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Do new mayors bring fresh air? Some evidence of regulatory capture in China

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Abstract

This paper provides evidence of regulatory capture in China's environmental regulation by exploring the relationship between subnational leaders' tenure and local firms' environmental protection behaviors. We find that firms discharge more exhaust and make less effort to abate air pollution when mayors' tenure increases. The results are robust to alternative specifications and measures, but show heterogeneity across regions and ownerships. The intensity of regulatory capture depends on institutional factors and firm characteristics. This study enriches the literature by analyzing regulatory capture under a regionally decentralized authoritarian system and provides clear policy implications for preventing regulatory capture.

1 Introduction

Regulatory capture, first proposed by Stigler (1971), is a key concept in institutional and political economics. A corruption of authority occurs when a political entity, policymaker, or regulatory agency is coopted to serve the commercial, ideological, or political interests of a minor constituency, such as a particular geographic area, industry, profession, or ideological group. Although the theory of regulatory capture is clear after the development of the theory by Becker (1983, 1985), Buchanan et al. (1980) and Laffont and Tirole (1991), (Lerner and Tirole 2004), among many others, it is still difficult to observe regulatory capture

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directly in practice. In this paper, we provide evidence of regulatory capture by analyzing the relationship between exhaust emissions and the tenure of subnational leaders in the context of China's environmental regulation.

The regionally decentralized authoritarian (RDA) system is widely believed to cause China's economic development (Xu 2011). Economic growth, however, is accompanied by environmental pollution. In response to environmental problems, the central government phased in a similar "environmentally decentralization system" in the 1990s; in this system, subnational governments are expected to take responsibility for environmental protection, as they do for economic activities. The environmental decentralization system, however, has not as successful as the economic decentralization system. In fact, environmental problems have even been increasingly severe.

The divergence between economic performance and environmental performance under the similar institutions has attracted broad attention but needs more academic studies in a united framework. Existing research usually focuses on only one of the two sides. For example, some of them analyze the economic performance of decentralization (Qian and Weingast 1997; Maskin et al. 2000; Li and Zhou 2005). Others explain the causes of environmental pollution under the environmentally decentralization system (Dean et al. 2009; Bombardini and Li 2016).

In this paper, we explain the causes of environmental pollution by using the theory of regulatory capture. Economic and environmental decentralization are essentially principal-agent relations between the central government and subnational governments. The central government authorizes subnational governments to govern economic activities and environmental protection. Since subnational governments face multiple tasks that cannot be encompassed under a single objective, they focus on more "valuable" tasks (economic growth) for career prospects. Less valuable tasks (e.g., environmental governance) are ignored. Although subnational governments' objectives diverge from those of the central government, they are in accordance with local firms' interests. For political performance and profit, both subnational governments and local firms, respectively, are willing to boost the local economy at the price of the environment. Consequently, environmental regulation exists in name only, and regulatory capture results.

We match data on 156 key iron and steel firms from the Annual Survey of Industrial Firms (ASIF) and the Environmental Protection Database with city leaders to study regulatory capture in the context of China's environmental governance. We focus on China's iron and steel industry for two reasons. First, the existing literature on regulatory capture focuses mainly on Western countries with democratic institutions; China provides an opportunity to observe regulatory capture in another institutional system, *specifically*, a regionally decentralized authoritarian system. Second, although rapid technical progress brings many kinds of new materials, iron and steel still play the most fundamental role in the modern economy. The iron and steel industry's production capacity determines the modernization of the whole industrial system. Therefore, this industry is closely watched by regulators. In addition, the iron and steel industry is a highly polluting industry, and firms have incentives to collude with local governments to capture environmental regulation, thus providing us with an excellent opportunity to study regulatory capture in China.

We try to answer the following questions: (1) Is there regulatory capture in China's environmental regulation? This is the fundamental question of the whole study, and we believe that the answer is yes because we find that mayors' tenure and firms' environmental behavior are highly correlated. When a mayor holds office one more year, firms discharge 27% more exhaust and make 8.7% less effort to abate air pollution. The results are robust to other specifications and alternative variables. (2) Does regulatory capture show some heterogeneity among regions or ownerships? This question is critical because when regulatory capture differs across groups, wealth redistribution occurs (Becker 1983, 1985). We find that regulatory capture is stronger in poor regions, such as central and western China, and for state-owned firms. Regional and ownership heterogeneity is consistent with the prediction of regulatory capture theory. (3) How does the regulatory capture depend on institutional factors and firm characteristics? We find that regulatory capture is stronger in regions with higher local protectionism and government interference, and weaker in regions with better legal environment. As for firm characteristics, firms with better profitability and operation capacity are less likely to collude with local government, while others with high debts and subsidies from the government are more likely to do this. These findings have clear policy implications for preventing regulatory capture.

This study is closely related to several strands of economic literature and makes two contributions. First, we provide evidence for the existence of regulatory capture in China. Economists have provided fruitful theories that clarify regulatory capture, but there is little empirical evidence of regulatory capture. While we cannot provide direct evidence due to unobservability of the collusion between regulators and the firms, we do find indirect evidence about such regulatory capture by examining the relationship between the major's tenure and environmental measures. This paper also enriches the literature on regulatory capture in another way. The classic theory of regulatory capture, from Stigler (1971) to Becker (1983, 1985), considers mainly the demand side of regulatory capture. Laffont and Tirole (1991), Lerner and Tirole (2004) develop the supply side of regulatory capture by using the principal-agent model to analyze the relationship between Congress and the regulatory agency. The correlation between environmental pollution and subnational leaders' tenure in this paper shows the supply side of regulatory capture in China. That is, mayors also have incentives to collude with firms when they firmly grasp power.

Second, this study is also related to a large empirical literature on the causes of environmental pollution in China. For example, many studies test whether the environmental Kuznets curve hypothesis is well supported in China (Song et al. 2008; Yin et al. 2015) and attribute environmental pollution to rapid economic growth. Similar to economic growth, income distribution is related to pollution because pollution-abatement technology shows increasing returns to scale. Accelerated urbanization is also blamed for deteriorating environmental quality in the long run (Li et al. 2016). A recent strand of literature focuses on the effect of trade on pollution (Antweiler et al. 2001; Frankel and Rose 2005). In the context of China, Dean et al. (2009) first explore the link between openness and water pollution across Chinese provinces, and Bombardini and Li (2016) investigate the causal relationship between exports and pollution by instrumenting export expansion by using the decline in

tariffs faced by Chinese exporters. The most closely related paper to ours is Gao and Liang (2016), who also investigate local officials' role in environmental deterioration. There are two differences between their paper and ours; they focus on water pollution, while we focus on air pollution; moreover, they pay more attention to local officials' personnel turnover, and we track air pollution along with the whole term of the official.

