Yuhua Wang*

Politically connected polluters under smog

Abstract: I conduct an event study of an exogenous pollution shock-smog in the winter of 2013 to examine how the market values of firms in polluting industries and environmental protecting industries, respectively, responded in "the world's worst polluter": China. I first show that politically connected polluters, defined by having at least one board member who was a former local bureaucrat, are more likely to be state owned and in debt. During the 21 days of the smog, polluters experienced a cumulative abnormal return of –5.38%, while protectors had a cumulative abnormal return of 3.50%. However, politically connected polluters were less susceptible to the shock: they experienced a 1% greater positive abnormal return than unconnected polluters. Connected protectors also benefited from a greater 1% abnormal return than unconnected protectors. The findings imply that environmental disasters have distributional effects, and support a theory that links rent-seeking behavior to pollution.

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1 Introduction

Pollution is one of the most pressing issues that human beings face today. According to the World Health Organization (WHO), air pollution is now the single-largest environmental health risk, contributing to 7 million deaths in 2012.[1] India had 620,000 premature deaths in 2010 caused by outdoor air pollution, which was deemed the sixth most common killer in South Asia.[2] Air pollution is estimated to shorten the lives of people in northern China by an average of 5.5 years compared to their southern counterparts, which will cause 500 million people to

1 *CNN*, 25 March 2014, "WHO: Air Pollution Caused One in Eight Deaths."
2 Lim et al. (2012).

***Corresponding author: Yuhua Wang,** Political Science, University of Pennsylvania, 208 South 37th Street Stiteler Hall, Room 217, Philadelphia, PA 19143, USA, Phone: +215-898-3293, e-mail: yuhuaw@sas.upenn.edu

lose an aggregate 2.5 billion years from their lives.[3] As many as 3.6 million people could end up dying prematurely from air pollution each year, mostly in China and India.[4]

Pollution is a problem of externalities. A classic example is an industrial plant's emission of air pollution as a byproduct of its production of a profitable good. The pollution harms human health, reducing pollution increases the firm's production costs. The social problem is that firms reap the benefits through selling the goods without having to internalize the costs they impose on others, such as health problems. In this typical scenario of market failure, government interventions, such as green taxes or emissions limits, are often used to limit the level of air pollution to one that balances firms' marginal costs and marginal benefits.

Many studies on pollution have therefore focused on estimating the costs and benefits of environmental quality to "get the prices right."[5] As Cropper and Oates (1992) note, "The great bulk of the literature on the economics of environmental regulation simply assumes that polluters comply with existing directives."[6]

This article, deviating from the prior literature's focus on the *formation* of environmental regulations, investigates how the rent-seeking behavior of firms and politicians distorts the "right prices." Specifically, I argue that pollution has distributional effects across groups, and firms' political connections bias policy makers' calculation of costs and benefits such that policy makers only implement the preferences of a subset of constituents at the expense of the majority. As a consequence, politically connected firms do not perfectly internalize the costs they impose on the society or disproportionally reap the benefits of pollution. So although the "prices" might be right on the books, they are distorted in practice by rent-seeking activities, which result in a downward bias of the optimal level of environmental quality.

I test this argument by comparing the costs and benefits of connected and unconnected firms during a pollution shock in what *The Economist* dubbed "the world's worst polluter": China.[7] In January 2013, a thick, fetid layer of hazardous smog settled on most parts of China. At least 600 million people – almost one-tenth of the world's population – were choking on smoky fog for several weeks. The "airpocalypse" in China is comparable to some of the world's worst environmental disasters, such as the Great Smog of London in 1952, America's Cuyahoga

3 Chen et al. (2013).

4 *New York Times*, 1 April 2013, "Air Pollution Linked to 1.2 Million Premature Deaths in China."

5 Muller and Mendelsohn (2009).

6 Cropper and Oates (1992: p. 695). There has been a growing interest among scholars on enforcement issues and measures, for example Cao and Prakash (2010, 2012) and Konisky (2007).

7 *The Economist*, 10 August 2013, "The East is Grey."

