

# Can Police Patrols Prevent Pollution? The Limits of Authoritarian Environmental Governance in China

*Denise van der Kamp*

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In 2015, China, the world's biggest polluter, pledged to achieve peak carbon emissions by 2030. This was not an empty pledge. In recent years, the Chinese government has phased out inefficient power plants, invested significantly in renewable energy,<sup>1</sup> and achieved its 2020 carbon reduction targets three years ahead of schedule.<sup>2</sup> The leadership has also ratcheted up its use of central pollution inspections, demonstrating their resolve to tackle the problem of bureaucratic non-compliance, where local officials under-enforce environmental laws to protect polluting industries.

In China—a single-party state where authority is concentrated in the leadership—the threat of sudden punitive sanctions from the center can be a very powerful tool for discouraging local non-compliance. However, even powerful authoritarian leaders are handicapped by information failures: censorship and shrinking political freedoms limit leaders' access to accurate, on-the-ground knowledge, making it harder for them to know which officials are shirking orders or which officials should be targeted for punishment.<sup>3</sup>

In other countries, leaders facing information failures will turn to bottom-up solutions, encouraging citizens to raise the alert on official corruption through protests, media reports, advocacy groups, and even elections.<sup>4</sup> However, autocracies are more wary of these bottom-up surveillance methods. Information-sharing by citizens, if uncensored, could lead to a widespread recognition of shared grievances, while frequent protests could transform into broader collective action—both threatening scenarios for single-party states. China's approach to policing non-compliance therefore tends to focus on top-down solutions, an approach that reflects its authoritarian power structure,<sup>5</sup> but which also exacerbates the leadership's information failures.

In recent years, China has begun to adapt its bureaucratic surveillance mechanisms to address these shortcomings. Specifically, it has moved towards a more hybrid

approach where leaders do solicit uncensored information from the public to guide their top-down efforts. However, citizen input is engaged in a supervised manner, where the regime continues to control the agenda, timing, and scope of participation. This hybrid approach enables the leadership to pursue more targeted punitive actions against local officials, while also revealing where public concerns are most acute. Crucially, uncensored information, if shared through supervised channels, allows the leadership to control the risk of collective action.

China's recent central pollution inspections campaign represents one of the most robust forms yet of this hybrid approach. During this campaign, the central government encouraged citizens to phone in suspected pollution violations, while sending thousands of inspectors across the country to follow up on citizen complaints and punish the officials and companies caught violating the law. Can China's hybrid surveillance model address ongoing problems with weak enforcement? Does it represent a viable solution for authoritarian governments that are wary of bottom-up participation?

To assess these questions, this article examines the impact of the central government's 2016–2017 pollution inspections campaign on pollution enforcement outcomes. Taking advantage of the gradual rollout of inspections across the country, I use matching and a difference-in-difference design to compare the change in pollution levels for cities that were inspected versus those that were not for the initial stage of the campaign.

Contrary to expectations, this article finds that China's hybrid surveillance campaign did not have a significant effect on reducing pollution. Drawing on interview evidence, I argue that central inspections had a limited effect because environmental enforcement requires a degree of sustained scrutiny on bureaucrats and polluters that the campaign could not provide. While the literature suggests that central inspections (otherwise known as "police patrols") can generate this sustained scrutiny when buttressed by the courts, citizen lawsuits, and public participation, this study indicates that bottom-up surveillance, when engaged in a controlled and supervised form, is unlikely to extend the short-term deterrent effect of top-down inspections. These findings illuminate the severity of China's enforcement problems and suggest that the authoritarian leadership's reluctance to empower an independent judiciary or accommodate independent action by civil society may be undermining their efforts to improve enforcement.

## **The Political Dilemmas of Pollution Enforcement**

In the developing world, governments seeking to enforce pollution policies often struggle with principal-agent problems. Enforcement requires a central state with the power to compel local officials to implement laws, even when these laws threaten economic growth. This, in turn, requires a state that can not only detect but also punish local officials who ignore central orders to serve their own interests.<sup>6</sup> Few governments in the developing world have this kind of power. Without resources and strong

accountability institutions, central leaders cannot easily monitor local implementation outcomes, nor punish everyday disobedience by local officials.<sup>7</sup>

Principal-agent problems are especially pronounced in the sphere of the environment, where new regulations impose enormous up-front costs on the local economy. Cognizant of the risk to growth and employment, local officials exploit gaps in the central government's oversight to shield factories from regulatory measures.<sup>8</sup>

Over the years, political leaders have learned to leverage bottom-up pressure to overcome weak enforcement. Known in the literature as "fire alarms," these mechanisms include the use of media reports, public protests, or public interest litigation to expose corrupt officials and shame non-compliant polluters.<sup>9</sup> By leaning on informed and engaged citizens to raise the alarm on local corruption, political leaders not only increase the chances of detecting violations, they also outsource the cost of detection to society.<sup>10</sup> In short, public scrutiny increases incentives for local officials to obey laws, even when central oversight is weak.

Yet bottom-up solutions to principal-agent problems are less straightforward for authoritarian governments. To gain information on local misconduct, leaders need citizens to raise the alert publicly—for instance, through the media, protests, or online forums—otherwise local officials can censor, hide, or distort complaints to prevent exposure.<sup>11</sup> However, once citizens are allowed to share information publicly, the risk of collective action increases. Complaints can expose shared grievances, prompting citizens to recognize that local problems and local scapegoats stem from central government policies.<sup>12</sup> Alternately, citizens may use information-sharing to connect and coordinate across the country, raising the risk of protests.<sup>13</sup> In China, large-scale collective action can be threatening to regime legitimacy because—unlike their democratic counterparts—party leaders cannot use elections or leadership turnover to appease public demands for government accountability. Thus, in authoritarian contexts, public participation acts as a double-edged sword. Leaders gain information on the inner working of their government, but also risk undermining the regime's legitimacy.

Authoritarian ambivalence to public participation can be seen in China's quasi-democratic feedback mechanisms in the environmental sphere.<sup>14</sup> On the one hand, the leadership provides a growing number of channels for citizen lawsuits, petitions, and protests, which citizens do use to expose corrupt or non-compliant local officials.<sup>15</sup> On the other hand, the leadership frequently interferes in these measures, rolling back reforms just as citizen participation begins to gain ground.<sup>16</sup> Citizens who use these channels find that they stumble into hidden roadblocks, where valid lawsuits are summarily dismissed and pollution complaints are acknowledged only to disappear within the black box of bureaucratic decision-making.<sup>17</sup>

In the sphere of pollution, it has become clear that the central government can no longer rely exclusively on top-down, party-based mechanisms to control local officials. For decades, the regime excelled at monitoring and motivating bureaucrats<sup>18</sup> through clear, stable performance targets, tied to material rewards. Performance-based promotions, combined with the threat of sudden surveillance from Beijing, discouraged excess corruption and encouraged local officials to work harder at delivering growth. It

also helped that the regime took to “paying bureaucrats like corporate employees,”<sup>19</sup> where bureaucrats were entitled to a percentage of the fees they made from delivering government services.

However, this top-down, target-based approach to motivating compliance works less effectively for pollution, because it sets up a tradeoff between implementing pro-growth and pro-pollution policies. The system’s focus on countable targets and verifiable outcomes—which facilitates monitoring from afar—pushes local officials to favor the policies with immediate, visible returns (such as economic growth or revenue collection)<sup>20</sup> over policies with high up-front costs and more variable payoffs (such as pollution reduction). After all, why would a local official invest in pollution control when the average term limit lasts three years and when their successors will likely reap the rewards of their efforts?<sup>21</sup>

Moreover, while the regime’s primary focus was on economic growth, the system worked because it was compatible with corrupt bureaucrats’ interests. Local officials who used their power to line their pockets knew they could collect higher rents or kickbacks if the economy was growing than if it was ailing.<sup>22</sup> In contrast, environmental policies directly threaten the interests of corrupt bureaucrats: not only does pollution control temporarily slow down growth, it also requires bureaucrats to punish industry, the main source of their rents. In short, whether corrupt or career-oriented, in the absence of direct pressure from party leaders, bureaucrats have very limited incentives to enforce pollution control policies.

