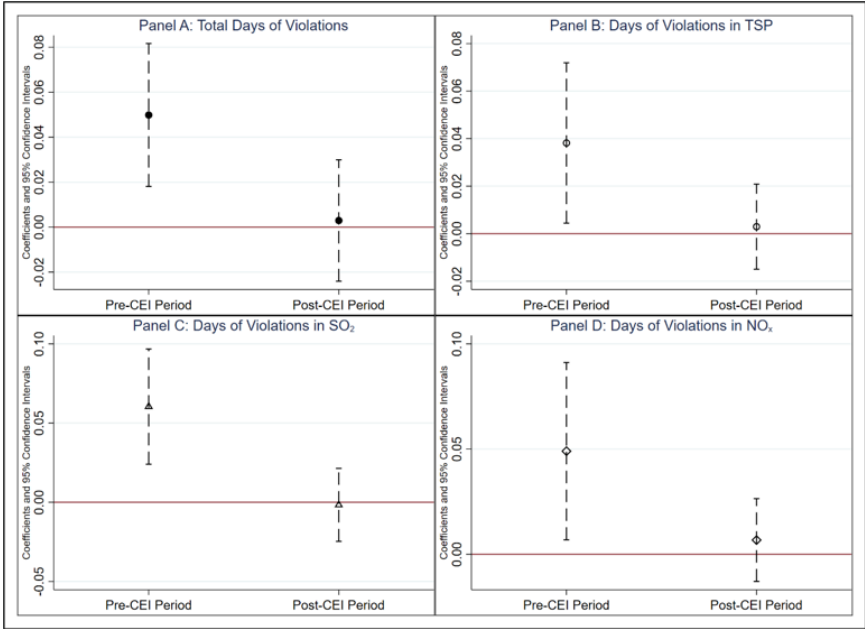
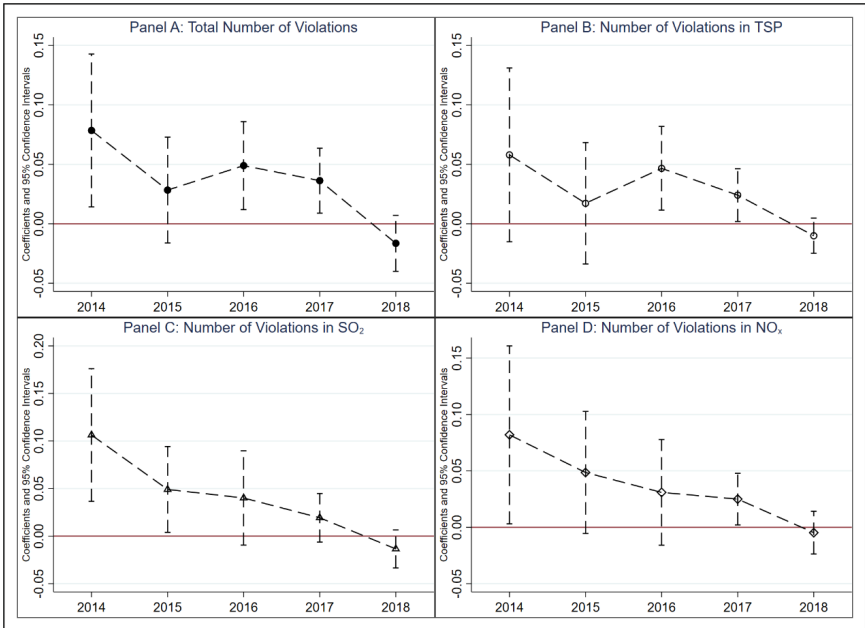