The organization of this paper proceeds as follows. In the next section, we discuss the research hypotheses after introducing related institutional backgrounds. After introducing the data and empirical specification, Sect. 3 presents the benchmark results, robustness checks, and heterogeneity analysis. Section 4 focuses on the mechanism from the perspective of institutional factors and firm characteristics. Section 5 concludes this paper.

2 Institutional backgrounds and research hypothesis

2.1 Institutional backgrounds

As reviewed by Xu (2011), the fundamental institution in postreform China is a regionally decentralized authoritarian (RDA) system. The RDA system comprises two parts. On the one hand, the backbone of China's RDA regime is the Chinese Communist Party (CCP), which controls the personnel matters of subnational governments (Xu 2011). There are four levels of subnational governments in China: provincial, municipal, county, and township. Two core leaders, *i.e.*, the secretary of the local Communist Party Committee and the head of the executive branch, hold the highest offices at each level. In theory, the party secretary and the mayor should be elected by the local Party Congress and the local People's Congress. However, in practice, these core leaders at each subnational level are usually appointed by the Organizational Department of the Communist Party in the government one level higher (Yao and Zhang 2015).

On the other hand, China is highly decentralized economically. The central government takes a relatively hands-off approach with respect to most of the national economy. In contrast, subnational governments run the bulk of the economy; they initiate, negotiate, implement, divert, and resist reforms, policies, rules, and laws (Xu 2011). In fact, Chinese subnational governments are more powerful than their counterparts in federal countries worldwide with respect to many important economic issues, although China is neither a de jure nor a de facto federal state. This is true at least after the tax distribution system was established in 1994, especially after the reform of state-owned enterprises at the beginning of the twenty-first century (Huang et al. 2017).

Given the centralized political control and the decentralized economic governance in this regionally decentralized authoritarian system, the appointments, promotions, and terminations, including retirements and demotions, of subnational officials are determined directly by upper-level governments and ultimately by the central government according to the performance of the jurisdictions of these officials. Li and Zhou (2005) describe moving up the government and party hierarchy

as a tournament. Lower-level officials compete with their counterparts for higher-level offices. The competition repeats until the officials reach the highest level, the Standing Committee of the Politburo in the Party's Central Committee.

We focus on city leaders in this paper. At the city level, two core officials hold the highest offices: the party secretary (the head of the local Communist Party Committee) and the mayor (*i.e.*, the head of the executive branch). By law, the mayor, as the executive officer of the city government, is under the guidance of the city Communist Party Committee. Therefore, the party secretary is the most influential figure in many cities. However, the secretary's power is also checked by the mayor because, in theory, executive orders should be delivered through the mayor. In the end, the party secretary and the mayor usually share power in a city. In general, the party secretary is in charge of personnel matters, while the mayor is in charge of the governments' daily operation, of which economic growth is the top priority (Yao and Zhang 2015).

2.2 Research hypotheses

As discussed above, under the regionally decentralized authoritarian system, subnational leaders have both power and incentives to develop the economy, but they also race to the bottom in providing some local public goods and in environmental protection (Keen and Marchand 1997; Fredriksson and Millimet 2002). For example, using the case of China's coal mine deaths, Jia and Nie (2017) find that under the pressure of promotion, local officials collude with coal mines to affect workplace safety.

In this paper, we aim to explore the impact of local leaders on environmental protection. Specifically, we want to analyze whether there is regulatory capture in environmental governance in China. A crucial characteristic of regulatory capture is the collusion between local leaders and firms, but collusion is impossible to observe. Since it is impossible to directly measure regulatory capture or rent-seeking, current studies usually resort to indirect methods. These studies observe the correlation between subnational leaders' characteristics and local firms' behaviors and test whether the correlation is consistent with regulatory capture. For example, Jia and Nie (2017) use a dummy for whether the regulator is native because, as they argue, for a native regulator, collusion has lower transaction costs. Gao and Liang (2016) use local leaders' tenure, where "tenure" refers to how many years the leaders have been in office. They argue that a longer tenure facilitates collusion.

Following Gao and Liang (2016), rather than Jia and Nie (2017), we also consider tenure to be the most important feature of mayors when studying regulatory capture.[1] As mayors' tenure increases, mayors and local firms become familiar with

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[1] There is another reason why we use tenure rather than native. To increase the transaction costs of collusion and corruption, officials are seldom appointed by upper-level governments as the core leaders of their hometown. So only a small number of leaders are native of the cities they serve.

each other. As dynamic regulation theory predicts, the transaction costs between regulators (mayors) and regulated firms will gradually be eliminated, so the possibility of collusion between them will gradually increase (Martimort 1999). This gives the first verifiable hypothesis as follows:

Hypothesis 1 Exhaust emissions increase and environmental protection decreases as mayor's tenure increases.

To investigate how regulatory capture happens, we consider both institutional factors and firm factors. First, we consider two types of institutional factors. First, government interference and local protectionism. As a result of economic performance-based personnel control, subnational governments are more actively involved in economic activities. On the one hand, these governments interfere with firms' development through industrial policy, land and finance resource allocation, and many other channels. Lowering environmental standards is also a common method. On the other hand, in addition to boosting the local economy, subnational governments have incentives to hinder other regions' economic growth because political promotion is based on relative rather than absolute performance. A widely used trick is tightening the local market, and that is how local protectionism forms (Young 2000). Second, legal environment. Institutional economic theory emphasizes both the formation and the enforcement of the law in understanding regulatory capture (Ogus 1994). First, an inadequate legal system surely results in regulatory capture; second, regulatory capture also appears when law enforcement is lenient (Ainsworth 1993). We thus have the following hypothesis:

Hypothesis 2.1 Regulatory capture is more severe in regions with stronger government interference, higher local protectionism, and weaker law enforcement.

Concerning firm characteristics, according to the theory of path dependence (Goodstein 1995), firms will inevitably encounter large costs when they switch from high-polluting to environmentally friendly technology. The pressure of technology upgrading incentivizes firms to influence regulation policies from local governments, thereby leading to regulatory capture. The incentive is stronger among firms for whom technology upgrading is more difficult. Therefore, firms' characteristics affect the possibility of regulatory capture in theory. Specifically, we expect well-functioning firms to have less incentive to affect environmental policies and poorly functioning ones to have more incentive. Thus, we hypothesize as follows:

Hypothesis 2.2 Regulatory capture is more severe for firms with worse performance.