As these misaligned incentives become more pronounced, the Chinese leadership continues to experiment with bottom-up mechanisms to buttress their top-down efforts to control bureaucrats. However, the regime’s contradictory impulse to engage and constrain public participation has led to a distinctive form of controlled public participation, known as “consultative authoritarianism.”<sup>23</sup>

On the one hand, the regime encourages citizens to publicly report information through social media,<sup>24</sup> digital environmental monitoring,<sup>25</sup> environmental hotlines, or traditional letters and office visits.<sup>26</sup> Citizens are also encouraged to participate in deliberative forms, where they can form and express views autonomously, providing the government a barometer on public opinion.<sup>27</sup> Moreover, these reporting channels are more than mere “transmission belts” for sharing information upwards without government responsiveness. In fact, studies show that these channels can genuinely influence government decision-making or prompt changes in policy implementation.<sup>28</sup> The government has also begun to share information downward with citizens through its transparency and open government initiatives. Citizens are encouraged to use this information to identify non-compliant actors<sup>29</sup> or seek out third parties to enforce regulation against violators.<sup>30</sup>

However, public consultation retains a distinct authoritarian stamp insofar as the regime still controls the agenda, timing, and scope of participation. Public input provided through these channels must respect the government’s top-down decision-making structure.<sup>31</sup> This leads to a distinctive hybrid form of bureaucratic surveillance,

where the emphasis is still on top-down control, but which incorporates supervised bottom-up engagement.

### **Hybrid Surveillance under Authoritarian Governance**

A hybrid approach to surveillance offers an interesting alternative for authoritarian governments that are wary of bottom-up solutions to local non-compliance. The use of supervised but uncensored public input allows leaders to take advantage of on-the-ground knowledge to monitor bureaucrats, while also limiting the risks of public participation. When undertaken in campaign-style form, it can also increase citizen satisfaction. By openly soliciting and then immediately acting on citizen complaints with top-down surveillance measures, the regime not only scares bureaucrats into respecting laws, it also makes the central government appear highly responsive to citizen concerns.<sup>32</sup>

This study addresses whether hybrid surveillance—where top-down surveillance is guided by controlled, bottom-up input—can improve enforcement outcomes. Beyond increasing citizen satisfaction, can hybrid surveillance help the central government solve its principal-agent problems and motivate bureaucrats to enforce neglected policies?

This study focuses on one of the most robust forms yet of hybrid surveillance, namely, China's pollution inspections campaign. During this campaign, which took place in 2016–17, Beijing sent teams of central inspectors to every city in China to investigate polluting firms and the local officials and environmental agencies responsible for regulating them. Beijing also set up citizen complaint hotlines for each province, encouraging citizens to phone in pollution violations and directing inspectors to follow up on these complaints within a month.<sup>33</sup> Complaints (which would come in from all over the province) typically reported on polluters, not corrupt bureaucrats. However, complaints on polluter violations—especially if ongoing or involving a major violation—often indicate that regulation is weakly enforced and is taken as a signal of official non-compliance. Indeed, central inspectors who investigated citizen complaints would issue punishments against companies caught violating the law and initiate disciplinary action against the bureaucrats responsible for regulating these companies.<sup>34</sup>

Under China's centralized, authoritarian governance model, there are two reasons why one might expect hybrid surveillance to be effective at overcoming bureaucratic non-compliance and improving pollution levels. First, the regime's decision to concentrate power in strong, central institutions means that its bureaucrats are especially sensitive to direct scrutiny from the center and especially responsive to sudden "hold to account" orders.<sup>35</sup> A bureaucrat that may be skilled at resisting citizens' complaints or deflecting bottom-up demands for accountability<sup>36</sup> is far less likely to defy orders when under direct scrutiny from central officials.

For instance, when interviewing participants in a pollution protest, I witnessed a high-level environmental official openly admit to local environmental activists that the polluting factories targeted would not be held accountable if "some higher-level

economic interests [are] involved.”<sup>37</sup> The official held fast to this line, even when activists threatened open unrest. This reflects a common practice where bureaucrats exploit the ambiguity of competing economic and environmental “high priority” implementation targets to exercise their discretion,<sup>38</sup> often at the expense of environmental policies.<sup>39</sup> Top-down inspections address this problem by signaling to local officials that they should be prioritizing the environment and that the protection of polluting firms—even powerful polluting firms—will not be tolerated.<sup>40</sup>

Second, critics of top-down inspections (or “police patrols”) note that, when initiated by the central government, inspections lack the on-the-ground knowledge to investigate issues that concern local citizens. Moreover, inspections are inevitably limited to a sample of cases, which may leave widespread instances of non-compliance undetected.<sup>41</sup> Hybrid surveillance solves this problem by ensuring that inspections are based on direct citizen input, not random samples. In this way, it combines citizen knowledge and bureaucrats’ sensitivity to upward accountability to push through the enforcement of neglected pollution policies.

However, top-down inspections—even if buttressed by citizen input—only galvanize temporary action on the environment. Local officials may—under clear orders from the center—choose to forsake growth for the environment or (in the case of local environmental regulators) resist pressure from their immediate superiors to under-enforce regulation. However, if Beijing’s goal is to improve long-term compliance and reduce pollution, then hybrid surveillance may be less effective. This is because environmental enforcement requires more than just accurate information. It also requires sustained pressure on violators to comply, something that the short-term, controlled nature of an inspections campaign is not designed to address.

Consider again the two key issues that prevent the center from improving bureaucratic enforcement of environmental policies. The first is the information barrier. In a country of China’s size, it becomes exponentially more difficult for the central leadership to police and punish the everyday actions of local officials across the country.<sup>42</sup> For these information problems, hybrid surveillance can be effective, because they allow the center to gain immediate information on who is misbehaving. Further, central leaders can quickly follow up on this information through top-down punishments, sending a warning to other officials and discouraging them from “adjusting” numbers excessively in the future. As one former local environmental regulator confessed, while regulators might normally manipulate data to improve performance records, “the only thing [they] fear is random spot checks from [the Central Ministry].”<sup>43</sup>

However, this deterrent effect only addresses the problem of misreporting or data falsification, whereas this article is examining the impact of inspections on enforcement outcomes, that is, changes in actual pollution levels.

To improve pollution levels, Beijing must overcome the second obstacle to improving environmental enforcement, namely, competing environmental and economic targets. While an inspections campaign may correct the ambiguity of competing policy targets by signaling Beijing’s commitment to prioritizing pollution, it does not

correct the incentives that more generally encourage cadres to focus on the economy. How can hybrid surveillance create a sustained pressure to comply with environmental policies when, outside of these campaign-like events, bureaucrats still stand to benefit more (both personally and professionally) from prioritizing growth?<sup>44</sup>

Moreover, getting local officials to temporarily prioritize environmental policies is unlikely to change pollution levels. To reduce pollution, the central government not only needs to convince bureaucrats to enforce pollution standards, it must also get firms to comply with these standards. Consider, for example, the insights of an Environmental Protection Bureau (EPB) employee from southern China. This employee was sent to Shandong Province to assist the central inspections team in their on-site investigations and found, to her surprise, that several factories they chose to inspect had temporarily ceased operations. When she quizzed a factory worker on why production had stopped, the factory worker stated: “The management was informed that inspectors were coming and told us to stop production,” later adding: “When do we restart work? As soon as you leave!” The inspector later suspected that local EPB employees were alerting factories to the arrival of central inspection teams, especially because the inspection car was sometimes tailed by a local EPB van.<sup>45</sup>

This scenario illustrates the underhanded ways in which polluters can still avoid compliance during inspections. This is why the literature shows that change in environmental outcomes—such as reduced emissions—comes through repeat interactions between regulators and firms,<sup>46</sup> not from one-off enforcement actions that local officials perform under duress.

These repeat interactions do not have to involve sanctions. Studies show that regulatory inspections focused on education or persuading polluters can also be effective, especially in resource-poor or institutionally weak environments.<sup>47</sup> However, regulators must interact with firms with a certain level of frequency to actually change polluter behavior. In other words, reducing pollution requires regulators who are motivated to consistently monitor polluting firms and who, in turn, put non-compliant polluters under sustained scrutiny.

Unfortunately, inspections, unless undertaken frequently, tend to generate a short-term, one-off enforcement pressure. For instance, an official from China’s Ministry of Environmental Protection (MEP)<sup>48</sup> noted in an interview that while they do see some improvement in bureaucratic compliance in the immediate aftermath of inspections, there are cases where local officials go back to “business as usual” several months after inspections take place.<sup>49</sup>

In sum, these latter theories suggest that if overall bureaucratic incentives are still focused on growth, and if police patrols only generate an intermittent focus on the environment, then hybrid surveillance is unlikely to solve China’s environmental enforcement problems.

