The Political Economy of Environmental Governance:
Assessing the Role of Performance Management and Anticorruption Efforts

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For Presentation at APPAM Research Conference, Nov. 5 2016
Washington, D.C.

Key Words: Performance management, Anticorruption, Environmental policy, China

Primary JEL code:
D73   Bureaucracy; Administrative Processes in Public Organizations; Corruption
D78   Positive Analysis of Policy Formulation and Implementation
Abstract

Little is known about the dynamic effects of two prominent public sector reforms – performance management and anticorruption efforts – on the achievement of policy goals in the absence of the rule of law and in the presence of incentives to take advantage of corruption resulting from high rewards for performance. In the context of environmental governance, using panel data for China’s 31 provinces in the 2000s, this study finds that the increase in treatment facility construction adds to emissions, but reduces their growth rate. High-powered incentives and anticorruption efforts do not have direct mitigation effects on pollution. To a small degree, performance regimes indirectly reduce the rate of growth of both mandated and non-mandated emissions, indicating a positive spillover effect of facility construction. Also, anticorruption efforts appear to make facility construction reduce the rate of increase of the visible, mandated pollutant, suggesting positive, but minor, effects on environmental policy management.
Performance management and anticorruption efforts are two prominent reforms of public administration (Bouckaert and Halligan 2008; Moynihan et al. 2011; Neshkova and Rosenbaum 2015; Newcomer 2015; Zhang and Lavena 2015). Yet evidence regarding whether performance regimes improve the public sector’s performance remains mixed, and the investigative lens of performance management is limited to a handful of policy areas (e.g., education, job training, crime/policing, public health, child support) (Gerrish 2016). Meanwhile, whether and how anticorruption activities in the public sector shape policy outcomes is still unclear, especially in the global context where corruption may be a common practice in some countries (Yang 2009). In addition, little research examines the relation between anticorruption efforts and performance management. Ironically, as we discuss later, especially in settings where the rule of law is not well established, pressure for performance can induce demands to take advantage of corruption to accomplish policy goals that are accompanied with high-powered rewards.

This study explores the interactive effects of performance management and anticorruption efforts on the relationship between outputs (i.e., measureable activities controlled or directed by governments) and outcomes (i.e., the goals that the activities are intended to accomplish) in the context of environmental policy management in China. Examining these questions in this specific setting is both theoretically and practically significant. Increasingly, China’s central government has recognized a wide array of adverse effects of air, water, and other forms of pollution on China’s own public health, economic productivity, social stability, and ultimately, regime survival (Chen, Hong, and Kan 2004; Economy 2004; Huang 2013; Shapiro 2016; World Bank 2007; Wang and Mauzerall 2006).

China has turned to tools of performance management to respond to this growing problem. Beginning with the environmental governance reform initiated by the Eleventh Five-
Year Plan for National Economic and Social Development (2006-2010) (“the Plan”), provincial high-ranking officials are held personally accountable for meeting targets that reduce pollutant emissions. Specifically, meeting these targets would play a decisive role in officials’ performance appraisal and their accompanying career and pecuniary benefits (State Council of China 2007). The mandated targets are a 10% reduction in emissions of each of two major pollution components: sulfur dioxide (SO₂, for air pollution) and chemical oxygen demand (COD, for water pollution) in 2010, compared to the 2005 base. According to the official reporting, at the end of the Plan, the emissions of SO₂ and COD were reduced by 14.29% and 12.45%, respectively (State Council of China 2011).

Empirical evidence shows that the responses of administrative agents to the policy signals of political principals are strategic and selective (Liang and Langbein 2015). Specifically, the high-powered results-based reform was effective only for outputs and outcomes related to the targeted, mandated, and highly visible pollutant (SO₂), and not for outputs and outcomes associated with the targeted, mandated, but less visible pollutant (COD), nor for outcomes of a targeted but non-mandated pollutant (soot). However, Liang and Langbein’s research failed to examine whether administrative outputs (i.e., treatment facility construction) directly brought about the desired policy outcomes (i.e., reduction in pollution emissions), especially after the introduction of high-powered incentive schemes. While performance incentives appeared to induce both facility construction and reduction in SO₂ pollution growth, whether the reduced growth resulted from facility construction or something else (e.g., reduced economic growth) remains unknown.

High-powered rewards may motivate high-ranking officials of subnational governments to demonstrate commitment to the central policy agenda by rapidly constructing facilities
intended to reduce pollution. However, construction of pollution treatment facilities may not be effective in this respect. Under a high-powered performance regime, administrative outputs are subject to the manipulation of public officials who are under pressure to produce both the desired activities and outcomes (Bevan and Hood 2006; Bohte and Meier 2000). However, in our case, the outputs are more controllable than the outcomes, but only the outcomes are rewarded by performance management. In the presence of uncertainty about the effectiveness of outputs for producing rewarded outcomes, it is possible that public officials are not keen to deliver outputs if they are not conducive to policy outcomes. Alternatively, they may still seek to produce outputs, especially if these outputs are likely, if not certain, not only to bring about desired outcomes but also to produce positive side benefits to themselves.

Moreover, rarely noted in extant literature is an unintended, secondary consequence of high-powered incentives. In the absence of the rule of law and practices that generate transparent, competitive bidding and awards for infrastructure construction, and in the presence of the need to generate timely and effective results, two unintended actions seem possible. Either bidders on construction can give local officials a bribe for advancing an offer to build pollution treatment facilities, or officials could bribe bid-winning firms to work faster on facility construction. The construction of pollution treatment infrastructure may not only help ameliorate environmental degradation, but also boosts the local economy. As such, reliance on high-powered, results-oriented management may lead to the synergy of two of the central government’s priority goals: economic growth and pollution reduction. In this circumstance, corruption may be tolerated and the government’s anticorruption efforts may be strategically ignored (Birney 2014; Rothstein 2015). In fact, in China, going after corrupt public officials is a political decision (Cai 2014; Chan and Gao 2009; Wedeman 2012). As such, the decision about
how to build pollution treatment facilities (e.g., more or fewer, sooner or later, superior or inferior quality) hinges on the comparison of benefits that public officials might receive from the high-stakes accountability system compared to costs that might ensue if corruption is punished.