3 An empirical analysis of the capture of environmental regulation

3.1 Data

Three datasets are used in the empirical analysis. The first is the Annual Survey of Industrial Firms (ASIF), which is widely used in the literature on almost all aspects of the Chinese industrial sector.[2] The ASIF, a collection of annual surveys conducted by the National Bureau of Statistics (NBS) of China, contains information on all state-owned enterprises and private firms with annual sales above 5 million before 2011 and 20 million after 2011 (both in Yuan, China). The quantity of plants covered in the data increased from approximately 165,000 in 1998 to over 450,000 in 2013. Therefore, a large, unbalanced panel is available. ASIF represents approximately 90% of gross output and value added in the industrial sector, thus guaranteeing the external validity of studies based on this database (Brandt et al. 2012). A variety of information provided by ASIF falls roughly into two categories, *i.e.*, basic information (such as firm identity, industry, region, ownership, and skill composition) and operation information (which includes all items on the balance sheet, the cash flow statement, and the income statement).[3]

We use a subsample of iron and steel firms in this paper because the second dataset, the Environmental Protection Database, provides only the information for some iron and steel firms. The database is established and maintained by the Ministry of Ecology and Environment of China (MEM). Specifically, the MEM monitors 156 iron and steel firms' pollutant discharges through its branches in each city. All these firms are nationally or at least locally leading firms, and most of them are state owned. The information includes the discharge amounts of three kinds of industrial wastes (wastewater, exhaust gas, and waste residue) and information on efforts by firms to control these wastes; these efforts include the physical and human capital that the firms invest in and the clean-production technology they adopt. This information is collected into the Environmental Protection Database.

In addition to using these two firm-level datasets, we collect data on local leaders (party secretaries and mayors) from the *China Yearbook of Municipalities* and supplement these data with information from public channels, such as Xinhua.net (*Xinhua Wang*), people.cn (*Renmin Wang*) and the official websites of local governments.[4] We then match the iron and steel firms to local leaders. Each firm-year observation is matched with one secretary and one mayor, as in Yao and Zhang (2015). If there is a turnover within a year, we use the leader being replaced because

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[2] Industrial sector includes mining industry, manufacture, and public utilities (production and supply of electric power, gas and water). In the National Industries Classification System (both GB/T 4754-94 and GB/T 4754-2002), industrial sector consists of two-digit industry ranging from 6 to 46. See Holz (2013) for detail of Chinese industrial classification systems.

[3] See, for example, Brandt et al. (2012), for more information on the Annual Survey of Industrial Firms.

[4] Xinhua.net is the official website of the Xinhua News Agency, the national news agency of China; people.cn is the website of People's Daily, the official media of China. The governments release information on appointment and removal of officials through these two medias and provide curriculum vitae of officials as well.

the policies and influence of the previous leader may continue. Finally, we obtain the sample we use in the empirical analysis, which spans the period 1988 to 2013.[5]

3.2 Empirical specification

As discussed above, we ascribe the environmental problems largely to subnational governments, which are captured by local firms and contravene the public welfare and central government's policy objective. To test the first hypothesis, we estimate the following function:

$$Y_{it} = \alpha + \beta \times Y_{i,t-1} + \gamma \times Tenure_{it} + X_{it}\delta + firm_i + year_t + \varepsilon_{it} \tag{1}$$

where i and t are subscripts that denote firm i and year t, respectively. Therefore, Y_{it} is the dependent variable of interest in firm i and year t, and $Y_{i,t-1}$ is the corresponding one-year lagged variable. In this study, we focus on two variables related to firms' pollution behavior: the emission of exhaust gas (*Emission*) and the effort to abate air pollution (*Effort*).[6] We use firms' investment in pollution abatement equipment and technology to measure firms' efforts to abate air pollution. To eliminate the impact of firm size, the quantity of exhaust emissions and size of investment are standardized by firm output. Including $Y_{i,t-1}$ allows *Emission* and *Effort* to have dynamic paths due to firms' behavioral habits, production technology, product composition, and many others.

Tenure_{it} is the key characteristic of mayors; this characteristic measures how many years the leaders have been in office. γ is the parameter of interest because it measures mayors' impact on pollution-related behaviors. As stated in hypothesis 1, when firms' environmental behaviors change with the increase in mayors' tenure, we obtain evidence of regulatory capture. Although the division of labor between mayors and party secretaries rationalizes our focus on mayors in empirical analysis, the tenure of party secretaries is also used as robustness checks. The problem of endogeneity does not overly concern us because the replacement of mayors is quite exogenous to both the mayors themselves and the regulated firms.

Figure 1 displays the distribution of mayors' tenures in the sample. The density of tenures decrease by definition. Ninety-one percent of mayors hold their office for more than one year; therefore, 9% of mayors leave the office in less than one year. Only a small fraction of mayors finish their first term (5 years in theory), let alone two whole terms. Frequent replacement provides an excellent opportunity to identify the effect of mayors' tenure on firms' environmental behaviors. Figure 2 provides a simple description of the relationship between mayors' tenure and firms' exhaust emissions. The mean emission of exhaust is 0.4 units in the

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[5] Although we have longer time series for the Environmental Protection Database and the data of local leaders, the Annual Survey of Industrial Firms (ASIF) is only available from 1998–2013.

[6] The industrial waste gas, or exhaust for short, is the most important source of air pollution. For example, the particulate waste gas is the direct source of PM_{10}, $PM_{2.5}$, and other kinds of air pollution; and the gaseous waste gas, especially those nitrogenous or sulfureted exhaust, results not only in air pollution, but also land and water pollution as well (Sher 1998).
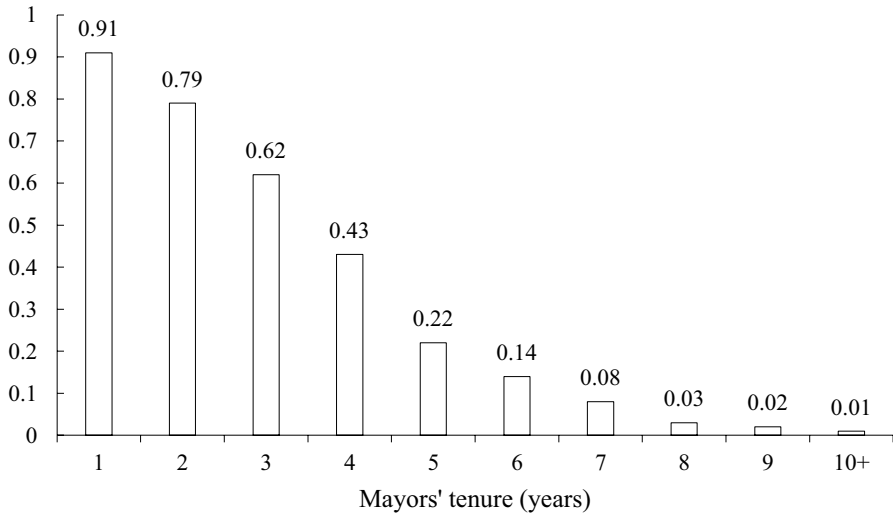
Fig. 1 The distribution of Mayors' tenure. *Note* Fig. 1 displays the mayors' tenure (in year). For example, 91% of mayors hold their office for more than one year; that also means 9% of mayors leave their offices for less than one year
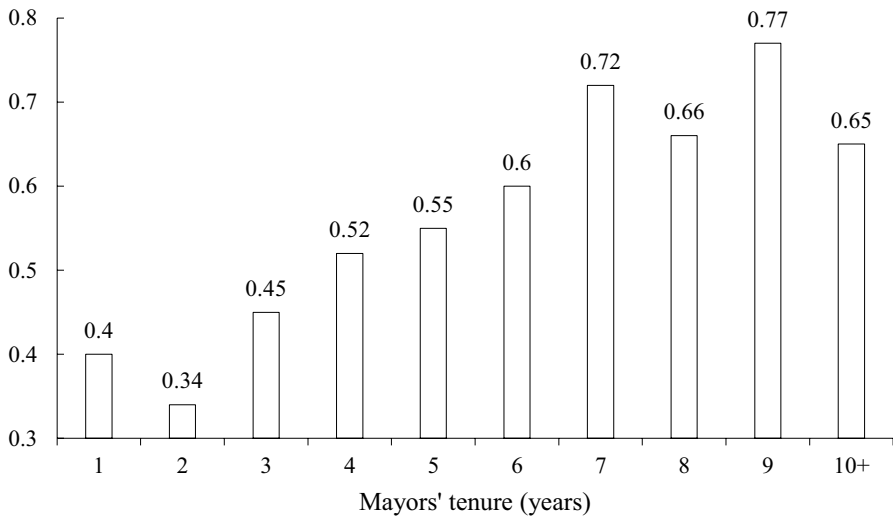
Fig. 2 Mean emission of exhaust by Mayors' tenure. *Note* The mean emission of exhaust is 0.4 unit in the first year of mayors' tenure, and is 0.67 for mayors in their ninth year in their office