Given China’s institutional makeup, is hybrid surveillance more or less likely to be successful at overcoming the regime’s persistent bureaucratic non-compliance problems? Does it offer an enforcement solution for authoritarian regimes that struggle with serious information failures? Specifically, was the central inspections campaign

able to improve local enforcement of environmental policies in China, leading to reduced pollution? In the following sections, I assess these questions. First, I introduce the background of the 2016–2017 central inspections and explain how the timing of the campaign allows us to examine the effects on policy enforcement. Through matching and a difference-in-difference design, I then assess the efficacy of police patrols in overcoming bureaucratic compliance problems in China.

## **The Police Patrol Campaign**

In July 2016, China's central government sent central inspection teams to eight provinces to uncover pollution violations. Under orders from the State Council, these inspections were to be jointly carried out by the Ministry of Environmental Protection (MEP), the Central Commission for Discipline Inspection, and the Central Organization Department. Modeled after the anti-corruption campaign, central inspectors would spend a month in each province to investigate local officials' compliance records. Each inspection team was also assigned a specific hotline and mailbox through which citizens were encouraged to report suspected polluter violations. While part of the inspection team met with the provincial party secretary and local agencies responsible for environmental protection (including the Development Bureau, Water Resources Bureau, and the Environmental Protection Bureau), another part of the team would investigate documents and respond to citizen complaints.<sup>50</sup>

A sample of inspection reports reveals that citizens phoned in several dozen, even a hundred violations per day from locations all over a province. Complaints focused on issues such as air pollution, black smoke, and excessive noise, and inspection teams would follow up each record individually. Polluting companies caught violating standards would be punished, which, depending on the violation, could include a penalty, stop production orders, or orders to meet standards by a certain deadline. In more serious cases, polluting companies would face prosecution in court. Note, however, that punishments against polluting firms were to be enforced by local officials and local environmental protection bureaus (EPBs), not the central inspectors. Instead, central inspectors would continue to oversee this process from afar, ordering provincial, municipal, and county governments to submit their "plan of action" for enforcement one month after the inspections were completed and then report on enforcement outcomes six months later.

In addition to punishing polluters, inspections also led to central officials issuing warnings, reprimands, or disciplinary actions against local officials. These included actions against regulators from local EPBs employees, who could face criminal prosecution for outright violations of the law (such as falsifying pollution monitoring data). However, it also included internal party hold-to-account mechanisms (a formal dressing down through the party hierarchy) against party cadres (such as leading village, county, and municipal officials) who were responsible for supervising environmental regulators.<sup>51</sup> Leading officials were also disciplined for failing to detect environmental

crimes or for encouraging regulators to turn a blind eye to pollution in order to protect local growth rates. These disciplinary actions made clear that central inspections were not only directed at punishing polluters, but also at deterring the bureaucratic non-compliance problems that had led to poor enforcement.

Over the rest of 2016 and 2017, the government continued to roll out inspection campaigns across the country. By the end of the campaign in August 2017, approximately 25,000 enterprises had been fined a total of 1.24 billion RMB, while 16,500 officials had been disciplined, and 1,400 people had been prosecuted.<sup>52</sup>

The campaign was rolled out in four phases, with different provinces across the country being targeted in each phase. Hebei (China's most polluted province) was inspected during a pilot campaign in early 2016, followed by four rounds of national inspections (see Table 1).

There are two important characteristics to note about this inspections campaign. First, because the campaign was rolled out in stages, for the period of January to March 2017, there was a three months lull in inspections. During this lull, approximately half of the cities in China had already been inspected, effectively creating a treatment and control group. This makes it possible to compare the before and after effect of pollution enforcement in cities that were inspected (or treated) and those that had not yet been subjected to inspections (the control group).

Second, contrary to expectations that the most polluting provinces would be targeted first, for each stage of enforcement, the central government included provinces from a combination of coastal, central, and northern regions. For example, in the group of provinces inspected in 2016, we see that wealthy developed provinces (such as Guangdong and Jiangsu) and wealthy cities (such as Shanghai and Beijing) were selected alongside more underdeveloped, polluted provinces (such as Henan and Inner Mongolia). While the process of selection was certainly not random, the mix of regions provides a basis for comparing the before and after effects across different regions.

**Table 1** Schedule of Inspections by Province

	Round 1	Round 2	Round 3	Round 4
<u>Pilot Province</u>	July 12-August 19	Nov 24-Dec 30	April 24-May 28	Aug 7-Sept 4
Jan 2016	2016	2016	2017	2017
Hebei	Inner Mongolia	Beijing	Tianjin	Jilin
	Heilongjiang	Shanghai	Shanxi	Zhejiang
	Jiangsu	Hubei	Liaoning	Shandong
	Jiangxi	Guangdong	Anhui	Hainan
	Henan	Chongqing	Fujian	Sichuan
	Guangxi	Shaanxi	Hunan	Tibet
	Yunnan	Gansu	Guizhou	Qinghai
	Ningxia			Xinjiang

Data Source: Ministry of Ecology and the Environment.

To get a sense of how the central government selected provinces for each stage of inspections, I conduct t-tests to assess whether there are systematic differences on key covariates between the cities inspected in 2016 (treatment group) versus cities inspected in 2017 (control group). I focus on variables that were most likely to influence a city's pollution control outcomes, such as GDP per capita, industrial structure, prior levels of pollution, levels of energy consumption, the number of cars in a city, and geographical features.

The results of this analysis indicate that central leaders were selecting less polluted, less developed, and less wealthy areas to conduct inspections first (see Figures A1 and A2 in the appendix).<sup>53</sup> This test shows that Beijing's process of selection was not random, but driven by some key factors linked to reducing emissions levels. Moreover, Beijing's preference for inspecting less polluted cities first could bias the results in favor of finding that inspections had a positive, significant impact on reducing pollution.

## **Research Design**

To mitigate the non-random selection of provinces for inspection, I use matching to assess the impact of top-down inspections on the pollution enforcement outcomes across China. Specifically, for every city that was inspected in 2016, I find a city not inspected in 2016 that closely matches it on key dimensions prior to inspections (or "treatment"). I then use a difference-in-difference design where for each matched pair I compare the change in pollution levels from before and after inspections that took place in 2016. I also compare the difference in means for the outcome variable (which is the monthly mean NO<sub>2</sub> levels from January to March 2017) for matched treated and control groups. Theoretically, changes in pollution levels for the two matched cities should be similar, except for the change induced by inspections in the treated city in each pair.

To identify a list of matched treated and control cities,<sup>54</sup> I use the nonparametric genetic matching (GenMatch) method.<sup>55</sup> Cities are matched on the dimensions that Beijing is most likely to take into account when deciding where to inspect first.<sup>56</sup> All data are drawn from China's statistical yearbooks, except for the variables measuring pollution levels in 2015 ("NO<sub>2</sub> emissions" and "SO<sub>2</sub> emissions"), which I measure using remote sensing data. All covariates are measured for the year 2015, the year before inspections took place. This ensures that cities won't be matched on measurements that might have been affected by the inspections campaign starting in 2016.

After matching, cities in the treatment and control groups no longer exhibit statistically significant differences for the variables that could influence their ability to reduce pollution (see Figure A3 in the appendix). This makes it possible to assess the impact of inspections on enforcement outcomes, while taking into account the non-random selection of cities for inspection.

The independent variable is "treat," that is, whether cities were inspected in the first two rounds in 2016. For all cities that were subjected to central inspections between July

and December 2016, treatment=1. For all cities that were only inspected between May and September 2017, treatment=0. I do not include cities in Hebei in this analysis, as they were inspected during the pilot campaign in January 2016.