River in 1969 ("the river that caught fire"), and the Chernobyl disaster in Ukraine in 1986. The smog was caused by a combination of high emissions and windless conditions: the two *necessary* conditions to create smog.[8] Although the high emissions were endogenous to firm behavior (mainly through coal burning), windless weather was exogenously determined regardless of firms' behavior.

I conduct an event study to examine the smog's impact on the market values of polluting firms and environmental protecting firms, respectively. The smog produced a 21-day cumulative abnormal return of –5.38% for publicly traded firms in polluting industries (polluters hereafter). However, politically connected polluters, defined by having at least one board member who was a former local bureaucrat, were less susceptible to the shock. Connected polluters experienced a 1% greater positive abnormal return than their unconnected counterparts.[9] On January 22, political connections saved polluters $2.37 billion on a single day, suggesting that polluting firms used political connections to alleviate the costs imposed by the pollution shock. I also show that listed firms in environmental protecting industries (protectors hereafter) experienced a positive cumulative abnormal return of 3.50% during the smog, and protectors connected with the local government benefited from a 1% greater abnormal return than their unconnected counterparts. Political connections helped protectors gain $219.42 million on January 22. In sum, the environmental disaster had distributional effects: it harmed the polluters, but less so the connected ones, and benefited protectors (more so the connected ones).

Using a novel method to estimate the costs and benefits of pollution, this article makes three contributions to the environmental politics literature. First, nearly all political science studies have focused on pollution and environmental laws and regulations at the national level; little research has examined firm-level evidence of pollution.[10] Second, most studies are interested in the formation of environmental regulations and do not pay enough attention to compliance issues.[11] Third, there is little empirical evidence of how corruption or rent seeking distorts environmental regulations at the firm level.

My findings cast doubt on a widely held belief that environmental quality will follow a "Kuznets curve" to deteriorate with economic growth and then improve after a turning point.[12] As the findings of this article imply, the "Kuznets

8 Kossmann and Sturman (2004).

9 For example, if unconnected polluters experienced a –4.00% abnormal return on January 22, connected polluters would only experience a –3.00% abnormal return on that day.

10 Prakash (2000) and Potoski and Prakash (2005) are exceptions.

11 Cao and Prakash (2010, 2012) and Konisky (2007) are exceptions.

12 Grossman and Krueger (1995).

turning point" is more a function of *political* environment than the level of economic development.

2 Prior studies on environmental politics

This is not the first effort to use stock market data to study environmental politics. Scholars have examined stock market reactions to media coverage on environmental disasters and the disclosure of environmental violations.[13] Nearly all of these studies have found that an event – an accident or the report of an accident – has a negative impact on firm value. The mechanisms include higher compliance costs, damage to fixed assets, business interruption, and revealing the riskiness of a firm to the market. After an accident, stakeholders and investors update their belief about a firm's profitability. Consequently, insurance companies may increase insurance premiums and require more stringent safety standards; public authorities may reinforce regulations and thereby raise the cost of regulatory compliance for firms; customers and suppliers may distance themselves from certain firms; analysts and investors may view firms' earnings riskier than previously expected; and, firms will have to spend money on advertising to improve their public image.[14] However, little research has explained why the same event could have differential effects on different firms.[15] In most studies, *politics* is ignored.

The political science literature on the environment has examined the impacts of formal political structures and processes, such as federalism and party politics, on the formation and enforcement of environmental regulations.[16] With a few recent exceptions, most studies have been conducted in democratic settings.[17] In addition, following Stigler (1971) and Becker (1983),[18] many studies have been based on a framework in which various interest groups vie with one another through a political process to determine the extent and form of environmental policies.[19] Last, the great bulk of international political economy literature has

13 Hamilton (1995); Capelle-Blancard and Laguna (2010); Karpoff, Lott Jr., and Wehrly (2005); Dasgupta et al. (2006).

14 Capelle-Blancard and Laguna (2010: p. 197).

15 One exception is Capelle-Blancard and Laguna (2010), who found that the number of casualties mediated the impact.

16 Wood (1992); Shipan and Lowry (2001).

17 Exceptions include Lorentzen, Landry, and Yasuda (2014) and Ward, Cao, and Mukherjee (2013).

18 Stigler (1971); Becker (1983).

19 Aidt (1998); Urpelainen (2012); Lorentzen, Landry, and Yasuda (2014).

been devoted to the "racing to the bottom" debate on environmental standards and enforcement.[20]