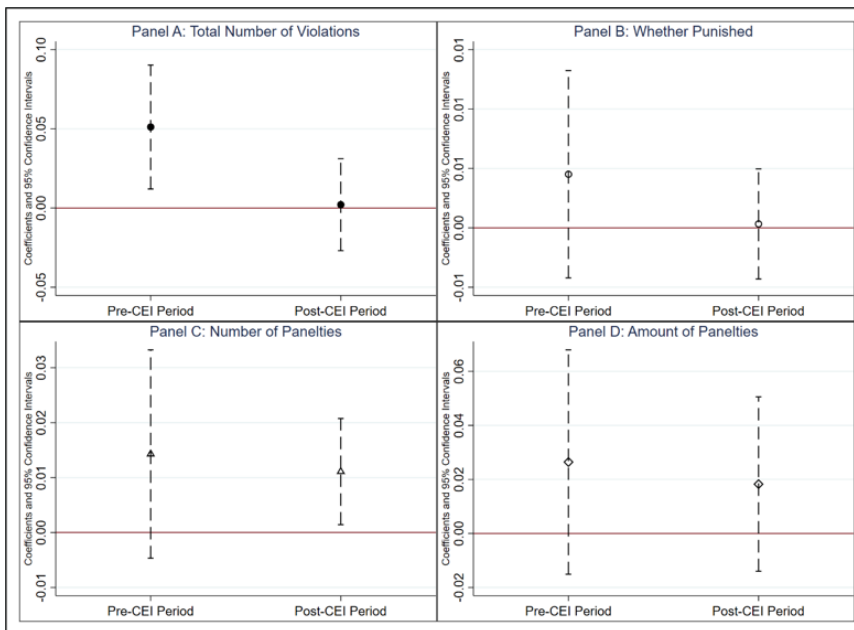
Figure A6. The relationship between the percentage of firm output and the number of days with violations, 2014–2018



Bargaining Power or Affordability?

An alternative explanation for the results presented in the main analyses is that higher-contributing firms violate standards more due to greater fines affordability rather than higher bargaining power. To alleviate that concern, we examine the relationship between the percentage of firm output and the punishments the firm receives for violations. To visually see the differences in the number of violations and the penalties issued, panel A in Figure 11 shows the results using the total number of violations during 2015–2018 as the outcome. Results in panel A indicate that the higher the relative contributions the firms made, the more they violated standards in the pre-CEI period. In contrast, results from panels B–D in Figure A7 suggest that during the same period, firms' receipt of, frequency in, and severity of punishments were similar regardless of their relative contributions to the city's industrial outputs, *ceteris paribus*. In other words, firms that made comparatively more contributions to the city's industrial outputs violated standards more without being punished more before the CEI. Thus, it is not because higher-contributing firms could afford to pay fines that they violated more standards; instead, their higher bargaining power led them to violate standards in the pre-CEI period. After the CEI, when the threat of future CEIs was imminent, firms received comparable punishments regardless of their relative contributions to the city's industrial outputs regarding whether they were punished and the monetary amount of fines they paid. Regarding the number of punishments, the higher-contributing firms, the more, on average, they received punishments, *ceteris paribus*.

Figure A7. The relationship between the percentage of firm output and violations (panel A) and penalties (panels B–D)