The dependent variable, which measures enforcement outcomes, is the change in pollution levels before and after the first two rounds of inspections. Given that the first two rounds of inspections took place from August to December 2016, and the third round only began at the end of April 2017, the period of January to March 2017 represents the ideal period for measuring treatment effects. To control for seasonal variation in pollution emissions, I use January to March 2016 as the pre-treatment period of comparison. Thus, the dependent variable is calculated as:

$$\text{Mean monthly NO}_2 \text{ levels (Jan–March 2017)} - \text{Mean monthly NO}_2 \text{ levels (Jan–March 2016)}$$

To overcome the biases of self-reported Chinese government pollution data, I use satellite measures of ground-level NO<sub>2</sub> levels<sup>57</sup>—obtained from the TEMIS NO<sub>2</sub> dataset—to calculate monthly NO<sub>2</sub> levels for each city.<sup>58</sup>

## **Findings**

To assess the impact of inspections on enforcement outcomes, I run a paired t-test on the matched data for the two outcomes variables (namely, “change in pollution levels” and “pollution levels in 2017”). I also conduct paired t-tests on two smaller sets of data: First, I use only the eighty-nine cities inspected in July 2016 as the treatment group. As with the original test, these cities are matched to cities from the control group, where inspections took place in May–September 2017. By using only cities treated in July 2016, I account for the longer time period (approximately five months) that it might take for local officials to compel firms to carry out changes in enforcement outcomes after disciplinary action. Second, I drop all cities with “treated neighbors” (i.e., cities with close neighbors that have already been inspected) from the control group before matching, to control for potential spatial spillover effects.<sup>59</sup>

Table 2 shows the findings of the t-tests. The main finding is that the inspections campaign had no effect on enforcement outcomes. This is true when testing for an effect immediately after inspections (models 1 and 4) and for the more long-term effect of up to eight months (models 2 and 5). This also holds true when controlling for spatial spillover effects (models 3 and 6). Table A1 (see appendix) repeats these tests while also controlling for the number of motor vehicles because, in addition to industrial emissions, NO<sub>2</sub> is also produced by vehicle exhaust emissions. Again, inspections have no statistically significant impact on pollution.

As an additional robustness check, I use a fixed effects model on the full, unmatched set of cities to assess the impact of inspections on pollution outcomes (see Table 3). This test uses location fixed effects, which provide a control for time invariant geographical features (such as basins, elevations, or climate) that make it harder to

**Table 2** Effect of Central Inspections on Air Pollution Levels (with matching)

	Change in NO <sub>2</sub> 2016-2017			NO <sub>2</sub> 2017		
	(1)	(2)	(3)	(4)	(5)	(6)
Mean of Differences	12.14	22.56	19.98	24.49	9.26	12.70
P value	0.5	0.3	0.2	0.3	0.8	0.6
Sample	Full	Round 1 only	Without treated neighbors	Full	Round 1 only	Without treated neighbors
Pairs	142	87	141	142	87	141

Table 2 shows the results of t-tests on paired treatment and control observations. See Figure A3 in the appendix for the list of variables used for matching.

reduce pollution. Given that inspections were carried out by province, I also include province-year fixed effects to account for province-wide common shocks and cluster standard errors at the provincial level. Finally, I include calendar month dummies to account for seasonal variations in pollution levels that affect all cities.

I decompose the period effects of inspections, testing the impact of inspections on air quality during the month-long inspections campaign (“inspections”) and for up to six months after treatment (“post inspections”).<sup>60</sup> In Table A2 (see appendix), I also use more granular temporal variables to break down the impact of inspections on pollution immediately before, during, immediately after, and six months after the campaign.

I run several models as additional controls. In models 1 and 2, I drop cities from the pilot province (Hebei) to control for the outlier effect of Hebei.<sup>61</sup> In models 3 and 4, I also run the same fixed effects model after dropping cities with treated neighbors to control for spatial spillover effects. Models 5 and 6 drop both treated neighbors and pilot province cities.

Results from these fixed effects models show that the main finding of this article holds: pollution inspections have no statistically significant effect on pollution outcomes, either before, during, immediately after, or six months after inspections took place.

A recent study finds that corruption inspections, undertaken as part of the anti-corruption campaign, are associated with increases in pollution levels up to three months after corruption inspections take place.<sup>62</sup> This raises the possibility that the impact of pollution inspections (which should, in theory, lead to less pollution) was cancelled out by increases in pollution resulting from corruption inspections. Data show that corruption inspections only took place within three months of pollution inspections in Gansu, Henan, Jiangxi, and Shaanxi provinces.<sup>63</sup> Table 4 controls for the effect of these overlapping corruption inspections on pollution outcomes. Table A3 (see appendix) also includes a model controlling for the number of motor vehicles. Again, results from all tables show that pollution inspections had no impact on pollution levels, even when controlling for the effect of corruption inspections.<sup>64</sup>

**Table 3** Effect of Central Inspections on Air Pollution Levels

	Level of NO <sub>2</sub> emissions (Monthly)					
	(1)	(2)	(3)	(4)	(5)	(6)
Pollution Inspections	-7.871 (34.814)		24.272 (39.608)		0.166 (34.603)	
Post Pollution Inspections		9.058 (57.687)		55.953 (56.530)		26.856 (53.501)
Sample	Without pilot province cities		Without cities with treated neighbors		Without treated neighbor or pilot province cities	
Location Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Province*Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2938	2938	2934	2934	2817	2817
Number of cities	272	272	272	272	261	261
R <sup>2</sup>	0.395	0.395	0.398	0.399	0.384	0.384

<sup>a</sup> Robust standard errors, clustered by provinces, are in parentheses. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01. The dependent variable is the monthly level of NO<sub>2</sub> emissions.

<sup>b</sup> “Pollution Inspections” means that cities are assigned a “1” for the duration of the inspections. “Post Pollution Inspections” means that cities are assigned a “1” from immediately after to 6 months after the inspections took place.

**Table 4** Effect of Central Pollution Inspections and Corruption Inspection on Air Pollution Levels

	Level of NO <sub>2</sub> emissions (Monthly)					
	(1)	(2)	(3)	(4)	(5)	(6)
Pollution Inspections	0.663 (31.543)		32.590 (37.212)		8.457 (31.827)	
Post Pollution Inspections		21.470 (51.905)		67.980 (50.752)		38.994 (47.587)
Corruption Inspections	-102.31 (63.474)	-106.74* (64.407)	-108.93 (67.125)	-113.54 (69.684)	-100.68* (59.531)	-106.30* (61.131)
Sample	Without pilot province cities		Without cities with treated neighbors		Without treated neighbor or pilot province cities	
Location Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Province*Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2938	2938	2934	2934	2817	2817
Number of cities	272	272	272	272	261	261
R <sup>2</sup>	0.399	0.399	0.402	0.403	0.388	0.388

<sup>a</sup> Robust standard errors, clustered by provinces, are in parentheses. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01. The dependent variable is the monthly level of NO<sub>2</sub> emissions.

<sup>b</sup> For cities that experienced corruption inspections, “Corruption Inspections” is coded as “1” during and three months after corruption inspections took place. Otherwise coded as “0.”

## Why the Inspections Campaign Failed

Why would central inspections have no discernable effect on enforcement outcomes? These results are especially puzzling because they show that even in the immediate aftermath of the inspections, there was no improvement in pollution outcomes. Theoretically, this is the period where we are most likely to see an impact because studies show that local officials in China are most responsive to central orders immediately after direct scrutiny from the Center.<sup>65</sup>

It could be that this study finds no effect because of spillover effects from the first round of inspections conducted in July 2016. This first round of inspections was widely reported in the Chinese media, so local officials across the country were aware of what was happening. It could be that local officials across China were galvanized by this news of inspections into pre-emptively enforcing regulation out of fear that they would be the next ones selected. If this is true, then there should be no discernable difference in outcomes between the treatment and controls groups in the January–March 2017 period, as all cities would effectively have been “treated” after the first round.

One way to assess if these spillover effects were salient is to look at the data on the sanctions following each round of inspections. Theoretically, if all local officials had been scared into action by the first round of inspections, we should see a decreasing numbers of officials disciplined per round with each new round of inspections. Table 5 shows a summary of the disciplinary actions taken in each round of inspections. Focusing on the number of officials disciplined and firms punished, we see that there are no clear trends on these indicators of punishment between rounds.

To test the presence of spillover effects more systematically, I include a dummy variable in my regression for “inspection round.” This tests for associations between the round of inspections and changes in pollution violations. Again, the results are inconclusive (see appendix, Table A4). When comparing cities inspected in rounds 2, 3, and 4 to round 1, there is no clear negative trend: the impact of inspections on pollution levels does not diminish with each round. Taken together these tests suggest that the first round of inspections did not create an overall deterrent effect and that it is unlikely that local officials were taking serious pre-emptive action in advance of inspections.