One gap in the literature is that most academic works on the environment have been focused on the macro level. Except for for Prakash (2000) and Potoski and Prakash (2005), very little political science research has directly investigated the behaviors of polluters, such as firms.[21]

The second gap is that, although enforceable regulations have been the dominant factor in dramatic improvements in countries' environmental quality over the last 35 years,[22] little research has focused on compliance issues.[23] The public enforcement of law literature developed by by Becker (1968) and Stigler (1970) stated that a plant that imperfectly controls emissions gains some economic benefit from a lower pollution abatement effort.[24] The plant weighs the benefits of this lower abatement effort against the potential costs of regulatory punishment if it is caught in noncompliance. Almost all studies use observational data to model the relationship between a compliance indicator and some measure of the perceived probability of an inspection.[25] Most studies found a positive association between enforcement and compliance.

However, as Gray and Shimshack (2011) point out, the most difficult challenge of empirically measuring the "deterrence" effects of environmental enforcement is reverse causality: environmental regulations are endogenous because polluters might lobby or bribe authorities to distort, soften, or ignore regulations, which happens more often among noncompliant firms.[26]

This leads to the third gap in the literature: most studies that examine the effect of corruption on pollution are conducted using nation-states as the unit of analysis. Fredriksson and Svensson (2003), for example, report results that support a negative relationship between corruption and the stringency of environmental regulations by examining a set of country-level measures.[27] In the same vein, Cole (2007) uses data for 94 countries covering the period 1987–2000 to find both direct and indirect impacts of corruption on air pollution emissions.[28]

20 Prakash and Potoski (2006); Konisky (2007); Holzinger, Knill, and Sommerer (2008); Cao and Prakash (2010, 2012).

21 Prakash (2000); Potoski and Prakash (2005).

22 Gray and Shimshack (2011); Kagan, Gunningham, and Thornton (2003).

23 Cao and Prakash (2010, 2012) and Konisky (2007), who use enforcement measures, are exceptions.

24 Becker (1968); Stigler (1970).

25 Gray and Deily (1996); Deily and Gray (2007).

26 Gray and Shimshack (2011: p. 11).

27 Fredriksson and Svensson (2003).

28 Cole (2007).

In sum, we have little knowledge regarding the relationship between rent-seeking behavior, pollution, and environmental compliance at the firm level.

3 Theory

I start with the standard theory of externalities that characterizes pollution as a public "bad" that results from "waste discharges" associated with the production of private goods.[29] Without a social planner, such as the government, firms disregard the external costs they impose on others and engage in socially excessive levels of polluting activities. Therefore, the solution is to confront polluters with a "price" equal to the marginal external cost of their polluting activities to induce them to internalize (at the margin) the full social costs of their pursuits.[30] In the ideal environment, the social planner aggregates the preferences of social groups and maximizes the net benefits by setting marginal benefits equal to marginal costs.

However, as Greenstone and Jack (2013) contend, with political economy constraints, the social planner might not optimize according to the ideal environment. This occurs when the social planner's own payoff or utility weights are biased in favor of her preferred group. In this case, the social planner's own utility may enter the function that determines policy, or there may be unequal welfare weights assigned to specific groups.[31] Therefore, environmental policy-making and enforcement have distributional outcomes that favor a set of groups at the expense of others.[32]

Meanwhile, scholars have been interested in connections between politicians and business, and how such connections distort regulations. Political connection is usually viewed as an inevitable precondition or consequence of corruption. As Faccio (2006) shows, connections are particularly common in countries that are perceived as being highly corrupt. She suggests that corruption and connection are complements, and that when corruption is not helpful enough to obtain significant benefits, firms need to become personally involved in politics to "squeeze

29 For a formal treatment of the theory, please see Cropper and Oates (1992) and Greenstone and Jack (2013).

30 Such a price is usually called a "Pigouvian tax." Please see Coase (1960) for a critique of "Pigouvian tax" from a transaction costs perspective, and Cropper and Oates (1992) for a response to such a critique.