This research uses panel data for China’s 31 province-level jurisdictions from 2001 through 2010 to examine the following questions: (1) does the construction of pollution reduction facilities correspond directly to reduction in pollution emissions? (2) do anticorruption efforts after the introduction of high-powered incentive system “grease the wheels” by making facility construction more effective in reducing pollution or just result in wasteful rents either by reducing facility construction or making it ineffective? Overall, our results suggest that the construction of pollution treatment facilities is associated with higher levels of emissions, but at a lower rate of growth. Neither the high-powered incentive system nor the anticorruption efforts have direct mitigation effects on pollution. Nevertheless, to a small degree, these two governmental reforms help reduce the rate of growth of emissions by reducing slightly the positive relationship between treatment facility construction and pollutant emissions. Notably, these social benefits are observed only in the visible, targeted, and mandated pollutant.

The next section of this article briefly reviews the literature on public officials’ motivations from the perspectives of performance regimes and anticorruption. Using these theories, we infer testable hypotheses to examine the research questions. The third section describes data, variables, measures, and models. After presenting the results in the fourth section, the fifth section discusses the findings and limitations, and the final section concludes.

**Theoretical Frameworks and Hypotheses**

Regardless of the form of political system (i.e., democratic or authoritarian), political principals formulate policies and then delegate implementation authority to bureaucratic agents,
who act locally. Also, in all systems, principals seek to stay in power. Providing desirable public services and goods to their constituencies at a low (visible) price is one way to do this. Providing public services locally can also enhance the ability of the current local coalition to maintain its power in government. Nonetheless, the actual production of services is largely driven by administrative agents who, by carrying out the preferences of their principals, may gain material rewards, career prospects, job security, and other extrinsic or intrinsic benefits (Rainey 2014). In many instances, it is not clear who the principal really is, in that national and local principals can both affect the ability of agents to carry out a local service or activity. There may be, to varying extent, disagreements among national and local principals, and between principals and agents, regarding goals, implementation methods, and timing (Waterman and Meier 1998). Goal conflicts and resource differences lead to agents’ moral hazard (e.g., shirking). For example, local officials may not have the resources to act with the alacrity that national officials would like. Alternatively, local residents may oppose the national goal, making it likely that the cooperative agent will be unable or unwilling to pursue national goals locally without additional resources to buy local support for swift action. However, in a single-party regime, like China, provincial and most local party-state officials, as bureaucratic agents, are policy implementers and primarily respond to the top-down accountability mechanisms devised by the central government, where the Chinese Communist Party (CCP) is the dominant political principal. High-powered performance management should work well in such an institutional context.

**Bureaucratic Incentives and Performance Management**

One of the most important institutional configurations in public management that shapes public officials’ motivations and alters their behavior relates to how the performance of public organizations is measured and how public officials are held accountable. Theoretically, an
external results-based accountability system devises high-powered incentives that align principals’ goals of achieving policy outcomes with agents’ goals of obtaining extrinsic rewards (Heinrich and Marschke 2010; Jakobsen et al. 2016). In this context, bureaucratic agents are rewarded with additional, extrinsic benefits for their production of a given level of policy outcomes that are desired by political principals, so that pay is related to performance (Binderkrantz and Christensen 2012; Heinrich 2007; Perry et al. 2009). Evidence is mixed regarding the effectiveness of such a performance-based measurement and evaluation system (Boyne and Chen 2006; Gerrish 2016; Heinrich 2002; Hvidman and Andersen 2014; Lazear 2000; Poister, Pasha, and Edwards 2013; Rodgers and Hunter 1992; Sanger 2013; Smith 2009).

Performance management is not new in China’s public administration (Gao 2009). Nevertheless, China’s long-standing results-oriented management has often been overlooked in the discussion of performance regimes (Carter and Mol 2006; Lo and Tang 2006; Rothstein 2015). Achieving political legitimacy by following the “rule of mandates” and “producing highly valued outcomes,” the cadre organization of the CCP is arguably one of the explanations for the country’s paradox of high development growth and the seemingly low quality of government (Birney 2014; Rothstein 2015, 545). Even with China’s economic decentralization, the party-state maintains effective political centralization by hierarchically controlling the appointment, promotion, and pay of high-ranking officials at both central and subnational levels (the nomenklatura) (Burns 1988; Chan 2004; Edin 2003a, 2003b; Landry 2008; Manion 1985). Over the past decades, to continue the country’s economic development, China’s central government relies on the efforts of subnational officials who are held accountable by a performance-based personnel system that rewards targeted activities with career and pecuniary benefits (Chen, Li, and Zhou 2005; Li and Zhou 2005; Whiting 2004).
With respect to improving environmental quality, which can sustain economic growth in the long term, the CCP has also chosen to rely on a high-powered performance regime. Although some elements of the bureaucratic evaluation system had been extended to the environmental domain over the years (Lo and Tang 2006; Ortolano 2010), the *nomenklatura* personnel management system, in conjunction with high-powered incentive schemes, was not formally incorporated into environmental policy management until the mid-2000s (Kostka 2016; Liang 2014; Liang and Langbein 2015; Wang 2013). Specifically, the Eleventh Five-Year Plan mandated personal accountability of provincial leading bureaucrats for the achievement of preset targets for two key components of air and water pollutants (i.e., SO$_2$ and COD). Moreover, the Plan made these specific environmental outcomes a “veto point” (yipiao foujue) in responsible officials’ overall performance evaluation in a given year by attaching bureaucrats’ wage incentives to the mitigation of targeted pollutants. The CCP offers rewards for pollution reduction, which is costly, but it does not completely or even partially pay for constructing facilities to do that. At the local level, where the policy is implemented, given limited resources, high-powered incentives will not always work, even in a seemingly hierarchical structure. Liang and Langbein (2015) find that compared to the non-mandated pollutant (soot) and mandated but less visible pollutant (COD), only the mandated pollutant with high visibility (SO$_2$) gained more implementation attention and responded to the performance incentives. The performance mandate also appeared to induce construction of more facilities for air pollution abatement, but had no impact on the construction of wastewater treatment plants. In addition, independent of the Plan, more pollution treatment facilities are being constructed over time. Given that pollution reduction is what is rewarded, it is likely that facility construction is effective in bringing about that outcome. However, Liang and Langbein (2015) did not test that hypothesis. Such patterns of
strategic policy implementation are consistent with the observations of “what gets measured gets done” and that implementation is selective (Bevan and Hood 2006; Birney 2014; Jakobsen et al. 2016; O’Brien and Li 1999). Two hypotheses follow:

Hypothesis 1: When outcomes are measurable and rewarded, performance management predicts a link between outputs (partly or largely controlled by bureaucrats) and outcomes (less controllable). Thus, the construction of pollution control facilities (administrative outputs) in the previous year leads to the reduction in the total amount (or the rate of growth) of targeted pollutant emissions (policy outcomes) in the subsequent year.