**Table 5** Summary of Disciplinary Actions Following Each Round of Inspections

	Round 1	Round 2	Round 3	Round 4
	July 2016	Nov 2016	May 2017	Aug2017
Enterprises Punished	2659	5779	7086	9181
Total Fines (10000 RMB)	19800	24302.2	33587.86	46583.84
Persons Detained	310	287	355	364
Officials Disciplined	2176	4066	6079	4210

Data Source: Ministry of Ecology and the Environment.

Consider also the logic of environmental enforcement in China. One of the biggest disincentives for enforcing environmental regulation is that it reduces business profits and weakens local economic growth. Given this tradeoff, it seems unlikely that local officials would actively sacrifice growth to take pre-emptive environmental action several months in advance of potential inspections. In fact, regulatory enforcement in China tends to follow a pattern of “putting out fires,” where local officials only make a concerted effort to address regulatory problems when a crisis erupts, or when under severe duress.<sup>66</sup>

What the results of this article suggest then is that the obstacles to pollution enforcement in China might be greater than we think. This is not to say that top-down inspections are an ineffective tool of state control. After all, how can the Central government discipline 17,000 officials around the country without having some effect?

Inspections could be considered effective in reminding bureaucrats of the Center’s absolute power.<sup>67</sup> This is a recognized pattern in the central government’s repertoire, where local officials are forced to give up what they are doing and carry out very specific tasks to resolve the crisis or issue of the moment.<sup>68</sup> Disrupting everyday tasks may or may not solve local problems, but they do remind bureaucrats that their fates rest on pleasing the Center. In forcing bureaucrats to suspend ordinary duties for weeks at time, the 2016–2017 pollution inspections campaign highlighted just how much power the leadership has over bureaucrats, even if they struggle to control their everyday actions.

Recent scholarship on China suggests that the government engages in showy efforts—such as investigating polluters and disciplining local officials—as a public relations exercise, to convince citizens that they are committed to tackling pollution problems.<sup>69</sup> This exercise enables Beijing to improve its legitimacy, while avoiding the complicated and costly task of actually enforcing pollution laws. In this respect, police patrols may have been very effective, especially because the response to citizen input was so immediate.

However, spending so many resources and so much time for purely disruptive or “performative” purposes seems somewhat excessive. As pollution problems continue, it is clearly in the regime’s interests to improve pollution enforcement. In this respect, findings from this article suggest that the inspections campaign has been less than effective.

I propose that the inspection campaign had a limited impact on pollution outcomes because this short-term, one-off enforcement mechanism cannot produce the consistent surveillance that is associated with improved compliance in environmental policies. Indeed, studies from India have shown that in the context of weak infrastructural power, unless regulators or local bureaucrats are monitored regularly, they are unlikely to maintain a consistent pressure on firms, even when they are offered economic bonuses to improve their enforcement.<sup>70</sup>

The one-off nature of the inspections campaign favors one-off bureaucratic actions that can produce immediate changes in enforcement outcomes. These one-off actions might include, for example, swift, large-scale measures to stop public health crises, such

as the SARS crisis in 2003.<sup>71</sup> They might also include “blunt force” regulatory action, where the Central government orders local bureaucrats to engage in extra-legal measures—such as dynamiting firms, forcibly reducing industrial output, or closing down entire industries—to quickly and decisively reduce pollution. In fact, data I gathered suggest that blunt force regulation can be very successful at overcoming bureaucratic non-compliance and reducing pollution.<sup>72</sup>

However, the toll that blunt force regulation imposes on the economy and employment<sup>73</sup> suggests that the Chinese government needs to develop a more sustainable approach to reducing pollution. Instead of resorting to extra-legal measures that reduce pollution quickly, they will need to improve everyday enforcement measures that are proportionate to the violations committed.

How might the Chinese government improve everyday enforcement measures? More broadly, how can they develop the consistent oversight that compels bureaucrats to enforce these measures?

One strategy that political scientists have identified is the use of the courts to create a pervasive sense of monitoring and certainty of punishment.<sup>74</sup> By specifying the actions expected of state officials or regulated entities and by empowering an independent judiciary to punish violations of these rules, political leaders can sustain the threat of punishment even after central inspections have ceased. **Moreover, by giving citizens legal standing to prosecute perceived violations, political leaders can delegate detection and enforcement to informed local actors, generating a sense of surveillance even after central inspectors have moved on.**<sup>75</sup>

**McCubbins and Schwartz further argue that unsupervised, unconstrained bottom-up oversight—which is not timed according to the state’s preferences, nor limited to certain issue areas—is much more effective at deterring repeat violations,**<sup>76</sup> because the threat of detection is more unpredictable and therefore less easily gamed. In his study of community-driven pollution enforcement in developing countries, O’Rourke also emphasizes the need for strong, cohesive communities that can attract outside allies (such as NGOs, the media, or sympathetic officials) to help sustain bottom-up pressure against violators. Otherwise, citizens will struggle to counteract the collusion that allows polluters to go unpunished and fail to move beyond a mere monitoring or information-gathering function to generate actual pressure for policy enforcement.<sup>77</sup>

However, the Chinese leadership seems to be turning away from the mechanisms which could provide more consistent enforcement pressure. Instead of strengthening legal institutions, they are increasingly rolling back the independent function of the judiciary.<sup>78</sup> Thus, even if citizens were able to prove bureaucratic or polluter misconduct in a court of law, the constraints on independent judges erode their chances of success.

Second, the regime’s insistence on controlled, supervised citizen input also weakens the power of bottom-up pressure and the surveillance function of “fire alarms.” If bureaucrats know that higher levels will only act on citizen input in pre-announced campaigns, they have fewer reasons to fear bottom-up surveillance outside these campaigns. Moreover, amidst a single-party regime committed to concealing divisions within the ruling apparatus, controlled citizen input is unlikely to move beyond a more

transmission-belt function.<sup>79</sup> How can citizens create strong, cohesive enforcement communities if they are only allowed to share information sporadically and under closely watched channels? How can they sustain their watchdog role, seek higher-level allies, or scare bureaucrats into compliance when the leadership is committed to preventing grassroots collective action? Thus, the institutional features that constrain bottom-up participation in China may also be undermining the impact of the central inspections campaign.

This is not to say that the space for public engagement is closed, nor that effective courts and bottom-up surveillance mechanisms are precluded in China. Over decades, wily and experienced citizen activists have learned to exploit divisions within the state to advance broader social interests, even when it is not in the immediate interest of the government.<sup>80</sup> In some issue areas, these “policy entrepreneurs” can bring about unexpected reversals in government policy-making.<sup>81</sup>

Civil society actors are also learning to sidestep the state and use market forces to confront polluters directly. For instance, NGOs target brand-sensitive companies, using information disclosed by the central government to shame these companies into cleaning up production.<sup>82</sup> Meanwhile international companies—which are under pressure from home country governments or lobby groups to green their supply chain—are also incentivizing Chinese suppliers to meet high environmental standards.<sup>83</sup> These innovations offer hope that polluter non-compliance can be mitigated, even when state enforcement is weak. They also suggest that civil society is at its most powerful when acting outside the controlled forums that leaders provide.

However, getting civil society to enforce polluter compliance does have its limits, especially when it comes to broad sectors of the Chinese economy that are less vulnerable to brand image or consumer activism (such as heavy industry) or less easily monitored (such as small and medium enterprises). To change behavior in these sectors, the Chinese government must generate broader regulatory pressures for polluter compliance, which, in turn, will require improvements in bureaucratic compliance.

## **Conclusion**

China’s efforts to reduce pollution are widely reported, but the impact of these efforts is less well understood. This article assesses the impact of one of China’s most high-profile efforts yet: a nationwide central inspections campaign to punish and prevent widespread pollution violations. Findings from this article show that inspections had no effect on pollution levels, not even six months after inspections took place. Drawing on comparisons with occasions where top-down efforts were effective, this article theorizes that the transitory, one-off nature of top-down inspections contributed to their limited impact. Without consistent, sustained surveillance, bureaucrats have few incentives to enforce environmental laws, leading polluters to disbelieve regulators’ threats of future punishment.

This article further suggests that the Chinese regime's wariness of bottom-up accountability mechanisms and control of the courts have weakened the deterrent threat of inspections campaign. Elsewhere, public participation and judicial surveillance can buttress the impact of police patrols, extending the threat of punishment beyond the immediate campaign. With the central inspections campaign, the regime showed a move in this direction, using supervised bottom-up input to strengthen the threat of surveillance, make inspections more targeted, and appease public concerns. However, the controlled nature of public input may also have undermined the most powerful aspect of bottom-up pressure: sustained, but unpredictable surveillance.