31 Greenstone and Jack (2013: p. 8).

32 This is also in line with Schattschneider's (1960) "group theory of politics" that emphasizes the "upper-class bias" of the political processes.

the state."[33] Wang (2015) argues that Indigenous Chinese firms use political connections to block legal reforms.[34] Ang and Jia (2014) show that Chinese private firms with political connections are more likely to take advantage of legal institutions to advance their interests.[35]

I combine these two theories – externalities and political connections – to examine how political connections create rent-seeking incentives that distort firms' internalization of the costs created by pollution. Based on the theoretical discussion, political connections bias the social planner's social welfare function so that connected firms, either polluters or protectors, disproportionally reap the benefits and avoid the costs. In many cases, this will result in a downward bias of the optimal level of environmental quality.

Under a pollution shock, such as smog, politically connected polluters are expected to incur lower costs and, therefore, smaller losses in market value than their unconnected counterparts. In contrast, political connections help protectors obtain greater benefits from a pollution shock and, therefore, increase their market value.

Hypotheses 1 and 2 summarize these expectations:

Hypothesis 1: Polluters' market values are negatively affected by the smog. However, politically connected polluters are less susceptible to the smog than unconnected polluters.

Hypothesis 2: Protectors' market values are positively affected by the smog, and politically connected protectors benefit more financially from the smog than unconnected protectors.

4 Empirical strategy

Empirically, identifying rent seeking has two challenges. First, I need to be able to classify firms along a dimension that ranks them by their propensity to be exposed to rent-seeking incentives. The current literature has suggested that connections between firms and politicians are a reasonable way to measure rent-seeking incentives.[36] Even with a measure of exposure to rent-seeking incentives, a second challenge is that spurious, unobserved factors may be driving the correlation of interest. For example, suppose I find that politically connected firms are more likely to shirk their responsibility to reduce emissions. Is this necessarily

33 Faccio (2006: p. 380).
34 Wang (2015).
35 Ang and Jia (2014).
36 Fisman (2001).

an indication of rent seeking? Perhaps political connectedness is simultaneously a proxy for firms with more resources and smarter managers.

A promising approach taken by existing work to isolate rent seeking has been to use financial market data to focus on the identity of the rent seeker, and to use indirect methods to reveal the rents accrued.[37] Financial market data are often incredibly detailed and comprehensive enough to allow for such an approach. Specifically, I use board members' working history data to identify rent seekers and exploit "differential treatment" to tease out the independent effect of rent seeking. The same attribute that we suspect may signify rent seeking, such as political connectedness, may also simply reflect firms' different abilities, resources, and/or information. As Khwaja and Mian (2011) suggest, we need to move away from single differences to more elaborate comparisons that involve double differences.[38]

Imagine that there are certain situations in which rent seeking is more (or less) likely to hold. If the identified actor earns more than the average participant (first difference) in situations that are more likely than other situations to allow for rent seeking (additional difference), then it is more likely that we have isolated rent seeking. This strategy's strength relies on arguing (1) that we have indeed correctly identified the rent-seeking situations, and (2) that these situations arise from factors that are exogenous.[39]

Here I investigate how an exogenous pollution shock affected the firm values of connected polluters and protectors compared to their unconnected counterparts. The smog in Winter 2013 that covered northeastern China was caused by a combination of high emissions and windless conditions. Although the high emissions were endogenous to firm behavior, windless weather was exogenously determined regardless of firms' compliance with environmental regulations. Based on the "differential treatment" approach, I expect to find first difference *between* polluters and protectors, and additional difference *within* polluters and protectors.

4.1 Data

In order to test my two hypotheses, I used two types of data: (1) stock market and accounting data for publicly traded companies in polluting industries and

37 For a review of such approaches, please see Khwaja and Mian (2011).

38 Khwaja and Mian (2011: p. 588).

39 For a more detailed discussion of this strategy, please see Khwaja and Mian (2011). For an application of such a strategy, please see Fisman (2001).

environmental protecting industries and (2) data on the political connections of these companies.