first year of the mayors' tenure. The mean emission increases with fluctuations as the mayors' tenure increases. When mayors are in the ninth year of their tenure, the volume of exhaust emissions almost doubles (0.77), thus implying a strongly positive correlation between mayors' tenure and emissions.

X_{it} is a set of firm-level control variables. These variables include firms' capacity for pollution governance; this variable is proxied by the share of environmental scientists and engineers in total employment within the firm (*Skill_share*). We also control for how environment-friendly the production technology is by adding into regression the proportion of pollution sources which have been taken control among all monitored sources (*Technology*). Other control variables include (1) *Firm size*, measured by total assets; (2) *Openness*, measured by the share of exports in sales; and (3) *Greenland* (*i.e.*, the share of land covered by plants within the factory), which is employed to control for the capacity of nature to absorb air pollutants. Last, *firm$_i$* and *year$_t$* are firm fixed effects and year fixed effects, respectively, and the error term ε_{it} includes unobservable determinants of pollution. Table 1 describes the key variables used in this paper.

3.3 Baseline regression

Since Eq. (1) includes the lagged dependent variables as controls, we estimate this linear dynamic fixed effect model by using the system-GMM method proposed by Arellano and Bond (1991). Table 2 reports the baseline results, with *Emission* and *Effort* as dependent variables in the first two columns. The autoregression tests show no second-order autocorrelation, and the Sargan test cannot reject the system-GMM setting either, thereby implying that the specification is appropriate.

The coefficient of mayors' tenure is positive in Column (1) and negative in Column (2), and both coefficients are significant at the 1% level, thus indicating that the longer a mayor holds office, the firms in his jurisdiction will emit more exhaust and make less effort to abate air pollution. Specifically, when a mayor holds office one more year, local firms' exhaust emissions increase by 27% (=0.154/0.565), and their investment in pollution-abatement equipment and technology decreases by 8.7% (=0.048/0.551).

The results provide evidence for the presence of regulatory capture. When a mayor is in power for more years in the same city, the transaction cost between him/her and local firms drops, thus enabling them to conspire (Martimort 1999). Once officials become captured agents, firms increase their exhaust emissions and decrease their investment in clean production technology. The collusion between subnational governments and local firms contravene the public welfare and the central government's policy and is a typical example of regulatory capture in environmental regulation.

3.4 Robustness checks

Regulatory capture emphasizes the trade-off the chief government leaders face between economic growth and environmental conservation. The correlation between tenure and environmental regulatory enforcement supports the existence of regulator capture, but there may be other explanations. One competing argument is that mayors near the end of their tenure may expect a greater opportunity to move, and they require higher economic growth to catch a chance of promotion when the move

Table 1 Descriptive statistics

Variable	Description	Obs	Mean	SD	Min	Max
Emission	Quantity of exhaust emission, standardized by output	972	0.565	0.337	0.012	1.993
Effort	Investment in pollution-abatement equipment and technology, standardized by output (×1000)	738	0.551	0.803	0.000	8.524
Tenure	How many years the mayor has assumed the office	994	2.794	1.769	1	10
Turnover	Whether the mayor takes office this year	994	0.280	0.449	0	1
LocalPromote	Whether the mayor is promoted from local governments	994	0.603	0.492	0	1
Secretary	The tenure of party secretary	994	2.451	1.677	1	8
Skill_share	Share of environmental scientists and engineers in employment	941	0.003	0.003	0.0001	0.024
Technology	Sources of pollution related to current technology	962	10.979	27.610	0.000	100
Firm size	Total asset (in million)	989	2010	3150	10.910	23,500
Openness	ratio of export to total sales	940	0.062	0.100	0.000	0.790
Greenland	Coverage of plants in factory	929	22.783	11.156	0.000	58.2
Log(GDP per capita)	The logarithm of GDP per capita	994	9.240	9.531	8.462	11.003
Eastern	Dummy for a firm in eastern China (yes=1)	994	0.570	0.495	0	1
Dist_1	Distance to the national capital, Beijing (km)	994	1011.685	656.525	0.000	2769
Dist_2	Distance to provincial capital (km)	994	166.903	162.069	0.000	725
SOEs	Dummy for SOEs (yes=1)	994	0.761	0.426	0	1
Protect	Indicator of local protectionism, from Fan et al. (2011)	994	8.379	1.842	0.160	11.080
Interfere	Indicator of government interference, from Fan et al. (2011)	994	4.821	2.473	0.070	12.670
Legal	Indicator of law enforcement, from Fan et al. (2011)	994	4.189	1.772	0.060	10.000
Profit	Firms' profitability, measured by the ratio of total profit to output	994	0.033	0.077	−0.516	0.674
Debt	The pressure of repaying debts, measured by the ratio of short-term debt to output	976	0.461	0.147	0.000	0.679
Manage	Firms' operating capability, measured by the ratio of administrative expenses to output	980	0.052	0.073	0.003	0.107
Subsidy	Firms' subsidy from government, standardized by output	751	0.002	0.006	0.000	0.014