In demonstrating the limitations of police patrols in China's institutional context, this article offers two broader insights. First, this study reveals that improving bureaucratic oversight is not a one-off problem that can be solved by concentrating resources into one campaign. For environmental issues, a more sustained form of oversight is required. In countries with weak institutions, it can be very difficult to produce this oversight, and in authoritarian countries that deliberately constrain bottom-up input, this can be even harder.

Second, this study acts as a counterpoint to recent theories of authoritarian efficiency in environmental policies. Some scholars suggest that a combination of long-term horizons, a strong coercive apparatus, and state-controlled financial institutions have allowed the Chinese leadership to enact costly pollution policies that would be impossible in democratic countries. An expensive, multi-year, nationwide inspections campaign is one example of this. This study suggests that theories of authoritarian enforcement efficiency fail to address a major gap in authoritarian capacities, namely, the inability of authoritarian institutions to produce diffuse and sustained forms of surveillance that can systematically address local non-compliance. Instead, they must turn to a much less ideal solution—top-down inspections.

If the Chinese central government continues to apply top-down inspections regularly, and if it becomes an integral part of the government's enforcement repertoire,<sup>84</sup> then perhaps the leadership will be able to create a more consistent form of accountability. Although expensive, the repeated use of hybrid surveillance and inspections could lead to long-term improvements in enforcement outcomes. But for now, this study suggests that China will face an uphill battle in its attempts to overcome problems with bureaucratic control.

## NOTES

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51. In the case of Shandong Province, for example, when random inspections revealed a large cluster of violations from small, polluting workshops, the deputy mayor of the responsible city was immediately called in for disciplinary action by the party. See *The Livings*, Oct 10, 2019.

52. Data from Ministry of Environmental Protection public records.

53. Due to space constraints, the Appendix is not in the print version of this article. It can be viewed in the online version, at [www.ingentaconnect.com/cuny/cp](http://www.ingentaconnect.com/cuny/cp).

54. Because there are an unequal number of treatment and control cities, I use matching with replacement to find matched cities for all treated observations.

55. This method does not require an estimation of the propensity score to match different observations. That is, matching is not based on a function provided by the researcher and therefore does not incorporate the researcher's biases. Instead, it uses a function that "finds optimal balance using multivariate matching where a genetic search algorithm determines the weight each covariate is given." See Roland R. Ramsahai, Richard Grieve, and Jasjeet S. Sekhon, "Extending Iterative Matching Methods: An Approach to Improving Covariate Balance that Allows Prioritisation," *Health Services and Outcomes Research Methodology*, 11 (December 2011), 95–114 for further details.

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57. See appendix for a detailed explanation of why I focus on Nitrogen Dioxide (NO<sub>2</sub>) as a measure of air pollution instead of Sulfur Dioxide (SO<sub>2</sub>).

58. See data appendix for details on how I use satellite data to measure pollution levels in cities and how I mitigate the sensitivity of satellite data to weather patterns.

59. Given the sequential timing of the inspections campaign, there is a risk that the results may be skewed by air pollution blown across borders by wind. For instance, the air quality in cities in untreated provinces may

improve prior to inspections because of air pollution reductions in treated cities close by. I deliberately chose to measure air quality with NO<sub>2</sub> levels to reduce this risk as NO<sub>2</sub> is a more stable pollutant and less easily carried across jurisdictions by wind. However, I also drop treated neighbors as an additional control.

60. I choose six months after treatment as the cut off because this is when local governments were required to submit reports on enforcement outcomes to the state council.

61. Hebei was the first province to be inspected, but also tends to be an outlier when it comes to pollution enforcement: It is adjacent to Beijing and also the most polluted province in China, so Beijing repeatedly subjects cities in Hebei to pollution campaigns and factory closures. The province therefore experiences frequent changes in pollution levels that are unrelated to inspections and that could skew overall results.

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64. The results in models 1 and 2 of Table 4 show that corruption inspections are negative and significant (albeit at the 10 percent level). Table A3 (see appendix) provides further tests of the impact of corruption inspections, showing statistically significant findings (at the 10 percent level) in some cases. These findings suggest that in the provinces where corruption inspections took place, they are associated with reduced pollution levels for up to three months after the inspections. While speculation on this finding is beyond the scope of this article, it may suggest that the biggest obstacle to reducing pollution is bureaucratic corruption and that a more direct scrutiny of bureaucrats and their activities could be more effective at reducing pollution.

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73. See "China's Smog Battle Loses 'Momentum' in Some Regions, Environment Minister Says," and "China's Smog Fight Goes on Regardless of Economic Pressures," *South China Morning Post*, Jan. 28, 2019 and Oct. 31, 2018.

74. See Migdal; Douglass C. North and Barry R. Weingast, "Constitutions and Commitment: The Evolution of Institutions Governing Public Choice in Seventeenth-Century England," *The Journal of Economic History*, 49 (December 1989), 803–32; McCubbins and Swartz, 166–72.

75. Neil Gunningham, Robert A. Kagan, and Dorothy Thornton, "Social License and Environmental Protection: Why Businesses Go Beyond Compliance," *Law & Social Inquiry*, 29, no. 2 (2004), 307–41.

76. McCubbins and Schwartz, 172.

77. O'Rourke, 59–68.

78. See, for example, Yuen Yuen Ang and Nan Jia, "Perverse Complementarity: Political Connections and the Use of Courts Among Private Firms in China," *The Journal of Politics*, 76 (April 2014), 318–32; Yuhua Wang, *Tying the Autocrat's Hands* (New York: Cambridge University Press, 2015).

79. Yongshun Cai, "Managing Group Interests in China," *Political Science Quarterly*, 129 (April 2014), 107–32; Timothy Hildebrandt, "The Political Economy of Social Organization Registration in China," *The China Quarterly*, 208 (December 2011), 970–89; Lorentzen, 2014; Minzner, 2015; Teets, 2014.

80. Greg Distelhorst, "The Power of Empty Promises: Quasi-Democratic Institutions and Activism in China," *Comparative Political Studies*, 50 (March 2017), 464–98; O'Brien and Li, 2006.

81. Andrew C. Mertha, *China's Water Warriors: Citizen Action and Policy Change* (Ithaca: Cornell University Press, 2014).

82. Mary Alice Haddad, "Increasing Environmental Performance in a Context of Low Governmental Enforcement: Evidence from China," *The Journal of Environment & Development*, 24 (March 2015), 3–25.

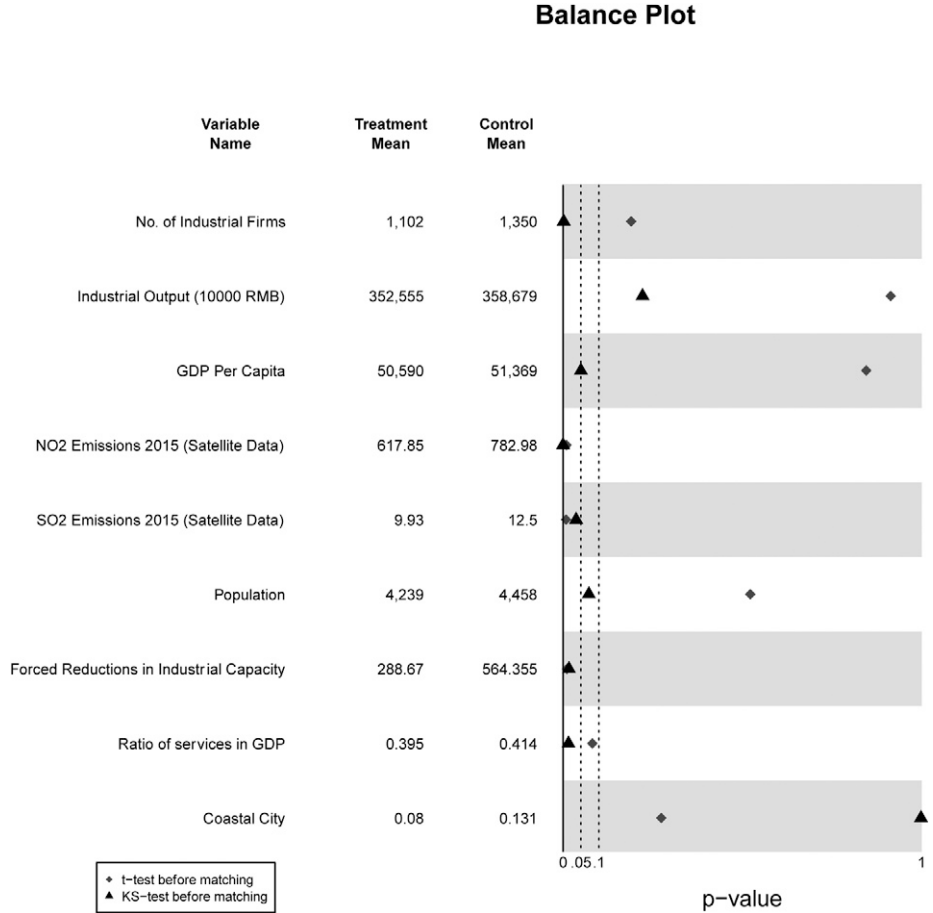
83. Sini Laari, Juuso Töyli, Tomi Solakivi, and Lauri Ojala. "Firm Performance and Customer-Driven Green Supply Chain Management," *Journal of Cleaner Production*, 112 (January 2016), 1960–70; Guangqin Li, Shuai Shao, and Lihong Zhang, "Green Supply Chain Behavior and Business Performance: Evidence from China," *Technological Forecasting and Social Change*, 144 (July 2019), 445–55.