Stock market and accounting data for Chinese listed companies were taken from the China Securities Market and Accounting Research (CSMAR)[40] database. Then, I picked four industries using Standard Industrial Classification codes that seemed to be the key contributors to air pollution and the target of China's Ministry of Environmental Protection (MEP)'s inspection: steel, coal, hydroelectric power, and cement. Identifying environmentally friendly firms is tricky. I collected information on firms' business activities and define a firm as a protector if one of its activities is related to the manufacture or sale of environmental-protecting products such as air cleaning, testing, or filtering. This standard gave me 72 polluters located in northeastern China, which was affected by the smog,[41] and 25 protectors nationwide.

For data on political connections, I obtained the biographical information of all the board members (chairperson, president, vice-president, CEO, executive director, non-executive director or secretary) in the sample companies as of December 31, 2012 from Wind Info, a leading integrated provider of financial data based in Shanghai.[42] I checked the reliability and consistency of the Wind data using public information found in a random sample of companies' annual reports to verify its accuracy. I then manually coded the career information of each board member in each firm to determine whether a member was politically connected.[43]

The board of directors, as "the common apex of the decision control systems" of a firm,[44] performs important duties, including selecting the chief executive, ensuring the availability of adequate financial resources, being held accountable to the stakeholders for the organization's performance, and setting the salaries and compensation of company management. The focus on the board is consistent with the identification of political connections in the previous literature.[45]

Because environmental regulations are enforced by local governments in China,[46] I define a firm as being connected if at least one of its board members

40 I accessed CSMAR through Wharton Research Data Services, a web-based business data research service from the Wharton School at the University of Pennsylvania. http://wrds-web.wharton.upenn.edu (Accessed August 9, 2013).

41 The smog area included Beijing, Tianjin, Hebei, Shanxi, Shaanxi, Inner Mongolia, Liaoning, Jilin, Heilongjiang, Shanghai, Jiangsu, Anhui, Shandong, Henan, and Hubei.

42 http://www.wind.com.cn/En/ (Accessed August 2, 2013).

43 Every board member was double-coded by a group of research assistants and me. Figure 5 in Appendix A shows an example of board members' biographies.

44 Fama and Jensen (1983: p. 311).

45 Agrawal and Knoeber (2001); Boubakri, Cosset, and Saffar (2008); Sun, Xu, and Zhou (2011).

46 Economy (2010).

was previously or currently an employee of the local government (from province to township) where the firm was registered. I define government very strictly, excluding any semi-governmental organizations such as research institutes affiliated with a government organization.[47] I found that 42 out of 72 polluters (58%) were connected, and 17 out of 25 protectors (68%) were connected.[48]

Two caveats are in order. My measure of connections is far from comprehensive. First, in some instances, politicians' families may control firms through shareholding, nominee accounts, or shell entities. As a *New York Times* article shows, China's former Premier Wen Jiabao's mother was a large shareholder of Ping An Insurance.[49] However, there is no comprehensive and accurate disclosed financial information of Chinese politicians. Nonetheless, my "board" approach can produce results that resonate well with unobserved connections. For example, using this procedure, Ping An Insurance is coded as a highly connected firm: five board members were connected with local governments. Second, there are many ways to build a connection, such as friendship, marriage, and bribery. I only focus on a direct measure that is observable for all firms.

4.2 Characteristics of connected firms

What are the characteristics of politically connected firms? I compare connected and unconnected firms on the following dimensions: size, profitability, state-owned share, leverage, and tax.[50] SIZE is defined as the natural log of total assets. Its mean is 9.56 for polluters and 7.98 for protectors. PROFIT is the natural log of a firm's total profit; it has a mean of 5.81 for polluters and 4.11 for protectors. STATE OWNED SHARE is the ratio of state-owned shares to total shares $\times$ 100; it has a mean of 9.28 for polluters and 6.15 for protectors. SOE is an indicator measuring whether a firm's state-owned share is >50%; 59% of polluters and 50% of protectors are state-owned enterprises (SOEs). Leverage is a proxy for access to debt financing, which is defined as the ratio of long-term debt to total assets $\times$ 100. Its mean is 7.00 and 3.40 for polluters and protectors, respectively. TAX is calculated as the ratio of tax and fees to total profit $\times$ 100; it has a mean of 16.94 for polluters and 20.93 for protectors.