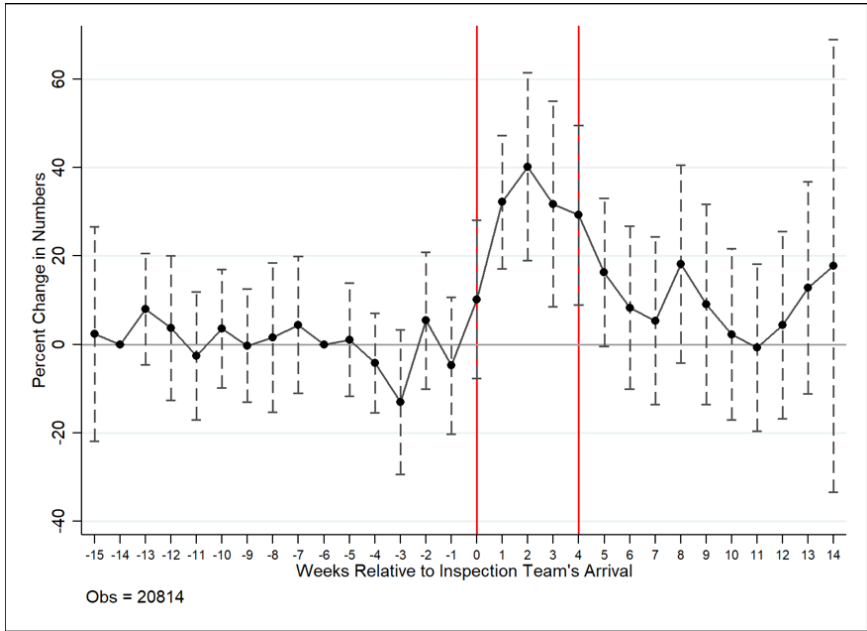


The Effect of Public Complaints

A potential alternative explanation for improved compliance after the CEIs is intensified public complaints. In 2006, the MEP set up the 12369 environmental appeals platform, offering a hotline phone service and a website for citizens to report suspected environmental violations to environmental authorities at all levels. The MEP instructed each prefectural EPB to open an office specifically to address the citizen appeals. When an appeal is made, it is directed to the corresponding EPB, which is legally obligated to investigate and issue fines to the responsible polluting firm if a reported violation is confirmed. The 12369 platforms have since become among the most popular channels for citizens to complain about the environment. We mapped the individual complaints to cities weekly with the comprehensive and confidential citizen complaints data we obtained directly from the MEP.

Since all the provincial units were treated for inspection eventually, we follow Sun and Abraham (2021) by using observations about firms inspected during the fourth batch or “cohort” as the control group. That is, we use the observations up to the week before the start of the fourth batch of inspections in our sample for analysis. Since there are only 15 weeks between the beginning of the third batch of CEIs and the beginning of the fourth batch of CEIs, we assess the effect of CEIs up to 14 weeks after their onset for all batches or cohorts. The results in Figure 12 suggest that complaints increased by 29 to 40 percent during the CEIs. However, the effect quickly becomes insignificant after the conclusion of the CEIs. One difference regarding who received the complaints is that the CEI teams received complaints during the CEIs, while the local EPBs received complaints after the CEI teams departed. One possible reason for the temporary increase in complaints is that residents believed the MEP had more authority and would be more willing to address reported environmental problems than local EPBs. While citizens also had channels other than the 12369 platforms to complain, these results alleviate the concerns that it was citizens’ complaints rather than the breakage of regulatory capture and the weakening of high-contributing firms’ bargaining power that were driving the changes in compliance.

Figure A8. The relationship between the timing of the CEIs and the number of citizen complaints made through the 12369 platforms¹²



Note: The dots represent the coefficients of the dummy variables for weeks before and after the CEI teams' arrival, designated as week 0. The interval between the two red lines, designating week 0 and week 4, denotes the inspection period. The vertical dashed lines represent the 95 percent confidence intervals of the coefficients.

Potential Confounding Effect of High-Pollution Days on Firms' Compliance

One might be concerned that air quality may influence a firm's compliance with environmental standards. This is plausible because a firm's bargaining power might be diminished on days when the air quality is palpably bad, and the local EPBs would be compelled to enforce environmental standards more rigorously so that bad air quality would not instigate social unrest. We use "heavily polluted" (i.e., AQI of 200 or above) as a criterion for palpably bad air quality days and include the number of heavily polluted days as a control variable in the regression analysis. The results in Table A2 show that heavily polluted days are not associated with firm violations.

¹² Since the number of complaints can be zero, we apply an IHS transformation of the complaint number rather than a log transformation.

Table A2. The relationship between the percentage of firm output and the number of violations, with the number of heavily polluted days included as a control variable

	Pre-CEI period (2014–2016)				Post-CEI period (2017–2018)			
	(1) Total	(2) TSP	(3) SO ₂	(4) NO _x	(5) Total	(6) TSP	(7) SO ₂	(8) NO _x
Percentage of output	0.0585*** (0.0217)	0.0451** (0.0185)	0.0645*** (0.0237)	0.0482** (0.0241)	0.00172 (0.0147)	0.00251 (0.00914)	-0.00217 (0.0120)	0.00826 (0.0111)
Output	0.0434 (0.0598)	0.0796* (0.0471)	-0.148*** (0.0566)	0.161** (0.0664)	0.142* (0.0776)	0.0404 (0.0495)	0.117* (0.0669)	0.0963 (0.0637)
Unemployed	-0.0125 (0.0805)	-0.103 (0.0720)	0.101 (0.0855)	0.0468 (0.0643)	-0.304*** (0.107)	-0.262*** (0.0798)	-0.157* (0.0866)	-0.221*** (0.0791)
Employees prop. from ind.	0.00594 (0.00742)	0.00543 (0.00714)	0.00775 (0.00603)	0.00154 (0.00710)	0.00713 (0.00630)	0.00412 (0.00429)	0.00739 (0.00458)	0.00239 (0.00493)
GDP per capita	0.0166 (0.168)	0.0676 (0.148)	-0.106 (0.145)	0.0672 (0.132)	0.137 (0.164)	0.105 (0.129)	0.0890 (0.133)	0.265** (0.127)
GDP prop. from ind.	0.0149 (0.0101)	0.00332 (0.00886)	0.00536 (0.0104)	0.0180** (0.00829)	-0.000331 (0.00976)	0.00126 (0.00731)	0.00284 (0.00709)	-0.00291 (0.00683)
Population density	-0.0697 (0.0976)	-0.0771 (0.0925)	-0.198** (0.0822)	0.00999 (0.0886)	0.0790 (0.109)	-0.0136 (0.0753)	0.0243 (0.0919)	0.0938 (0.0807)
Heavily polluted days	0.0768 (0.0665)	0.0568 (0.0615)	0.0526 (0.0610)	0.0731 (0.0550)	0.0230 (0.0695)	0.0375 (0.0500)	0.0533 (0.0522)	0.0206 (0.0490)
Province-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ownership-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9003	8622	8836	8607	6641	6386	6479	6392
Adj. R ²	0.258	0.229	0.182	0.239	0.114	0.111	0.114	0.0758