84. Beijing's use of central pollution inspections has intensified since the initial 2016–2017 campaign. In June 2018, Ministry of Ecology and the Environment announced that 200 teams of 18,000 inspectors and support staff would continue investigating polluters in provinces and cities across China, effectively "tripling the workforce for the inspections carried out [in the winter of 2017]." See "China to Expand Environmental Checks to More Cities and Regions in Anti-Pollution Drive," *South China Morning Post*, Jun. 9, 2018. Then in December 28, 2018, the government announced that it would be expanding inspections to central SOEs. See "China to Expand Environmental Inspections of State-Owned Companies," *Nasdaq*, Dec. 28, 2018.

## APPENDIX

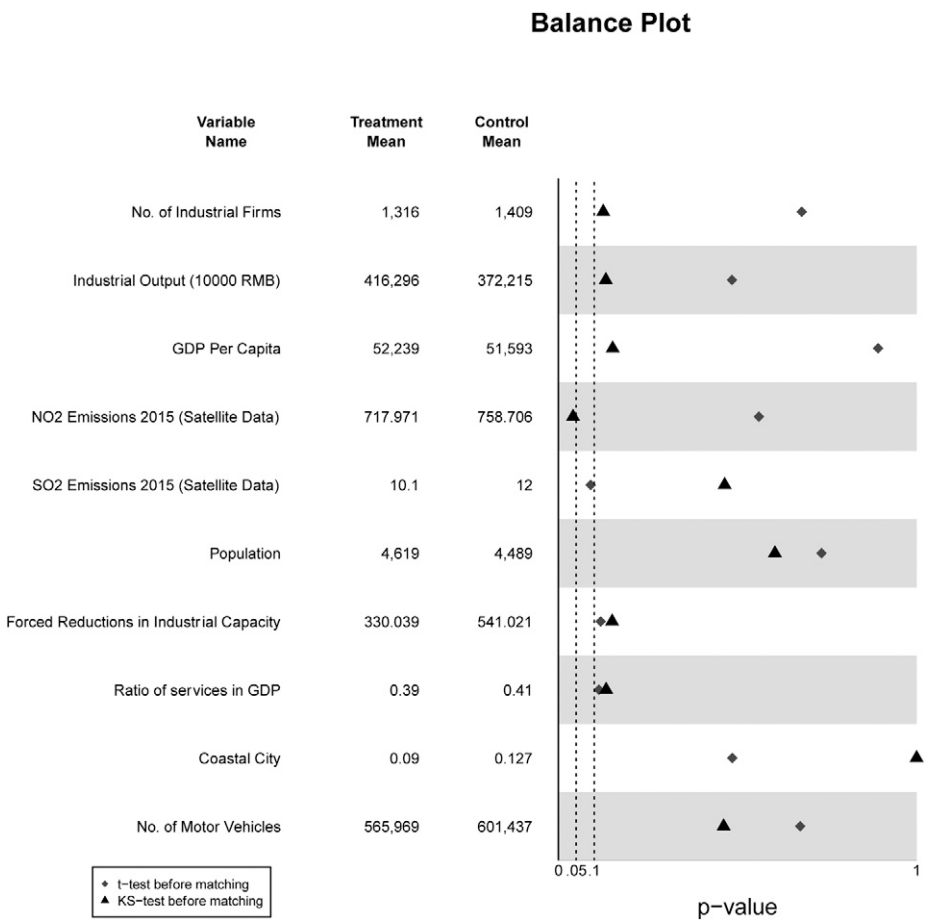
This balance plot shows that on several key dimensions, there are statistically significant differences between the cities selected for inspections in 2016 and 2017. First, cities

**Figure A1:** Balance on pre-treatment covariates before matching (without motor vehicles)



with lower air pollution levels were more likely to be inspected first. Further tests show that this is true on all measures of air pollution that I use (including two types of air pollution ( $\text{NO}_2$  and  $\text{SO}_2$ ) measured with both satellite data and with government-reported data). Second, on the industrial variables, cities with fewer industrial firms (‘no. of industrial firms’) and cities that had been subjected to fewer forced reductions industrial capacity were more likely to be selected first. Third, cities with a lower GDP per capita and lower ratio of services in GDP were likely to be selected first.

**Figure A2:** Balance on pre-treatment covariates before matching (with motor vehicles)



This plot shows the balance across treated and untreated cities when including number of motor vehicles as a control. Missing data on motor vehicles means that around 100 observations have been dropped from this analysis, providing slightly different results. However, results continue to show that when it comes to pollution emissions (both for NO<sub>2</sub> and SO<sub>2</sub>), there are statistically significant differences between treatment and control groups, where less polluted cities were likely to be selected first.

**Figure A3:** Balance on Pre-Treatment Covariates After Matching

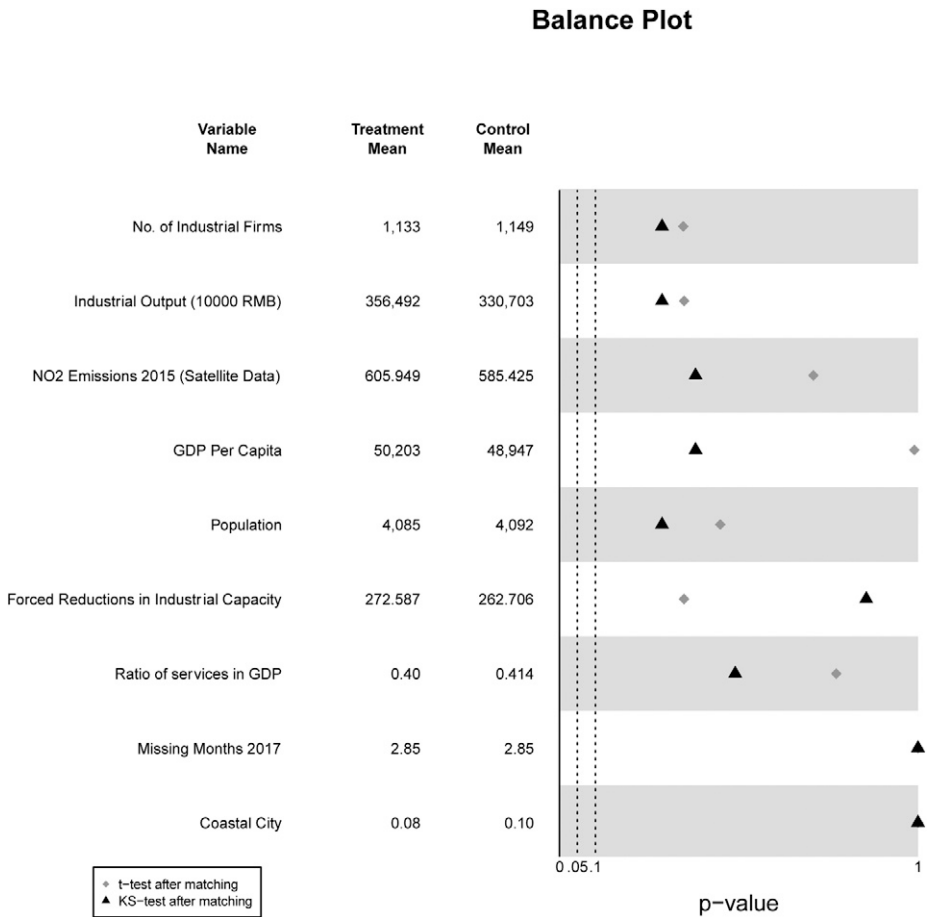


Figure 3 shows the balance on pre-treatment covariates between treated and control groups after matching. Note that compared with the balance plot before matching (see figure 1 and 2), there are *no* statistically significant differences on these key covariates between treatment and control groups. For the results presented in table A1 (below) I also include “No. of Motor Vehicles” when matching. Again, balance plots for this test after matching also shows no statistically significant differences.