I conduct *t*-tests of these variables between connected and unconnected firms. Results, summarized in Table 1, show that connected polluters are more

47 For my code book, please see Appendix B.

48 Tables 1 and 2 in the web appendix show all the firms and their connectedness.

49 *New York Times*, 25 October 2012, "Billions in Hidden Riches for Family of Chinese Leader."

50 Accounting data for Chinese listed companies were taken from CSMAR.

Table 1 Characteristics of connected firms.

Variable	Polluters		*t*-statistic
	Connected	Unconnected	
SIZE (LOG)	9.10	9.14	−0.13
PROFIT (LOG)	5.26	5.34	−0.21
STATE OWNED SHARE (%)	16.76	6.16	1.83
SOE STATUS	0.68	0.53	1.63
LEVERAGE (%)	9.87	6.01	2.20
TAX (%)	14.20	16.74	−0.43
Variable	**Protectors**		***t*-statistic**
	Connected	Unconnected	
SIZE (LOG)	8.14	7.49	1.35
PROFIT (LOG)	4.26	4.04	0.42
STATE OWNED SHARE (%)	6.15	0.00	1.29
SOE STATUS	0.59	0.38	0.97
LEVERAGE (%)	3.38	1.77	0.53
TAX (%)	22.06	7.14	1.23

likely to be state owned and more capable of debt financing, and there is no significant difference between connected and unconnected protectors. Connected and unconnected firms do not vary in size, profitability, or tax rates. The relationships are correlational rather than causal.

4.3 Event study

Event studies use financial market data to measure the impact of a specific event on the value of a firm. The rationale of such a study is based on the fact that, "given rationality in the marketplace, the effects of an event will be reflected immediately in security prices."[51] Event studies have been widely applied to a variety of economic events, and have recently gained popularity in the study of political events such as as Roberts (1990)' study of the death of US Senator Henry Jackson,[52] Fisman's (2001) study on the health of Suharto,[53] Johnson and Mitton's (2003) study on the onset of the Asian Financial Crisis in Malaysia,[54] Jayachandran's (2006)

51 MacKinlay (1997).
52 Roberts (1990).
53 Fisman (2001).
54 Johnson and Mitton (2003).

study on US Senator James Jeffords' leaving the Republican Party,[55] Ferguson and Voth's (2008) study on the rise of Hitler in Germany,[56] Bernhard and Leblang's (2006) study on the 2000 US presidential election,[57] and Acemoglu et al.'s (2013) study on Obama's nomination of Tim Geithner for Treasury Secretary.[58]

4.4 The event

The event under study is one of the worst environmental disasters in history: smog in China in the Winter of 2013. The 2013 smog was not the first instance of smog in China – air pollution had long been a problem. However, the 2013 smog was the first *nation-wide* air pollution event, which was significant enough to cause a stock market reaction.[59] In addition, the 2013 smog was so severe that it caught intensive media attention both at home and abroad.[60] The information disseminated by the media triggered government responses and helped investors reassess the value of firms. Smog has been shown to have serious health effect; increases in cardiovascular deaths are often associated with urban pollution episodes.[61]

In winter 2013, because of coal burning and windless conditions, particulate matter – fine dust and soot – with a diameter of 2.5 microns or less ($PM_{2.5}$) accumulated, stayed, and "exploded the index" in mid-January. At its peak, the concentration of $PM_{2.5}$ hit 900 parts per million – 40 times the level the WHO deems safe. Figure 1 shows the level of $PM_{2.5}$ (Beijing-Shanghai average) from October 1, 2012 to March 5, 2013.

4.5 Procedure

I follow the standard event study procedure to estimate the market-adjusted cumulative abnormal return for the 21-day period (event window) around the event dates (days 0 to +20).[62] I set the event date as January 11, 2013 because

55 Jayachandran (2006).
56 Ferguson and Voth (2008).
57 Bernhard and Leblang (2006).
58 Acemoglu et al. (2013).
59 Previous pollution episodes, such as sandstorms in Beijing and water pollution in major rivers, were limited to certain regions.
60 For example, both *People's Daily* and The *New York Times* reported on the smog. *People's Daily*, 13 January 2013, "What's Wrong With Our Air." *New York Times*, 13 January 2013, "Breathing in Beijing: Coping With China's Smog."
61 Seaton et al. (1995).
62 MacKinlay (1997).