Standard errors are clustered at the province level and given in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Cities with Lower Industrial Outputs Have Less Capacity, Leading to More Violations

Lastly, cities with lower industrial outputs may also have lower state capacities. The EPB having less capacity to regulate might increase higher-contributing firms' bargaining power, leading to more violations. To alleviate that concern, we add an additional control variable to our models: city industrial output. The results in Table A3 show that city industrial output is not significantly related to violations, which holds across all models.

Table A3. The relationship between the percentage of firm output and the number of violations, with the city industrial output included as a control variable

	Pre-CEI period (2014–2016)				Post-CEI period (2017–2018)			
	(1) Total	(2) TSP	(3) SO ₂	(4) NO _x	(5) Total	(6) TSP	(7) SO ₂	(8) NO _x
Perc. of output	0.0648*** (0.0202)	0.0461** (0.0188)	0.0636*** (0.0208)	0.0595** (0.0241)	-0.000559 (0.0150)	0.000808 (0.00943)	-0.00338 (0.0126)	0.00826 (0.0113)
Firm output	0.0566 (0.0607)	0.101** (0.0483)	-0.135** (0.0564)	0.171** (0.0690)	0.147* (0.0786)	0.0446 (0.0508)	0.117* (0.0670)	0.0949 (0.0634)
Unemployed	0.0351 (0.0852)	-0.0901 (0.0785)	0.157* (0.0866)	0.0419 (0.0788)	-0.262** (0.120)	-0.224** (0.0908)	-0.132 (0.0940)	-0.219** (0.0870)
Employees prop. from ind.	0.00659 (0.00708)	0.00582 (0.00680)	0.00748 (0.00590)	0.00298 (0.00691)	0.00718 (0.00630)	0.00413 (0.00429)	0.00702 (0.00454)	0.00212 (0.00496)
GDP per capita	0.00147 (0.191)	0.00500 (0.171)	-0.0387 (0.177)	0.00659 (0.152)	0.223 (0.187)	0.178 (0.135)	0.109 (0.143)	0.246* (0.146)
GDP prop. from ind.	0.0193** (0.00952)	0.00578 (0.00839)	0.0105 (0.00910)	0.0182** (0.00837)	0.00137 (0.00978)	0.00303 (0.00791)	0.00416 (0.00710)	-0.00275 (0.00663)
Population density	0.00589 (0.0853)	-0.0426 (0.0840)	-0.118 (0.0780)	0.0566 (0.0825)	0.119 (0.113)	0.0269 (0.0863)	0.0473 (0.0995)	0.0921 (0.0795)
City industrial output	-0.0349 (0.115)	0.0383 (0.102)	-0.111 (0.111)	0.0552 (0.104)	-0.0973 (0.116)	-0.0874 (0.0894)	-0.0360 (0.0899)	0.0133 (0.0743)
Province-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ownership-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9998	9580	9815	9545	6648	6393	6485	6398
Adj. R ²	0.269	0.245	0.191	0.245	0.115	0.111	0.114	0.0756

Standard errors are clustered at the province-month level and given in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Acknowledgements

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