Table 2 Baseline regressions and competing hypothesis

	Emission (1)	Effort (2)	Emission (3)	Effort (4)
Emission$_{-1}$	0.198** (0.076)		0.198*** (0.070)	
Effort$_{-1}$		−0.412*** (0.007)		−0.356*** (0.014)
Tenure	0.154*** (0.041)	−0.048*** (0.004)	0.129*** (0.026)	−0.042*** (0.010)
Skill_share	−0.138 (0.170)	−0.278*** (0.050)	0.069 (0.102)	−0.065 (0.143)
Technology	−0.274*** (0.099)	−0.104*** (0.029)	−0.110* (0.056)	−0.047 (0.042)
Firm size	−0.036 (0.097)	0.063*** (0.012)	−0.589*** (0.096)	0.020 (0.015)
Openness	0.062* (0.033)	0.063*** (0.009)	0.056* (0.030)	0.026 (0.016)
Greenland	0.995*** (0.333)	−0.073** (0.030)	0.344*** (0.080)	−0.093** (0.046)
AR(1)	0.098	0.000	0.004	0.068
AR(2)	0.225	0.600	0.319	0.233
Sargan	1.000	0.469	0.905	0.910
N	686	475	399	328

Firm fixed effects, year fixed effects and city fixed effects are controlled in all columns. Columns (3) and (4) confine the sample to the mayors older than 55 years old when they begin taking the offices. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively

happens. Thus, the environment is more likely to be sacrificed for economic growth near the end of a mayor's tenure.[7] To rule out this competing argument, we confine our sample to mayors older than 55 years old when they begin their tenure. The likelihood of getting promoted decreases with age. In theory, mayors have little probability of being promoted after some age threshold (Yao and Zhang 2015; Xi et al. 2018). Therefore, mayors older than age 55 have weak political incentives to require higher economic growth at the price of the environment. The analysis using this sample gives similar results (the last two columns in Table 2), thus implying that regulatory capture explains the correlation well after ruling out the competing argument.

We conduct several other robustness checks to test whether regulatory capture truly exists. All of these checks pay closer attention to the rationality that we use the tenure of mayors as the key explanatory variable. First, the politically sensitive period around the replacement of local officials will deter the existing government-firm relationship from collusion. The existing collusion is interrupted

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[7] We are indebted to one of the reviewers for this idea.

Table 3 Robustness checks

	Emission				Effort			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Emission_{-1}$	0.072*	0.039	0.211***	0.129***				
	(0.037)	(0.039)	(0.048)	(0.044)				
$Effort_{-1}$					−0.196***	−0.237***	−0.169***	−0.258***
					(0.016)	(0.007)	(0.013)	(0.091)
Turnover	−0.004			−0.021	0.099***			0.066**
	(0.049)			(0.065)	(0.023)			(0.026)
LocalPro-mote		0.456***				−0.003		
		(0.153)				(0.018)		
Secretary			0.094***				−0.171***	
			(0.053)				(0.012)	
N	646	686	686	587	475	475	475	413

The sample sizes are smaller in Columns (4) and (8) due to data missing in the Heckman selection function. Firm fixed effects, year fixed effects and city fixed effects are controlled in all columns. Autocorrelation and Sargan tests are passed in all specifications, and we do not report the statistics to save space. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively

during this period, and new collusion has yet to be developed. The lack of regulatory capture implies less emission of exhaust and more effort to protect the environment. To test this conjecture, we construct a dummy variable, *Turnover*, which equals one if a new mayor assumes power this year and 0 otherwise. As the results in Columns (1) and (5) of Table 3 show, the assumption of new mayors into office lead firms to increase their efforts to regulate pollution, and emissions decrease (though not significantly).

Second, as we argued above, when a mayor has held the office for many years, it is easier for him to collude with local firms because the transaction cost decreases. The transaction cost is also lower for locally promoted mayors than for those transferred from other cities. If the regulatory capture logic argument is right, it is expected that locally promoted mayors become captured agencies more easily. To test this conjecture, we generate a dummy variable, *LocalPromote*, which equals 1 when the mayor is promoted by the local government and 0 otherwise. The results in Columns (2) and (6) of Table 3 show that firms discharge more exhaust in regions with locally promoted mayors, and the effort by these firms to abate pollution also weakly declines. This implies that firms know the mayor from years before and that some relationship has been in operation.

Third, although mayors are widely expected to take responsibility for economic activities, secretaries are actually the most influential figures in most cities. Sometimes the division of power between secretaries and mayors is unclear but depends on the personality of the secretaries. Therefore, we also use the tenure of party secretaries as a key explanatory variable. The coefficients of the secretary in Columns (3) and (7) are similar to those in Table 2, although the value and significance vary across columns. Generally, firms will emit fewer exhaust gases and make more effort to abate air pollution when a secretary has been in office for more years.

Fourth, although the problem of endogeneity does not overly concern us, we still consider its possibility. For example, the omitted variable problem and reverse causality problem may exist.[8] First, the iron and steel producers in our sample are large, and iron and steel production may play a large part in the local economy in some regions. Hence, the replacement of mayors might be determined by the local economic structure, which is also related to the regulated firms. Second, since some regulated firms are important for the local economy, the appointment of mayors would consider the regulated firms' interests.

To overcome the problem of endogeneity, we employ a Heckman treatment effect model. Following Gao and Liang (2016), we consider the turnover of provincial secretaries, among other controls, as the most important factor in mayors' turnover. The selection function predicts mayors' turnover; this prediction is used to estimate Eq. (1). The results, as reported in Columns (4) and (8) of Table 3, are similar to those in Columns (1) and (5), respectively. Firms will again emit less exhaust and increase their efforts to abate pollution when new mayors assume office; this finding is consistent with the regulatory capture hypothesis.[9]

3.5 Heterogeneity analysis

3.5.1 Regional heterogeneity in regulatory capture

Another way to check robustness is to test whether the heterogeneity is consistent with the prediction of our regulatory capture story. We investigate two types of heterogeneity. When interpreting the mechanism behind the environmental Kuznets curve, Chichilnisky (1994) and Copeland and Taylor (1994) propose the "pollution haven" hypothesis. According to this hypothesis, developed countries shift pollution, along with economic development, to developing countries during industrial transfer. Pollution transfer also reveals the difference in governments' objectives in different development stages. Environmental regulation in developed countries has become increasingly strict, while developing countries often have incentives to prioritize economic growth at the price of the environment. The hypothesis also holds for regions within a country if some regions are richer than others.

As we discussed before, under the regionally decentralized authoritarian system, China uses personnel control to induce desirable economic outcomes (Li and Zhou 2005; Xu 2011). That is, the likelihood of promotion of subnational leaders increases as their economic performance increases, while the likelihood of termination decreases as their economic performance increases. Therefore, economic development is closely related to local officials' likelihood of being promoted and affects the trade-off between environmental protection and economic growth. Given the large disparity in economic development across regions in China, local leaders

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[8] We thank one of the reviewers for pointing this possibility out.

[9] Notice that coefficient in Column (4) is not statistically significant, but its counterpart in Column (1) is not significant either. Both Column (5) and Column (8) are significant, implying that the potential endogeneity is not severe enough to change our basic conclusion.

of poorer cities have stronger incentives to prioritize economic growth over environmental protection. However, the poorest cities may give up unreachable economic growth, thus benefiting the environment. Therefore, we may also observe a Kuznets curve of regulatory capture.