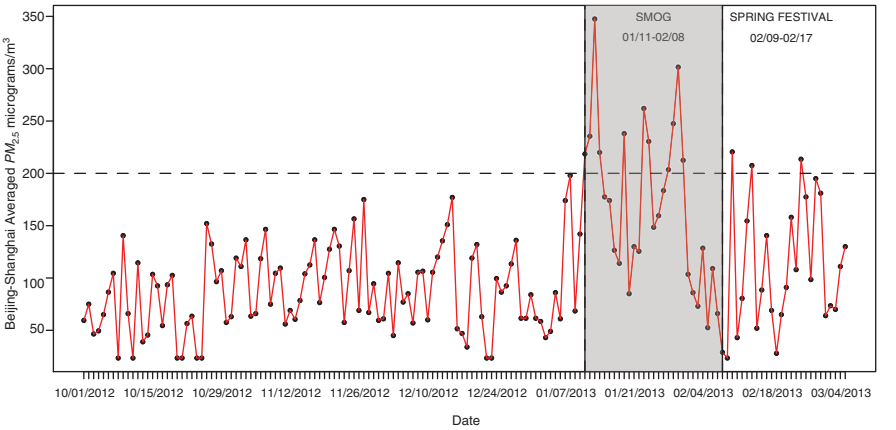

Figure 1 Level of $PM_{2.5}$ during the Winter of 2012–2013.
Data on $PM_{2.5}$ are from the US Embassy in Beijing and the US Consulate in Shanghai. An average between the two cities was taken. Data used to generate this graph are presented in Table 4 in the web appendix.

that was the first day the level of $PM_{2.5}$ went over 200 – the threshold for visible smog – and the last trading day before the smog got wide media attention.[63] The event window ended on February 8, 2013 because the stock market was closed on February 9 for China's Spring Festival until February 18, when the sky had been cleared by wind.

I included all the 72 polluters and 25 protectors that have daily return data in the analysis.[64] Firms' political connections were measured on December 31, 2012. I then estimate the abnormal return and cumulative abnormal return during the event window [0, 20] using the standard event study methodology.

Normal return is the expected return without conditioning on the event taking place. Abnormal return (AR) is defined as the actual *ex post* return of the security during the event window [0, 20] minus the normal return of the firm during the event window [0, 20]. I use the estimation window [–110, –10] to estimate the normal return based on the "market model:"

$$\text{NORMAL RETURN}_{it} = \alpha_i + \beta_i \text{MARKET RETURN}_{mt} + \epsilon_{it}, \quad (1)$$

where $\text{NORMAL RETURN}_{it}$ and $\text{MARKET RETURN}_{mt}$ are the period t (in this case [–110, –10]) returns on security i and the market portfolio, respectively, and ϵ_{it} is

63 *People's Daily*, the Chinese Communist Party's mouthpiece, reported on the smog on January 13, a Sunday. The *New York Times* also published its first report on January 13. *New York Times*, 13 January 2013, "Breathing in Beijing: Coping With China's Smog."
64 The daily return data are from CSMAR.

the zero mean disturbance term with variance of Σ_{ϵ}^{2}. α_i and β_i are the parameters of the market model. Since firms were listed either on the Shanghai or Shenzhen Stock Exchange, the Hu-Shen (Shanghai-Shenzhen) 300 Index was used for the market portfolio.

With the estimated parameters $\hat{\alpha}_i$ and $\hat{\beta}_i$, the AR is

$$\mathrm{AR}_{i\tau} = \mathrm{RETURN}_{i\tau} - \hat{\alpha}_i - \hat{\beta}_i \mathrm{NORMAL\ RETURN}_{m\tau}, \tag{2}$$

where $\mathrm{RETURN}_{i\tau}$ is the daily return of stock i during the event window τ ([0, 20]), and $\mathrm{NORMAL\ RETURN}_{m\tau}$ is the estimated normal return based on Equation (1) during the event window τ [0, 20].