Hypothesis 2: Performance management, when it embeds high-powered incentive schemes, strengthens the mitigation effects of pollution control facility construction on the emissions of targeted pollutants. However, given limited resources, these effects are more likely to be observed for visible, mandated targets than for less visible, mandated targets or targeted but not-mandated emissions.

Rent Seeking and Anticorruption Efforts

Corruption in China has grown significantly along with the massive and rapid structural transformation and commodification of the country’s economy (e.g., continual growth of international and domestic markets, along with increased economic decentralization) (Wedeman 2012). Today, corruption is rampant, if not universal (Manion 2015). Correspondingly, the CCP has intensified its war on corruption (Cai 2014). It is clear that the CCP regards corruption as a serious threat to China’s economic growth as well as to regime survival. Nevertheless, the effectiveness of those efforts is still unclear (Wedeman 2010). In China and other authoritarian regimes, anticorruption efforts remain fundamentally a political decision (Cai 2014; Chan and
Gao 2009; Manion 2015). Corruption will not always be punished, and in some circumstances, it may be ignored, or even be encouraged.

First, visible anticorruption activities in an authoritarian state help increase political legitimacy, but the campaigns must be targeted, because some corruption may be essential for continued governmental performance and normal operations (Fu 2015; Yang 2009; Zhu 2016). As Ngo (2008) observed, there is a logic of sustainability of corruption in China in that rent seeking by corrupt exchanges “has been institutionalized as the constitutive parts of economic governance,” as different levels of government have utilized economic rents as a powerful instrument to achieve government’s policy goals (27). Hollyer and Wantchekon (2015) pointed out that corruption, especially when the state has monopoly control of many resources, can often be a complement, rather than a substitute, for autocrats’ efforts to foster employment and welfare for citizens, economic growth for the nation, and their own stability. Birney (2014) also noted that the rule of mandates in China, which allows for and even enhances the discretion of lower levels of public officials in the policy implementation process, increases the costs of information acquisition for political principals to ascertain the incidence of shirking at the local level and thus complicates the country’s anticorruption program. As a result, political principals’ punishment against corrupt administrative agents is both selective and strategic.

In addition, in societies with high trust among individuals, bribe relations are rather stable (Li and Wu 2007, 2010). In China, “cultural factors such as guanxi (particularistic relations) and a culture that emphasizes gift giving and banqueting create an environment in which the line between acceptable social interactions and corruption is blurred and easily crossed” (Wedeman 2012, 6). As levels of trust that evolve from collective corruption increase, both the briber and the bribed trust each other not to squeal, because both gain from the transaction: the briber gets a
permit, and the bribed collects a rent (Li and Wu 2010; Wedeman 2012, 6). The stable single-party regime may reinforce such trust, since there are no alternative providers, and none are likely to emerge in the future. The implication is that parties involved in bribery may not be responsive to changes in anticorruption efforts (e.g., corruption investigations), or to changes in opportunities for corruption (e.g., increased demands for licenses or permits).

Furthermore, corruption can work as a form of compensation for agents’ efforts that aid principals (Groenendijk 1997; Van Rijckeghem and Weder 2001). Allowing the most loyal officials to keep the rents from corruption helps resolve some moral hazard problems for the CCP in controlling the high-ranking officials governed by the nomenklatura system, particularly because it is difficult to contract *ex ante* on loyalty (Fan and Grossman 2001). Rents retained from corruption are not useful to the CCP if they are universally tolerated. Some corruption must be publicly punished, with greater or lesser severity. However, anticorruption efforts are also costly. Hollyer and Wantchekon (2015) expect that, when there is general support for the autocrat and low levels of polarization, the threat and costs of adverse selection are relatively small. Thus, anticorruption efforts may be relaxed. But the gains from opportunism increase in this case of low polarization and little monitoring. Thus, the relationship between anticorruption efforts and pecuniary rewards is ambiguous. Our hypothesis follows:

Hypothesis 3: Anticorruption efforts in the previous year affect the impact of pollution control facility construction on the emissions of targeted pollutants in the subsequent year, but the direction of this relationship is unclear.

**Performance Management and Anticorruption Efforts**

Performance management and anticorruption efforts are two governmental reforms jointly shaping public officials’ likely compensation. The relation between the two could either
reinforce or dampen the connections between administrative outputs and policy outcomes. Birney (2014) implied that regimes of central mandates, which designate varying levels of priority to different policies, coupled with the inherent discretion delegated by political principals or necessitated by the need for desirable political outcomes, are likely to undermine the efficacy of anticorruption activities (see also Rothstein 2015). As Birney argued:

Definitions of corruption that are understood to invoke an absolute standard elsewhere [under a rule of law] actually invoke a relative standard under China’s rule of mandates. By a relative standard, I mean that activities that are officially viewed as corruption under certain circumstances are not viewed as corruption under other circumstances, since local officials are given discretion to adjust the implementation of laws to achieve higher political priorities (2014, 57).

We expect to find this “relative standard” at play in China’s pollution control agenda. On one hand, the threat of corruption investigations may do little to deter bribe payments. A bribe payment, especially a small one, may sometimes well be worth the risk, if it speeds the construction of pollution treatment facilities, particularly when there is a high reward for any emissions reduction that they may bring about. One the other hand, the threat of corruption investigations may be so powerful that it can deter a bribe, especially if the bribe is costly. Therefore, it is unclear whether the signal conveyed by anticorruption activities would reinforce or weaken the effectiveness of high-powered performance regimes. Corruption investigations may signal to public officials that awards of construction contracts should be “clean”, but that could either delay the process, or investigations (without adverse consequences) could induce an incentive to wrap side payments with infrastructure that actually works, enhancing the
effectiveness of awards. With no expectation about the sign of the effect, we test a two-sided null hypothesis².

Hypothesis 4: Anticorruption efforts in the previous year affect the impact of performance management on the emissions of targeted pollutants in the subsequent year, but the direction of this relationship is unclear.