To test this hypothesis, we use city-level GDP per capita to measure economic development and estimate the following function:

$$Y_{it} = \alpha + \beta \times Y_{i,t-1} + \gamma \times Tenure_{it} + \theta_1 \times Tenure_{it} \times GDPpc_{it}$$
$$+ \theta_2 \times Tenure_{it} \times GDPpc_{it}^2 + X_{it}\delta + firm_i + year_t + \varepsilon_{it} \quad (2)$$

The parameters θ_1 and θ_2 therefore measure the difference in regulatory capture due to economic development. The results presented in Table 4 show that the interaction terms' coefficients are significantly negative in Column (1) and positive in Column (5), thus implying that regulatory capture is weak in rich cities and strong in poor cities. The pattern, however, is inconsistent with the environmental Kuznets curve. Actually, the sample cities fit only the right half of the environmental Kuznets curve. To verify the difference in regulatory capture between rich regions and poor regions, we also use a dummy for eastern China to substitute for GDP per capita:

$$Y_{it} = \alpha + \beta \times Y_{i,t-1} + \gamma \times Tenure_{it} + \theta_1 \times Tenure_{it} \times East_i + X_{it}\delta + firm_i + year_t + \varepsilon_{it}$$
$$(2')$$

The results are shown in Columns (2) and (6) of Table 4.[10] The interaction terms' coefficients give the difference in regulatory capture between eastern China (a rich region) and middle and western China (poor regions). The results again suggest that the richer regions in eastern China pursue a relatively good living environment, while the other poorer regions cherish the opportunity for economic growth.

In addition to economic conditions, political factors may lead to differences in regulatory capture. When a city is near the political center, it is easier for upper-level governments to supervise the mayor and the firms within their jurisdiction (Huang et al. 2017). This is especially true with respect to exhaust emissions because superior officers, who also breathe the same air, have the incentive to supervise. To test the impact of distance to the political center on regulatory capture, we generate two new variables: the distance to Beijing (the national political center) (*Dist_1*) and the distance to the provincial capital (*Dist_2*). Replace *East_i* with *Dist_1* or *Dist_2* in Eq. (2′), and the estimated results are shown in the other four columns in Table 4. The coefficients are positive in Columns (3) and (4), thus implying that the effect of mayors' tenure on exhaust emissions is stronger in regions far from political centers. In accordance with this, the effect of mayors' tenure on firms' effort to abate air pollution is weaker in regions far from political centers, as shown in Columns (7) and (8). All four columns show that regulatory capture is weaker in regions close to the political center, as the regulatory capture story predicts.

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[10] Among the 156 firms in our sample, 102 firms are in eastern China and the rest are in central and western China.

Table 4 Heterogeneity: by region

	Emission				Effort			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Emission_{-1}$	0.234*** (0.055)	0.200*** (0.042)	0.210*** (0.067)	0.241*** (0.083)				
$Effort_{-1}$					−0.395*** (0.008)	−0.240*** (0.005)	−0.400*** (0.008)	−0.206*** (0.007)
Tenure	0.292*** (0.050)	0.136*** (0.047)	0.146** (0.060)	0.157*** (0.048)	−0.048*** (0.005)	−0.072*** (0.005)	−0.048*** (0.004)	−0.039*** (0.006)
Tenure*GDPpc	−0.121** (0.057)				0.041*** (0.011)			
$Tenure*GDPpc^2$	−0.057** (0.023)				0.008** (0.003)			
Tenure*East		−0.103*** (0.017)				0.049*** (0.006)		
Tenure*Dist_1			0.116*** (0.037)				−0.016*** (0.005)	
Tenure*Dist_2				0.098* (0.055)				−0.010* (0.005)
N	686	686	686	686	475	475	373	475

Firm fixed effects, year fixed effects and city fixed effects are controlled in all columns. We use the log of GDP per capita. Autocorrelation and Sargan tests are passed in all specifications, and we do not report the statistics to save space. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively

Table 5 Heterogeneity: by ownership

	Emission	Effort
	(1)	(2)
$Emission_{-1}$	0.239***	
	(0.035)	
$Effort_{-1}$		−0.435***
		(0.004)
Tenure	−0.196**	0.067***
	(0.096)	(0.013)
Tenure*SOEs	0.475***	−0.258***
	(0.096)	(0.016)
N	686	475

Firm fixed effects, year fixed effects and city fixed effects are controlled in all columns. Autocorrelation and Sargan tests are passed in all specifications, and we do not report the statistics to save space. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively

3.5.2 Ownership heterogeneity in regulatory capture

Regional heterogeneity appears because local governments make trade-offs between economic growth and environmental protection according to development stages and supervision difficulty. From the perspective of firms themselves, the ownership structure may also lead to heterogeneity in regulatory capture. For example, state-owned enterprises (SOEs) have a naturally close relationship with governments, and the collusion between them is easier. More importantly, SOEs undertake some social functions, such as stabilizing employment and building infrastructure (Li and Lin 2008; Huang et al. 2017). In return, local governments usually support SOEs through generous subsidies, through tax cuts, and most relevant to our analysis, by reducing environmental standards.

We classify the firms into two categories by ownership: SOEs and non-SOEs.[11] By interacting mayors' tenure with a dummy for SOEs, we estimate a revised Eq. (2′) and present the results in Table 5. The interaction term's coefficient is positive in Column (1), thus implying that regulatory capture is more serious for SOEs because when a mayor stays in office for more years, the increase in exhaust emissions is larger for SOEs than for non-SOEs. The results in Column (2) confirm this explanation. The negative coefficient of the interaction term means that efforts to abate air pollution decrease more for SOEs than for non-SOEs. According to the regulation theory proposed by Becker (1983, 1985), when regulation standards differ across interest groups, a redistribution of wealth occurs. The ownership heterogeneity observed here, therefore, indicates the transfer of wealth from non-SOEs to SOEs. This channel has not been documented in the literature.

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[11] 102 of the 156 sample firms are SOEs, and the rest are non-SOEs.