**Table A1:** Effect of Inspections on Enforcement Outcomes (with matching)

	Change in NO <sub>2</sub> 2016-2017			NO <sub>2</sub> 2017		
	(1)	(2)	(3)	(4)	(5)	(6)
Mean of Differences	8.375	17.17	22.88	7.599	-29.9	20.42
P value	0.7	0.5	0.2	0.8	0.5	0.5
Sample	Full	Round 1 only	Without treated neighbors	Full	Round 1 only	Without treated neighbors
Pairs	122	69	121	122	69	121

Note: Table A1 shows results of t-tests on paired treatment and control observations. Compared with table 2 in the paper, this table shows results after matching on “no. of motor vehicles”, in addition to the other covariates. Table A1 has fewer observations than table 2 because of missing data for motor vehicles. However, the results (no effect for pollution inspections) are consistent with the findings in table 2.

**Table A2:** Effect of Central Inspections on Municipal Air Quality (Fixed Effects Models)—with decomposed period effects

	Level of NO <sub>2</sub> emissions (Monthly)				
	(1)	(2)	(3)	(4)	(5)
Pre-inspections	-40.100 (27.442)				
Inspections		14.860 (39.642)			
0-3 months post inspections			4.869 (37.857)		
4-6 months post inspections				-1.946 (67.217)	
6 months post inspections					-38.248 (57.543)
Location Fixed Effects	Yes	Yes	Yes	Yes	Yes
Province*Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	3055	3055	3055	3055	3055
Number of cities	283	283	283	283	283
R <sup>2</sup>	0.407	0.408	0.407	0.407	0.408

<sup>a</sup>. Robust standard errors, clustered by provinces, are in parentheses. \* p<0.1; \*\* p<0.05; \*\*\* p<0.01. The Dependent variable is the monthly level of NO2 emissions

<sup>b</sup>.“Pre-inspections” means that all cities are assigned a “1” one month before pollution inspections took place. “Inspections” means that all cities are assigned a “1” for the duration of the inspections. For the remaining variables, cities are assigned a “1” for 0-3 months, 4-6 months, and 6 months post inspections respectively.

<sup>c</sup>. Results are presented for the full sample of 283 cities.

**Table A3:** Effect of Central Inspections on Air Quality (Fixed Effects Models)—Controlling for Corruption Inspections and Motor Vehicle Emissions

	Level of NO <sub>2</sub> emissions (Monthly)					
	(1)	(2)	(3)	(4)	(5)	(6)
Pollution Inspections	8.457 (31.827)		-12.901 (52.137)		0.222 (48.307)	
Post Pollution Inspections		38.994 (47.587)		23.469 (70.091)		40.005 (60.989)
Corruption Inspections	-100.68* (59.531)	-106.30* (61.131)		-101.34 (68.798)		-108.30 (69.812)
No. of Motor Vehicles (1000s)			-0.441 (0.377)	-0.441 (0.378)	-0.440 (0.378)	-0.441 (0.378)
Location Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Province*Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2817	2817	1819	1819	1819	1819
Number of cities	261	261	168	168	168	168
R <sup>2</sup>	0.388	0.388	0.379	0.378	0.385	0.386

<sup>a</sup> Robust standard errors, clustered by provinces, are in parentheses. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ . The dependent variable is the monthly level of NO<sub>2</sub> emissions.

<sup>b</sup> All cities that experienced corruption inspections within 3 months of pollution inspections are assigned a “1” during and three months after the months that corruption inspections took place.

<sup>c</sup> For the models that include “number of motor vehicles”, this table has around 100 fewer observations compared to the models shown in table 3, because there is a lot of missing data on the number of motor vehicles per city for the years 2016-2017. I therefore only include this control in some model.

<sup>d</sup> The sample for all models is: Cities without treated neighbors or pilot province cities.

**Table A4:** Effect of Each Round of Inspection on Air Quality

	<b>Outcome: Level of NO<sub>2</sub> emissions (Monthly)</b>	
	<b>(1)</b>	<b>(2)</b>
Inspections	-7.870 (34.814)	
Post Inspections		9.058 (57.687)
Round 2	-33.779 (32.204)	-31.364 (33.746)
Round 3	306.91*** (39.933)	314.17*** (63.561)
Round 4	-214.57*** (15.663)	-214.48*** (15.721)
Sample	Without pilot province cities	Without pilot province cities
Observations	2938	2938
Number of cities	272	272

<sup>a</sup>Models 1 and 2 are estimated with OLS regression. Coefficients for round 2, 3, and 4 are reported in relation to round 1 (the reference category).

<sup>b</sup>City, province and month dummies are included in all models but not reported.

<sup>c</sup>Robust standard errors, clustered by provinces, are in parentheses. \* p<0.1; \*\* p<0.05; \*\*\* p<0.01. The dependent variable is the monthly level of NO<sub>2</sub> emissions.

## ADDITIONAL DATA NOTES

### Note on the Use of Satellite Data

Satellite estimates of NO<sub>2</sub> levels are sensitive to extreme weather patterns, severe cloud cover, snow coverage, and larger solar zenith angles, which can result in months with missing data. To address this problem, I have dropped all observations with an unequal number of months with missing data between the treatment and control period.

For details, see Boersma, K.F., H.J. Eskes, R. J. Dirksen, R. J. van der A, J. P. Veefkind, P. Stammes, V. Huijnen, Q. L. Kleipool, M. Sneep, J. Claas, J. Leitao, A. Richter, Y. Zhou, and D. Brunner, An improved retrieval of tropospheric NO<sub>2</sub> columns from the Ozone Monitoring Instrument, Atmos. Meas. Tech., 4, 1905-1928, 2011

### Note on the Use of NO<sub>2</sub> Satellite Data over SO<sub>2</sub> satellite data

This study uses Nitrogen Dioxide (NO<sub>2</sub>) as a measure of air pollution for three reasons: First, since 2013, NO<sub>2</sub> has become an important measure of pollution in China's cities, and local officials are required to report their annual NO<sub>2</sub> emissions. Second, satellite measures of NO<sub>2</sub> are more fine-grained than other satellite measures of pollution (such as Pm2.5 or

Sulphur-dioxide), which each pixel representing approximately  $13 \times 13 \text{ km}^2$ . This makes it easier to pin down satellite measurements of  $\text{NO}_2$  to individual cities, rather than broader geographical areas, such as prefectures. Third,  $\text{NO}_2$  satellite data is a lot less noisy than  $\text{SO}_2$  satellite data, particularly when it comes to monthly averages, or to measuring pollution during the winter months. Given that this research design requires monthly averages in non-summer months,  $\text{NO}_2$  is the better choice for measuring pollution levels. Third, while sulfur-dioxide ( $\text{SO}_2$ ) is often the main pollutant used for measuring industrial pollution,  $\text{NO}_2$  is also produced from burning fuels (such as coal or diesel) and also tracks closely with industrial air pollution in China.<sup>1</sup> However, for additional accuracy, I include the variable “number of motor vehicles” when matching cities to control for vehicle exhaust emissions (which is also a source of  $\text{NO}_2$ ).

1. See Rohde, R. A., & Muller, R. A. (2015). Air pollution in China: mapping of concentrations and sources. *PloS one*, 10(8), e0135749; Wang, S., Streets, D. G., Zhang, Q., He, K., Chen, D., Kang, S., ... & Wang, Y. (2010). Satellite detection and model verification of  $\text{NO}_x$  emissions from power plants in Northern China. *Environmental Research Letters*, 5(4), 044007.