**Research Methods**

We test the hypotheses with panel data on China’s 31 province-level jurisdictions (i.e., province, autonomous region, or directly-controlled municipality) from 2001 through 2010. The empirical analysis examines the emissions with both mandated and non-mandated targets. In our case, SO₂ and COD are targeted and mandated pollutants. In contrast, soot, which is a prevalent airborne particulate matter, is targeted but non-mandated. Soot serves as a meaningful comparison because its production process is analogous to that of SO₂. We use information from the *China Statistics Yearbooks* about provinces’ environmental, economic, and demographic characteristics.

**Dependent Variables**

Three indicators are used as the dependent variables. The first two are mandated pollutants: annual emissions of SO₂ and COD. Although both are mandated, SO₂ is more visible than COD. The third indicator is a non-mandated pollutant: annual emissions of soot. The unit of measurement of each of the three indicators is 10,000 (or 10⁴) tons in logarithmic form.

**Independent Variables**

*Environmental Infrastructure Construction*. The Chinese government regards the construction and operation of pollution treatment facilities as critical to address the degradation of environmental quality (Ministry of Environmental Protection of China 2011; Zhou and Ji
Infrastructure construction is necessary for the production of many public goods, including clean air and water. It can also be a beacon for corruption, especially in centralized economies (Kenny 2007, 2009). This study measures infrastructure constructed to abate environmental pollution by the number of hazardous air or wastewater pollutant treatment facilities (in logarithmic form) in each province-year, lagged by one year, relative to the dependent variable.

*High-Powered Incentive Structure.* The Eleventh Five-Year Plan (2006-2010) targeted SO$_2$ and COD and featured high-powered rewards for subnational leading bureaucrats who successfully reduced these mandated emissions. In contrast, the previous plan (2001-2005) targeted these two pollutants, but included no high-powered mandates. Because the Plan was promulgated in March 2006, we regard the last four years of the time period as the effective dates of the performance management system. We code 2007-2010 as 1 and 2001-2006 as 0.

*Anticorruption Activities.* We treat the procuratorates’ investigation of corruption-related crimes as a proxy for the intensity of anticorruption efforts by the Chinese government (Cole, Elliott, and Zhang 2009; Dong and Torgler 2013; Guo 2008; Wedeman 2010, 2012; Yu 2008; Zhu 2016). Investigations, even if there is no prosecution, send a message that the CCP notices potentially corrupt activities. The information comes from the *Procuratorial Yearbooks of China* that document the annual performance reports of the province-level People’s Procuratorates. We measure the yearly number of registered cases for investigation of public officials’ corruption and misfeasance by the procuratorates$^3$ as the indicator of subnational anticorruption efforts. According to the procuratorial yearbooks, corruption includes graft, bribery, and embezzlement, while misfeasance includes abuse of legal authority and infringement of citizen’s rights.
The empirical analysis evaluates anticorruption activities as a continuous variable (in logarithmic form, with a lag of one year). Missing values are coded as zero. There will be more investigations where there is more corruption. We deliberately examine only the registered number of investigations, as the actual outcome of an investigation is often politically negotiated. The existence of an investigation tells public officials that the CCP is watching, but it conveys no information about the content of the intended message. It is expected that this information is as opaque to the officials whose behavior we are studying as it is to us.

**Control Variables**

The control variables are province- and year-specific factors that are related to corruption investigations and are also likely to affect environmental pollution. We include three indicators of leading officials’ characteristics that are related to the prospect of their career mobility: the provincial governor’s age, odds of the provinces’ access to higher levels of bureaucratic hierarchy, and integration of the province with the central government (see Liang 2014; Liang and Langbein 2015) Anticorruption investigations may be particularly effective for provincial officials who seek promotion, and pollution reduction will also be particularly valuable for these same officials. Age is relevant, since 65 is the mandatory retirement age for high-ranking bureaucrats (i.e., provincial and ministerial levels) (Ministry of Civil Affairs 2013). Bureaucrats whose age is close to 65 have little incentive to comply with high-powered mandates, or to avoid corruption investigations (Li and Zhou 2005; Qiao, Zhou, and Liu 2014; Zhang and Gao 2008).

To control for the differences in bureaucrats’ incentives, the analysis measures the gap between 65 and the governor’s age at the first plenary session of the upcoming National Congress of the CCP where personnel decisions concerning top bureaucrats are made.
Numerous studies have shown that integration of the subnational unit with the central government enhances subnational responses to the Center’s policy priorities (Huang 1999; Huang and Sheng 2009; Liang 2014; Sheng 2007). This study includes an indicator of the likely political distance between the province and the CCP with a dichotomous variable indicating whether the provincial Party secretary concurrently serves as a Politburo member in the given year. We also measure cadres’ potential access to higher levels of bureaucratic hierarchy as the historical likelihood of a given province being represented in the Politburo. Administrative chiefs in provinces that have favorable odds of advancing to the Politburo are more likely to pursue an agenda that is consistent with the Center’s policy intent and to escape corruption investigations (Li 2008). To measure the chance of promotion to the Politburo, each province is assigned one point for an incumbent Politburo member who was working or had worked as the Party secretary, governor, or both. We compute the aggregate score for each province for each year for every Politburo since 1992. The index is the sum of the points for each province in the past four Politburos. Thus, the index can change if the yearly probabilities change.

Resources also affect the ability to comply with centrally mandated goals. The Chinese government has strived to pay increased attention to social welfare and equity, as well as the environment. These issues are critical for social stability, which is among the top concerns of the central government (Croll 1999; Liu and Wu 2006; Tang and Ngan 2001; Wong 2004). Consequently, subnational administrative agents may allocate public resources not only to environmental infrastructure, but also to key social insurance and welfare programs that also support national priorities. We expect that governments that allocate more resources to the area of social welfare and security will also intensify resources for ameliorating environmental pollution, since deteriorating environmental quality has accelerated the public’s outrage over
government’s deficient management of environment programs (Albert and Xu 2016; Economy 2004; Gao 2015; Hook 2013). Additionally, as noted earlier, environmental degradation directly bears on public health, ability to work, and productivity. To control for this possibly confounding influence, the analysis includes two variables: the annual share (%) of provincial spending on social security and welfare, and the annual share (%) spent on education and health.