Table 6 Mechanism: institutional factors

	Emission			Effort		
	(1)	(2)	(3)	(4)	(5)	(6)
$Emission_{-1}$	0.431***	0.415***	0.374***			
	(0.097)	(0.096)	(0.073)			
$Effort_{-1}$				−0.227***	−0.186***	−0.208***
				(0.006)	(0.008)	(0.007)
Tenure	0.196***	0.219***	0.275***	−0.046***	−0.076***	−0.029***
	(0.045)	(0.047)	(0.051)	(0.004)	(0.009)	(0.008)
Tenure *Protect	0.205**			−0.060***		
	(0.094)			(0.011)		
Tenure *Interfere		0. 240***			−0.078***	
		(0.062)			(0.008)	
Tenure *Legal			−0.205***			0.004
			(0.068)			(0.004)
N	686	686	635	475	475	441

Firm fixed effects, year fixed effects and city fixed effects are controlled in all columns. Autocorrelation and Sargan tests are passed in all specifications, and we do not report the statistics to save space. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively

4 Mechanism analysis and its policy implications

The empirical analysis above shows some evidence of regulatory capture. The sub-national leaders collude with local firms to develop the economy at the expense of the environment, which goes against the public welfare and the central government's policy objective. The following question is how does this happen. In other words, what kinds of institution and firm characteristics are more likely to bring out regulatory capture? In this section, we analyze the mechanism from the perspective of institution and firms' characteristics. The mechanism analysis would provide implications for improving environmental regulation in China's iron and steel industry.

4.1 The institutional factors

Hypothesis 2.1 states that regulatory capture will be more severe in regions with stronger government interference, higher local protectionism, and weaker law enforcement. To empirically test the impact of these institutional factors on regulatory capture, we estimate functions like this

$$Y_{it} = \alpha + \beta \times Y_{i,t-1} + \gamma \times Tenure_{it} + \theta \times Tenure_{it} \times Institution_{it} + X_{it}\delta + firm_i + year_t + \varepsilon_{it} \tag{3}$$

where $Institution_{it}$ is the institutional factors we discussed above. To be specific, we use the indicators of government interference (*Interfere*), local protectionism (*Protect*), and law enforcement (*Legal*) from Fan et al. (2011) to implement the empirical analysis. The results are presented in Table 6, with the exhaust emission as the

dependent variable in the left panel and the effort to abate pollution as the dependent variable in the right panel.

The coefficient of the interaction term between mayors' tenure and Local Protectionism is positive in Column (1) and negative in Column (4), suggesting the regulatory capture is strong for regions with high local protection and weak for regions with an open market. The results in Columns (2) and (5) confirm this finding: the stronger the government interference is, the regulatory capture is more likely to occur. The coefficient of the interaction term between mayors' tenure and Legal environment is negative in Column (3) and positive in Column (6), indicating that the regulatory capture is weak when the enforcement of law is strict, as argued by the institutional economists. The results in Table 6 together show the importance of the institution in preventing regulatory capture. Strengthening law enforcement can help avoid regulatory capture directly. Under the regionally decentralized authoritarian system, however, it is more difficult to overcome the drawbacks of local protectionism and government interference.

4.2 The firm characteristics

As for the relationship between firms' characteristics and regulatory capture, Hypothesis 2.2 states that regulatory capture is more severe for firms with worse performance and higher pressure for updating their production technology. To test this conjecture, we choose three firm-level indicators. (1) It is clear that firms with higher profits have smaller difficulty in technology upgrading and lower incentives to hinder environmental protection policies. We use the ratio of total profit to output to measure firms' profitability (*Profit*). (2) When firms have debts to repay, especially the short-term debts, the pressure of repaying debts makes them short-sighted and neglect the long-term benefit of switching to non-polluting technology. In this situation, they would like to collude with local governments to avoid technology upgrading. We use the ratio of short-term debt to output to measure the pressure of repaying debts (*Debt*). (3) The last one is the firms' operating capability. The logic is straightforward. Firms with a higher operation capacity have no difficulty switching to clean production technology, reducing their incentives to impede environmental-friendly policies. We use the ratio of administrative expenses to output to measure firms' operating capability (*Manage*). Notice that it is a contrary indicator; the larger the ratio is, the lower the operating capability.

To empirically test the impact of these firm characteristics on regulatory capture, we estimate the function as follows:

$$Y_{it} = \alpha + \beta \times Y_{i,t-1} + \gamma \times Tenure_{it} + \theta \times Tenure_{it} \times Feature_{it} + X_{it}\delta + firm_i + year_t + \varepsilon_{it}$$
(4)

where $Feature_{it}$ is the firm characteristics we discussed above. The results are shown in Table 7, with the exhaust emission as the dependent variable in the first four columns and the effort to abate air pollution as the dependent variables in the last four columns.

The coefficient of the interaction term between mayors' tenure and profitability is negative in Column (1) and positive in Column (5). This is consistent with the

Table 7 Mechanism: firm characteristics

	Emission				Effort			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Emission$_{-1}$	0.205***	0.210***	0.208***	0.167***				
	(0.078)	(0.077)	(0.073)	(0.054)				
Effort$_{-1}$					−0.215***	−0.275***	−0.367***	−0.477***
					(0.005)	(0.006)	(0.013)	(0.037)
Tenure	0.134***	0.202***	0.125***	0.211***	−0.057***	−0.085***	−0.114***	−0.072***
	(0.043)	(0.042)	(0.045)	(0.047)	(0.005)	(0.006)	(0.017)	(0.007)
Tenure*Profit	−0.048**				0.051***			
	(0.024)				(0.005)			
Tenure*Debt		0.151*				−0.004		
		(0.077)				(0.005)		
Tenure*Manage			−0.084***				0.189**	
			(0.008)				(0.073)	
Tenure*Subsidy				0.582***				−0.486**
				(0.043)				(0.213)
N	686	686	686	454	475	475	475	368

Firm fixed effects, year fixed effects and city fixed effects are controlled in all columns. Autocorrelation and Sargan tests are passed in all specifications, and we do not report the statistics to save space. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively

analysis that firms with high profitability have little difficulty switching to clean production technology and have low incentives to collude with local officials. The coefficient of the interaction term between mayors' tenure and debt is positive in Column (2) and negative in Column (6). It is understandable that firms with large pressure to repaying debts have strong incentives to collude with local officials to impede environmental regulation. Lastly, the coefficient of the interaction term between mayors' tenure and management is negative in Column (3) and positive in Column (7). Since management capacity is weak when the administrative expense is large, Columns (3) and (7) state that the regulatory capture is more likely to happen for the firms suffering from weak management capacity. All the results in Table 7 lend us the information that regulatory capture is related to firms' characteristics. In order to avoid regulatory capture, it is necessary for firms to enhance operational capacity and improve profitability, and for governments to facilitate firms' external financing.

To supplement the "regulatory capture" story, it is more important to test how the correlation between mayors' tenure and local firms' environmental behavior depends on firms' connection with governments. It would be better to measure managers' political connections, but the data we use have no information on this. Instead, we use firms' subsidies from the government as a proxy for firms' political connections. Firms with a better government-enterprise relationship, ceteris paribus, get more subsidies. The coefficients of the interaction between mayors' tenure and firms' subsidy (standardized by firm output) are positive in Column (4) and negative in Column (8), implying that firms with closer political connection are less likely to protect the environment. This is again consistent with the regulatory capture hypothesis.

5 Concluding remarks

By matching 156 key iron and steel firms from the Annual Survey of Industrial Firms (ASIF) and the Environmental Protection Database with city leaders, this paper studies the relationship between mayors' tenure and local firms' environmental behaviors. This relationship provides clues of regulatory capture in China's environmental governance.

The main findings and policy implications are as follows. First, there is indeed regulatory capture in China's environmental governance. We find that local firms' environmental behavior is highly correlated with core officials' tenure. Specifically, firms' emission of exhaust increases with an increase in mayors' tenure, and the effort by firms to abate air pollution decreases with an increase in mayors' tenure. This is a typical manifestation of regulatory capture. Second, the regulatory capture shows regional and ownership heterogeneity. Regulatory capture is strong in poor regions, such as central and western China, and in regions far from political centers, such as Beijing or provincial capitals. The regional heterogeneity is consistent with the so-called "pollution haven" hypothesis. Concerning ownership heterogeneity, regulatory capture is stronger for SOEs. SOEs are keen to collude with local governments, and this eagerness may derive from the social function of SOEs. Third, we also find regulatory capture depends on institutional factors such as local protectionism, government interference, and legal system, and depends on firms'

characteristics as well. The regions with an open market, less interference, and a better legal system has weak regulatory capture. The firms with higher operation capacity and profitability and less debts are less likely to capture regulators.

The causes of regulatory capture are deeply rooted in China's regional decentralization authoritarian system, in which the central government controls personnel matters while decentralizing economic and environmental activities. Since moving up the government and party hierarchy is an economic performance-based tournament, subnational leaders are willing to develop the economy at the expense of environmental protection. The incentives of subnational leaders contravene the central government's policy objectives but are consistent with benefiting local firms. Then, collusion between subnational governments and local firms takes shape. It is helpful to reduce regulatory capture by improving the legal environment and improving firms' capacity, among many others, but it seems difficulty to completely avoid regulatory capture under the regional decentralization authoritarian system. In recent years, China launched a series of institutional reforms in environmental governance system. The local environmental protection administrations (EPA) are directly supervised by the upper-level EPA, instead of the local governments. Since local leaders such as mayors and secretaries cannot control local EPA any more, the regulatory capture problem is expected to be mitigated.

References

Ainsworth S (1993) Regulating lobbyists and interest group influence. J Polit 55(1):41–56

Antweiler W, Copeland BR, Taylor MS (2001) Is free trade good for the environment? Am Econ Rev 91(4):877–908

Arellano M, Bond S (1991) Some Tests of specification for panel data: Monte Carlo evidence and an application to employment equations. Rev Econ Stud 58(2):277–297

Becker GS (1983) A theory of competition among pressure groups for political influence. Q J Econ 98(3):371–400

Becker GS (1985) Public policies, pressure groups, and dead weight costs. J Public Econ 28(3):329–347

Bombardini M, Li B (2016) Trade, pollution and mortality in China. National Bureau of Economic Research working paper, No. w22804

Brandt L, Van Biesebroeck J, Zhang Y (2012) Creative accounting or creative destruction: firm level productivity growth in Chinese manufacturing. J Dev Econ 97(2):339–351

Buchanan JM, Robert D, Gordon T (1980) Toward a theory of the rent-seeking society. Texas A&M University Press, College Station

Chichilnisky G (1994) North-south trade and the global environment. Am Econ R 84(4):851–874

Copeland BR, Taylor MS (1994) North-south trade and the environment. Q J Econ 109(3):755–787

Dean JM, Lovely ME, Wang H (2009) Are Foreign investors attracted to weak environmental regulations? Evaluating the evidence from China. J Dev Econ 90(1):1–13

Fan G, Wang X, Zhu H (2011) The report on China marketization index-the relative process of regional marketization 2011. Economic Science Press, Beijing

Frankel JA, Rose AK (2005) Is trade good or bad for the environment? Sorting out the causality. Rev Econ Stat 87(1):85–91

Fredriksson PG, Millimet DL (2002) Strategic interaction and the determination of environmental policy across U.S. States. J Urban Econ 51(1):101–122

Gao N, Liang P (2016) Fresh cadres bring fresh air? Personnel turnover, institutions, and China's water pollutions. Rev Dev Econ 20(1):48–61

Goodstein E (1995) The economic roots of environmental decline: Property rights or path dependence? J Econ Issues 29(4):1029–1043

Holz C (2013) Chinese statistics: classification systems and data sources. SSRN Electron J 54(5–6):532–571

Huang Z, Li L, Ma G, Xu C (2017) Hayek, local information, and commanding heights: decentralizing state-owned enterprises in China. Am Econ Rev 107(8):2455–2478

Jia R, Nie H (2017) Decentralization, collusion and coalmine deaths. Rev Econ Stat 99(1):105–118

Keen M, Marchand M (1997) Fiscal competition and the pattern of public spending. J Public Econ 66(1):33–53

Laffont JJ, Tirole J (1991) The politics of government decision-making: a theory of regulatory capture. Q J Econ 106(4):1089–1127

Lerner J, Tirole J (2004) Efficient patent pools. Am Econ Rev 94(3):691–711

Li Z, Lin Y (2008) Policy burden, privatization and soft budget constraint. J Comp Econ 36:90–102

Li H, Zhou L (2005) Political turnover and economic performance: The incentive role of personnel control in China. J Public Econ 89(9):1743–1762

Li T, Wang Y, Zhao D (2016) Environmental kuznets curve in China: new evidence from dynamic panel analysis. Energy Policy 138–147

Martimort D (1999) The life cycle of regulatory agencies: dynamic capture and transaction costs. Rev Econ Stud 66(4):929–947

Maskin E, Qian Y, Xu C (2000) Incentives, scale economies, and organization forms. Rev Econ Stud 67:359–378

Ogus AI (1994) Regulation legal form and economic theory. Clarendon Press, Cambridge

Qian Y, Weingast B (1997) Federalism as a commitment to preserving market incentives. J Econ Perspect 11:83–92

Sher E (1998) Environmental aspects of air pollution. In: Sher E (ed) Handbook of air pollution prevention and control. Academic Press, Boston

Song T, Zheng T, Tong L (2008) An empirical test of the environmental kuznets curve in China: a panel cointegration approach. China Econ Rev 19(3):381–392

Stigler GJ (1971) The theory of economic regulation. Bell J Econ 2(1):3–21

Xi T, Yao Y, Zhang M (2018) Capability and opportunism: evidence from city officials in China. J Comp Econ 46(4):1046–1061

Xu C (2011) The fundamental institutions of China's reforms and development. J Econ Lit 49(4):1076–1151

Yao Y, Zhang M (2015) Subnational leaders and economic growth: evidence from Chinese cities. J Econ Growth 20(4):405–436

Yin J, Zheng M, Chen J (2015) The effects of environmental regulation and technical progress on CO_2 kuznets curve: an evidence from China. Energy Policy 77:97–108

Young A (2000) The razor's edge: distortions and incremental reform in the People's Republic of China. Q J Econ 115(4):1091–1135