Wealthier provinces and provincial governments with ample financial resources are likely to abate pollution more aggressively. Consequently, the analysis also includes per capita disposable income of urban households (RMB, inflation-adjusted) and provincial tax revenues (10 million RMB, inflation-adjusted). Furthermore, provinces with greater dependence on pollution-intensive industries, measured by the fixed asset investment (10,000 RMB, inflation-adjusted) in these types of industries (i.e., mining; manufacturing; production and distribution of electricity, gas and water; construction), are likely to have higher levels of pollution emissions. Lastly, we control for provincial population (10,000 persons) and population density (persons per square kilometer). Values of per capita disposable income, tax revenues, pollution-related fixed asset investment, population, and population density are in logarithmic form. Table 1 provides descriptive statistics.

[Table 1 here]

Estimating Models

The empirical analysis evaluates two sets of models, estimating the relation between the construction of pollution abatement facilities (outputs) and the emissions of both mandated and non-mandated pollutants (outcomes) as well as whether high-powered incentive system or anticorruption activities affect the relation between outputs and outcomes. The first set of estimates recognizes that, over time, China’s growing population and economy will give rise to
an underlying trend of increases in emissions. Consequently, our baseline model includes a lagged dependent variable to take account of the impact of previous pollutant emissions on the present ones. The lagged dependent variable also helps diminish omitted variable bias (Angrist and Pischke 2009, 243-245; Keele and Kelly 2006). The risk is that the lagged dependent variable tends to mask the effect of the theoretically important variables (Achen 2001). To mitigate this risk, we also estimate a model that replaces the lagged dependent variables with 30 province fixed effects indicators (with one reference province) and includes a year trend variable (coded from 1 to 10 corresponding to the years 2001 through 2010) (Angrist and Pischke 2009, 246). Table 1 lists the specific variables.

The estimating equation with the lagged dependent variable is specified as:

\[
\text{Ln(Emissions)}_{ij} = \beta_0 + \beta_1 \text{Ln(Emissions)}_{(t-1)ij} + \beta_2 \text{Ln(Facility)}_{(t-1)ij} + \beta_3 \text{Plan} + \\
\beta_4 \text{Ln(Anticorruption)}_{(t-1)ij} + \beta_5 \text{Ln(Facility)}_{(t-1)ij} \times \text{Plan} + \beta_6 \text{Ln(Facility)}_{(t-1)ij} \times \text{Ln(Anticorruption)}_{(t-1)ij} + \beta_7 \text{Plan} \times \text{Ln(Anticorruption)}_{(t-1)ij} + \beta_8 \text{Controls}_{ij} + \epsilon_{ij}
\]

The fixed effects estimating equation is specified as:

\[
\text{Ln(Emissions)}_{ij} = \beta_0 + \beta_1 \text{Ln(Facility)}_{(t-1)ij} + \beta_2 \text{Plan} + \beta_3 \text{Ln(Anticorruption)}_{(t-1)ij} + \\
\beta_4 \text{Ln(Facility)}_{(t-1)ij} \times \text{Plan} + \beta_5 \text{Ln(Facility)}_{(t-1)ij} \times \text{Ln(Anticorruption)}_{(t-1)ij} + \beta_6 \text{Plan} \times \\
\text{Ln(Anticorruption)}_{(t-1)ij} + \beta_7 \text{Controls}_{ij} + \beta_8 \text{Fixed}_i + \beta_9 \text{Trend}_t + \epsilon_{ij}
\]

We estimate several variations of these models, all of which have an underlying time-series cross-section (TSCS) panel design. The preferred model with the lagged dependent variable uses cluster-adjusted standard errors. The fixed effects model uses panel-corrected standard errors (PCSE) with a first-order autocorrelation [AR(1)] structure within each panel. Our discussion of results focuses on the theoretically central variables: facility construction,
high-powered performance regimes, and anticorruption investigations. The focal results are qualitatively the same, no matter what estimation method we use.

**Results**

Tables 2 and 3 report the analytical results. Table 2 makes clear the continual effect of generally increasing lagged emissions. SO₂, which is a targeted, mandated, and visible pollutant, is increasing at 1% each year, while COD, which is also targeted and mandated, but less visible, is increasing at nearly the same rate, at 0.9% per year. Soot, which is visible and targeted but non-mandated with high-powered incentives, is growing at about 0.7% per year. Thus, to be effective, policy initiatives need to reduce, if not reverse, these underlying trends.

With respect to evidence regarding a link between pollution control facility construction with the emissions of targeted pollutants, using any of the lagged dependent variable estimates, the results show that for each percent increase in facility construction in the previous year, all pollution emissions actually increase (table 2). Specifically, for each 1% percent increase in facilities (before the Plan), SO₂ and COD emissions increase approximately 0.05% (models 1 and 2). This implies that even as air and water treatment facility construction increase, SO₂ and COD emissions, respectively, also continue to increase, but at a rate slower than the rate of facility construction. The results for the emissions of soot (model 3), which is a targeted but non-mandated pollutant, show a higher rate of increase with respect to air pollution treatment facilities. For each 1% increase in air treatment facilities, soot emissions increase by 0.3%. In all three cases, the magnitude of the elasticity of about 0.2% emissions with respect to a percent increase in facilities appears small. However, the substantive effects are notable. A 0.2% parameter estimate is equivalent to 0.002 times the average emissions, which, for SO₂ are 725,790 tons, translating to approximately 1,452 tons in an average year during the 10-year time
period that this study observes. This represents about one third of a standard deviation in the average year. The results from the fixed effects estimates are larger, but have the same sign and significance (table 3). The larger, but still positive, magnitude of the effect size estimates for the relation between facility construction and emissions in the fixed effects models undoubtedly reflects the omission of the underlying trend of increasing emissions that characterizes the data.

[Table 2 here]

[Table 3 here]

The Plan, which initiated high-powered incentives to reduce emissions, appears to have failed in that respect. From before the Plan, and continuing for each year of its implementation, emissions continue to increase, with one important exception. While the Plan did not augment the growth of the targeted and mandated SO₂ emissions (model 1), it contributes to the growth of emissions that are either not visible (COD) or mandated (soot), by about 23% and 35%, respectively (models 2 and 3).

The Plan appears to alter the relation between facility construction and emissions. After the introduction of the Plan, the rate of increase in SO₂, COD, and soot emissions drops consistently in every model from about 0.02% to 0.04% for every percent increase in facility construction. For instance, if the annual rate of increase before the Plan is 0.05 for each percent increase in facility construction, as it is for SO₂, then it is 0.03 (i.e., 0.02 less than 0.05) after the Plan (model 1). In other words, the establishment of a high-powered reward system appears to have made it clear that the purpose of pollution abatement facility construction is to reduce the rate of emissions increase. Also, the implementation of performance regimes for SO₂, which is targeted and rewarded, may have had a spillover effect, since the results for soot (targeted but not-mandated) are similar. This may imply that the construction of air pollution treatment
facilities functions also to reduce soot emissions, which is another type of air pollution. Table 3 shows that these results do not depend on the method of estimation, as they also reveal larger effect sizes in the fixed effects estimates, again suggesting that this model may insufficiently control for the general trend of increase in emissions in China.

The analysis further examines whether anticorruption efforts reinforce or weaken these apparent gains. Anticorruption cases appear to do little to reverse the increase in SO$_2$ emissions: a 1% increase in anticorruption cases is associated with a 0.02% to 0.04% increase in SO$_2$ emissions, but they have no consistent association with COD or soot emissions, implying that anticorruption efforts do not deter emissions of target pollutants. Instead, the increases in emissions continue along with corruption investigations. However, the impact of treatment facilities on pollutant emissions is not independent of the intensity of anticorruption cases in the same province-year. Specifically, using either the lagged dependent variable or fixed effects estimates, a 1% increase in lagged facility construction along with anticorruption cases is associated with a slight decrease (i.e., 0.003% to 0.004%) in the targeted, mandated, and visible emissions (SO$_2$). By contrast, the estimates for COD and soot are inconsistent in this regard.

In summary, the increase in facility construction appears to add to emissions. The inception of high-powered incentives has indirectly reduced the rate of increase not only for the targeted and mandated air pollutant, but also for the targeted but not-mandated air pollutant, indicating a positive spillover from the construction of facilities for reducing air pollution. An increase in anticorruption cases is associated with an increased growth rate for SO$_2$ emissions, but the results for other emissions are inconsistent. Evidence regarding the interaction between anticorruption cases and facility construction is only consistent with respect to SO$_2$. Specifically, anticorruption cases make facility construction actually, but slightly, reduce the rate of increase...
in this pollutant. Thus, minor social benefits resulting from these two public sector reforms are consistently observed in the visible, targeted, and mandated pollutant (SO₂) only. However, given that the underlying rate of increase is nearly 1% per year for SO₂ and the reduction in its rate of increase is never greater than 0.02%, the effectiveness of these policies is questionable. Moreover, the construction of pollution treatment facilities appears actually to facilitate more pollution, at least with respect to the pollutants at issue.

**Discussion**

The results suggest several connections between performance regimes, anticorruption efforts, administrative outputs, and policy outcomes in China’s environmental governance, but they are not always in the intended direction. The first observation is that there is a clear positive association between output (facility construction) and outcome (the growth rate of emissions). Controlling for the underlying trend and other factors that vary by geographical locations, the construction of pollution control facilities, in the spirit of moral hazard, may enable the production of more emissions of targeted pollutants. In other words, the effects of building pollution treatment facilities appear to accelerate the growth rate of pollutant emissions, which is clearly not the intended outcome. It is also plausible that the building of treatment facilities itself, like other infrastructure construction, is a source of ambient air or water pollution. It is also possible that that the number of administrative outputs is not necessarily equivalent to high quality. A limit of our research is that we use the number of treatment facilities as a proxy for the government’s activities to accomplish the policy goals; this measure reveals little information about capacity or location of the facilities.

Second, we find that adopting performance regimes appears to be ineffective in directly reducing emissions; however, the inception of performance management strengthens the impact
of government’s outputs on policy outcomes. Specifically, through the construction of facilities, the high-powered, results-based accountability system that rewards pollution mitigation reduces pollutant emissions, but only slightly. This finding corresponds with other evidence regarding the limited efficacy of performance regimes (Gerrish 2016). The small effect of performance management may not be an entire surprise, for several reasons particular to China. Growing domestic consumption as a result of demographic changes, increased wealth, rapid urbanization, and constant demands for economic growth and pollution-intensive lifestyles (e.g., increasing motor vehicle ownership) pose daunting obstacles to the central government’s agenda of environmental sustainability (Ortolano 2010). It is reasonable to believe that this trend will persist in the near future.

The third observation is that the party-state’s anticorruption activities have no discernible adverse impact on the policy outcomes of emission reduction. However, analogous to performance regimes, the corruption cases brought by the procuratorates have small, indirect, mitigation effects on the rate of pollution emissions growth, working through the construction of treatment facilities. While anticorruption cases may use resources that might otherwise have gone directly to activities to combat environmental pollution, investigations may provide an incentive to the local officials to make sure that facility construction is effective. Political principals, who choose which corruption cases to pursue, probably also chose to overlook corruption in the pursuit of pollution abatement facilities.

However, we recognize that this study relies on information about the number of cases in each province that the procuratorates choose to investigate, but has no information about the number of prosecutions, the magnitude of bribes in any particular case, or the content of particular corruption cases. Rather, we assume that investigations convey a general signal of the
party-state’s interest in using corruption investigations to stimulate effectiveness in the conduct of policies of high salience and high reward. In other words, “the mandates may effectively demand that a few high priorities are met, even as the resultant relative standards for corruption help veil corruption” (Birney 2014, 64).

Conclusion

Overall, in our study, administrative outputs (facility construction) appear actually to increase the growth rate of undesired outcomes (emissions). Also, there is little evidence that performance pay works to bring about desired outcomes, even in a centralized management system. Threats of punishment for corruption and the use of high-powered rewards are expected to work well in centralized environments such as these, but it is well known that high-powered rewards may be ineffective when the local agents who control actual implementation have limited resources and motives that may not entirely correspond to those of the CCP principals.

We do not conclude that either performance management or anticorruption efforts will always display the mixed results that we find in this case. However, we believe that our evaluation context (i.e., China) is one where both ought to work. China has a centrally controlled personnel management system, which means that local administrators largely respond to the same principal. Also, the policy goal (i.e., reduced emissions) is largely visible, measureable, and supported by both the public and stability-seeking politicians. Yet we find questionable effectiveness of high-powered performance management and anticorruption efforts. As Radin (2006) argued, without carefully considering the complexity of key organizational properties in a particular context, general theories of performance management may well be misleading.

Notes
1. In China, inspection and reporting are separate from enforcement and punishment. Substantively, investigations focus on normal operations of the government and public officials who are responsible for these functions. Procedurally, the process has two elements at each level of government: the Discipline Inspection Commission (DIC) of the CCP and the procuratorial department of the state (the procuratorate). The DIC, which is largely comprised of leading party cadres and administrative officials, monitors and discovers possible malfeasance and corruption. The DIC refers selected, suspected cases of both corruption and misfeasance to the corresponding procuratorates (Cai 2014). It is the responsibility of the procuratorate to report cases and decide on punishment, but it does not act without the CCP’s consent. We focus on reports of corruption filed by the procuratorates.

2. This research also investigates a three-way interaction between the Plan, corruption investigations, and facility construction. The results do not differ substantively from the results we present.

3. The performance reports of People’s Procuratorates do not separate these two types of crimes (corruption, misfeasance) in most circumstances.

4. Wooldridge’s test for autocorrelation rejects the null hypothesis of no autocorrelation. To check the robustness of the estimates, we also estimate a fixed-effects and a random-effects GLS model, both with panel-clustered standard errors (Cameron and Trivedi 2010). While the Hausman test suggests that the two models’ estimates are significantly different, the differences appear in the control variables, while the estimates for the variables central to our hypotheses rarely differ from those reported here.

5. We also estimate a model with anticorruption activities measured as an indicator variable (i.e., presence or absence of cases for investigation, with a one year lag). Results are
consistent with those presented, based on models measuring the number of corruption cases under investigation.

References


Washington, DC: The Author.


Table 1. Descriptive Statistics of Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Emission</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SO₂ (10,000 tons)</td>
<td>72.579</td>
<td>46.867</td>
<td>0.075</td>
<td>200.3</td>
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<td>SO₂ (log)</td>
<td>3.841</td>
<td>1.385</td>
<td>-2.592</td>
<td>5.300</td>
</tr>
<tr>
<td>COD (10,000 tons)</td>
<td>43.251</td>
<td>28.044</td>
<td>0.790</td>
<td>111.934</td>
</tr>
<tr>
<td>COD (log)</td>
<td>3.458</td>
<td>0.942</td>
<td>-0.235</td>
<td>4.718</td>
</tr>
<tr>
<td>Soot (10,000 tons)</td>
<td>32.117</td>
<td>23.794</td>
<td>0.011</td>
<td>112.2</td>
</tr>
<tr>
<td>Soot (log)</td>
<td>2.999</td>
<td>1.347</td>
<td>-4.547</td>
<td>4.720</td>
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<tr>
<td><strong>Pollutant treatment facility</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hazardous air (lag)</td>
<td>4877.361</td>
<td>3319.881</td>
<td>19</td>
<td>14526</td>
</tr>
<tr>
<td>Hazardous air (lag, log)</td>
<td>8.108</td>
<td>1.189</td>
<td>2.944</td>
<td>9.584</td>
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<td>Wastewater (lag)</td>
<td>2254.877</td>
<td>1950.386</td>
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<td>9968</td>
</tr>
<tr>
<td>Wastewater (lag, log)</td>
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<td>2.197</td>
<td>9.207</td>
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<tr>
<td><strong>Eleventh Five-Year Plan</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticorruption cases (continuous, lag)</td>
<td>1053.384</td>
<td>872.725</td>
<td>0</td>
<td>4068</td>
</tr>
<tr>
<td>Anticorruption cases (continuous, lag, log)</td>
<td>4.804</td>
<td>5.323</td>
<td>-9.2103</td>
<td>8.31091</td>
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<td>Anticorruption cases (dichotomous, lag)</td>
<td>0.877</td>
<td>0.328</td>
<td>0</td>
<td>1</td>
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<tr>
<td>Relative age</td>
<td>5.126</td>
<td>4.212</td>
<td>-2</td>
<td>20</td>
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<tr>
<td>Chance of Access to the Politburo</td>
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<td>2.778</td>
<td>0</td>
<td>15</td>
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<td>Politburo incumbent</td>
<td>0.181</td>
<td>0.385</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Share of social security and welfare spending (%)</strong></td>
<td>13.814</td>
<td>4.654</td>
<td>3.559</td>
<td>25.724</td>
</tr>
<tr>
<td><strong>Disposable income per capita (RMB)</strong></td>
<td>10999.930</td>
<td>4583.029</td>
<td>5175.88</td>
<td>30879.1</td>
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<td><strong>Disposable income per capita (log)</strong></td>
<td>9.230</td>
<td>0.382</td>
<td>8.552</td>
<td>10.338</td>
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<tr>
<td><strong>Tax revenues (10 million RMB)</strong></td>
<td>566.736</td>
<td>612.137</td>
<td>6.105</td>
<td>3383.87</td>
</tr>
<tr>
<td><strong>Tax revenues (log)</strong></td>
<td>5.789</td>
<td>1.178</td>
<td>1.809</td>
<td>8.127</td>
</tr>
<tr>
<td><strong>Pollution-intensive industry fixed assets (10,000 RMB)</strong></td>
<td>1493.505</td>
<td>1896.53</td>
<td>16.429</td>
<td>11058.7</td>
</tr>
<tr>
<td><strong>Population (10,000 persons)</strong></td>
<td>4178.5</td>
<td>2652.27</td>
<td>263</td>
<td>10441</td>
</tr>
<tr>
<td><strong>Population (log)</strong></td>
<td>8.050</td>
<td>0.876</td>
<td>5.572</td>
<td>9.253</td>
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<tr>
<td><strong>Population density (person per square kilometer)</strong></td>
<td>390.052</td>
<td>523.273</td>
<td>2.141</td>
<td>3631.67</td>
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<tr>
<td><strong>Population density (log)</strong></td>
<td>5.246</td>
<td>1.472</td>
<td>0.761</td>
<td>8.197</td>
</tr>
<tr>
<td><strong>Year trend</strong></td>
<td>5.5</td>
<td>2.877</td>
<td>1</td>
<td>10</td>
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Number of observations = 310
Table 2. Determinants for the Control of Major Pollutants (2001-2010), Including High-Powered Incentive System and Anticorruption Activities, with Lagged DV

<table>
<thead>
<tr>
<th></th>
<th>SO₂</th>
<th>COD</th>
<th>Soot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
<td>Model 2</td>
<td>Model 3</td>
</tr>
<tr>
<td>Lagged emissions</td>
<td>0.962†</td>
<td>0.011</td>
<td>0.877†</td>
</tr>
<tr>
<td>Eleventh Five-Year Plan</td>
<td>0.058</td>
<td>0.070</td>
<td>0.225*</td>
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<tr>
<td>Hazardous air treatment facilities</td>
<td>0.046***</td>
<td>0.016</td>
<td>--</td>
</tr>
<tr>
<td>Wastewater treatment facilities</td>
<td>---</td>
<td>---</td>
<td>0.054**</td>
</tr>
<tr>
<td>Anticorruption cases</td>
<td>0.024**</td>
<td>0.011</td>
<td>0.002</td>
</tr>
<tr>
<td>Hazardous air treatment facilities × Plan</td>
<td>-0.024***</td>
<td>0.008</td>
<td>---</td>
</tr>
<tr>
<td>Wastewater treatment facilities × Plan</td>
<td>---</td>
<td>---</td>
<td>-0.042**</td>
</tr>
<tr>
<td>Anticorruption cases × Plan</td>
<td>-0.002</td>
<td>0.002</td>
<td>-0.001</td>
</tr>
<tr>
<td>Hazardous air treatment facilities × anticorruption cases</td>
<td>-0.003**</td>
<td>0.001</td>
<td>---</td>
</tr>
<tr>
<td>Wastewater treatment facilities × anticorruption cases</td>
<td>---</td>
<td>---</td>
<td>0.000</td>
</tr>
<tr>
<td>Relative age</td>
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<td>0.001</td>
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<td>0.000</td>
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<td>Share of social security and welfare spending</td>
<td>0.006†</td>
<td>0.002</td>
<td>0.005*</td>
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<tr>
<td>Share of education and health spending</td>
<td>0.006**</td>
<td>0.002</td>
<td>0.006*</td>
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<tr>
<td>Disposable income per capita</td>
<td>0.130***</td>
<td>0.039</td>
<td>-0.015</td>
</tr>
<tr>
<td>Tax revenues</td>
<td>-0.072***</td>
<td>0.022</td>
<td>0.007</td>
</tr>
<tr>
<td>Pollution-intensive industry fixed assets</td>
<td>0.025**</td>
<td>0.009</td>
<td>0.029**</td>
</tr>
<tr>
<td>Population</td>
<td>0.045**</td>
<td>0.017</td>
<td>0.039</td>
</tr>
<tr>
<td>Population density</td>
<td>-0.027†</td>
<td>0.007</td>
<td>-0.016**</td>
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<tr>
<td>Constant</td>
<td>-1.547†</td>
<td>0.441</td>
<td>-0.446</td>
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<tr>
<td>R²</td>
<td>0.9949</td>
<td>0.9835</td>
<td>0.9388</td>
</tr>
<tr>
<td>F value</td>
<td>NA†</td>
<td>11390.7†</td>
<td>3.84E+03†</td>
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</table>

N = 310; robust standard errors in the right column.

* p < 0.10; ** p < 0.05; *** p < 0.01; † p < 0.001
Table 3. Determinants for the Control of Major Pollutants (2001-2010), Including High-Powered Incentive System and Anticorruption Activities, with Province Fixed Effects

<table>
<thead>
<tr>
<th></th>
<th>SO₂</th>
<th>COD</th>
<th>Soot</th>
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<tbody>
<tr>
<td></td>
<td>Model 4</td>
<td>Model 5</td>
<td>Model 6</td>
</tr>
<tr>
<td>Eleventh Five-Year Plan</td>
<td>0.603***</td>
<td>0.208</td>
<td>0.522†</td>
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<tr>
<td>Hazardous air treatment facilities</td>
<td>0.192**</td>
<td>0.082</td>
<td>---</td>
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<tr>
<td>Wastewater treatment facilities</td>
<td>---</td>
<td>---</td>
<td>0.187†</td>
</tr>
<tr>
<td>Anticorruption cases</td>
<td>0.038**</td>
<td>0.016</td>
<td>0.032***</td>
</tr>
<tr>
<td>Hazardous air treatment facilities × Plan</td>
<td>-0.087†</td>
<td>0.023</td>
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</tr>
<tr>
<td>Wastewater treatment facilities × Plan</td>
<td>---</td>
<td>---</td>
<td>-0.077†</td>
</tr>
<tr>
<td>Anticorruption cases × Plan</td>
<td>-0.001</td>
<td>0.003</td>
<td>-0.004**</td>
</tr>
<tr>
<td>Hazardous air treatment facilities × anticorruption cases</td>
<td>-0.004**</td>
<td>0.002</td>
<td>---</td>
</tr>
<tr>
<td>Wastewater treatment facilities × anticorruption cases</td>
<td>---</td>
<td>---</td>
<td>-0.004**</td>
</tr>
<tr>
<td>Relative age</td>
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<td>0.002</td>
<td>0.001</td>
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<td>Chance of access to the Politburo</td>
<td>-0.016</td>
<td>0.011</td>
<td>-0.017**</td>
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<td>Politburo incumbent</td>
<td>0.007</td>
<td>0.025</td>
<td>0.064†</td>
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<tr>
<td>Share of social security and welfare spending</td>
<td>0.006</td>
<td>0.005</td>
<td>0.003</td>
</tr>
<tr>
<td>Share of education and health spending</td>
<td>0.013***</td>
<td>0.005</td>
<td>0.007**</td>
</tr>
<tr>
<td>Disposable income per capita</td>
<td>-0.663***</td>
<td>0.218</td>
<td>-0.436†</td>
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<tr>
<td>Tax revenues</td>
<td>0.107</td>
<td>0.114</td>
<td>0.140*</td>
</tr>
<tr>
<td>Pollution-intensive industry fixed assets</td>
<td>0.093***</td>
<td>0.034</td>
<td>0.008</td>
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<tr>
<td>Population</td>
<td>-0.208</td>
<td>0.151</td>
<td>-0.126</td>
</tr>
<tr>
<td>Population density</td>
<td>0.085*</td>
<td>0.046</td>
<td>0.035</td>
</tr>
<tr>
<td>Year trend</td>
<td>0.061***</td>
<td>0.021</td>
<td>0.030**</td>
</tr>
<tr>
<td>Constant</td>
<td>7.878</td>
<td>2.354</td>
<td>5.678†</td>
</tr>
</tbody>
</table>

R²  | 0.9941   | 0.9917   | 0.9684   |

Wald χ² | 2.83E+06† | 127398.37† | 2.22E+06† |

N = 310; robust standard errors in the right column; fixed effects included but not shown.
Estimated with panel-corrected standard errors with a first-order autocorrelation structure.
* p < 0.10; ** p < 0.05; *** p < 0.01; † p < 0.001