The cumulative abnormal return (CAR) is the sum of the abnormal return over the event window,

$$\mathrm{CAR}_i(\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} \mathrm{AR}_{i\tau}, \tag{3}$$

Using this formula, I find that polluters experienced a 21-day cumulative abnormal return of –5.38%.[65] Considering the total market capitalization of these firms, the smog brought polluters a loss of $15.25 billion, which was 0.18% of China's 2012 GDP. Conversely, protectors had a 21-day cumulative abnormal return of 3.50%,[66] which amounted to a $758.01 million gain (0.01% of China's 2012 GDP). Figure 2 shows the distributions of cumulative abnormal returns for polluters and protectors, respectively. There is large variation within polluters and protectors as well.

While most previous studies using stock market data stop here (first difference), I seek to explain the variations across firms (second difference). The following specification is estimated using ordinary least squares (OLS) to test the argument that political connections mediate the impact of the shock:

$$\mathrm{ABNORMAL\ RETURN}_{it} = \alpha_t + \beta \mathrm{CONNECTION}_i + \mathbf{XB} + \epsilon_{it}, \tag{4}$$

where $\mathrm{ABNORMAL\ RETURN}_{it}$ is the estimated abnormal return of firm i on day t and $\mathrm{CONNECTION}_i$ is a dummy variable indicating whether the firm was connected with the local government. **X** includes controls such as SOE in the benchmark model to tease out the independent effect of political connections from the

65 The CAR of polluters during the smog is not statistically significant at any conventional levels because there is a large standard deviation (SD=10.05), indicating that there is large variation among polluters, which is to be explained below.

66 The CAR of protectors during the smog is not statistically significant at any conventional levels because there is a large standard deviation (SD=11.44), indicating that there is large variation among protectors, which is to be explained below.

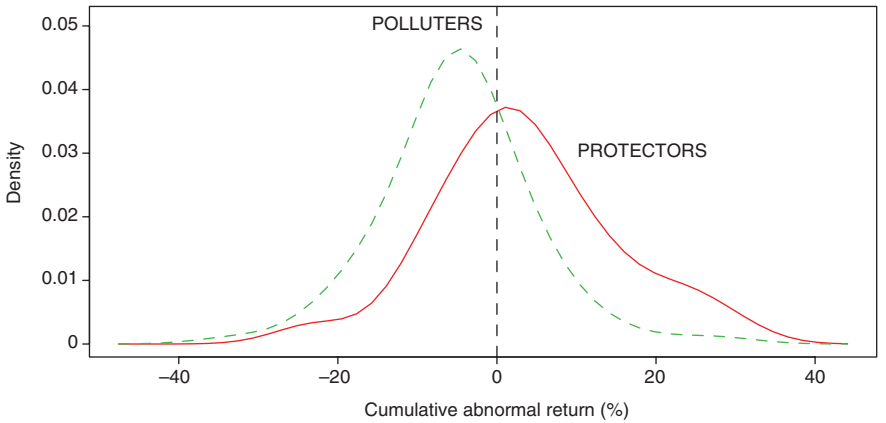

Figure 2 Kernel Density plots of cumulative abnormal returns for polluters and protectors. Data used to generate this graph and additional details are presented in Table 5 in the web appendix.

effect of state ownership[67] and other variables in the robustness checks. β is the parameter of interests, which should be positive in models of both polluters and protectors according to Hypotheses 1 and 2. Robust standard errors are estimated to tackle heteroskedasticity.

I use ABNORMAL RETURN here as the dependent variable rather than the CAR because air pollution shocks should be considered to be a series of events rather than one event. In some previous studies that used CAR as the dependent variable, such as Jayachandran's (2006) study on the impact of Senator James Jeffords's leaving the Republican Party, the event occurred on a single day, and the quantity of interest is the effect of this one event on the returns of firms that had soft-money donations to the Republican Party.[68] However, in the case of smog, the events include a series of episodes of pollution shocks, which is similar to Fisman's (2001) study on the impact of episodes of adverse rumors about the state of Suharto's health on connected firms.[69]

4.6 Results

Figure 3 summarizes the results.[70] The solid lines are the estimated coefficients, and the dotted lines are the 90% confidence intervals. The upper panel shows the

67 I include the indicator variable SOE rather than the continuous variable STATE-OWNED SHARE to avoid collinearity.

68 Jayachandran (2006).

69 Fisman (2001).

70 The web appendix shows the full results.

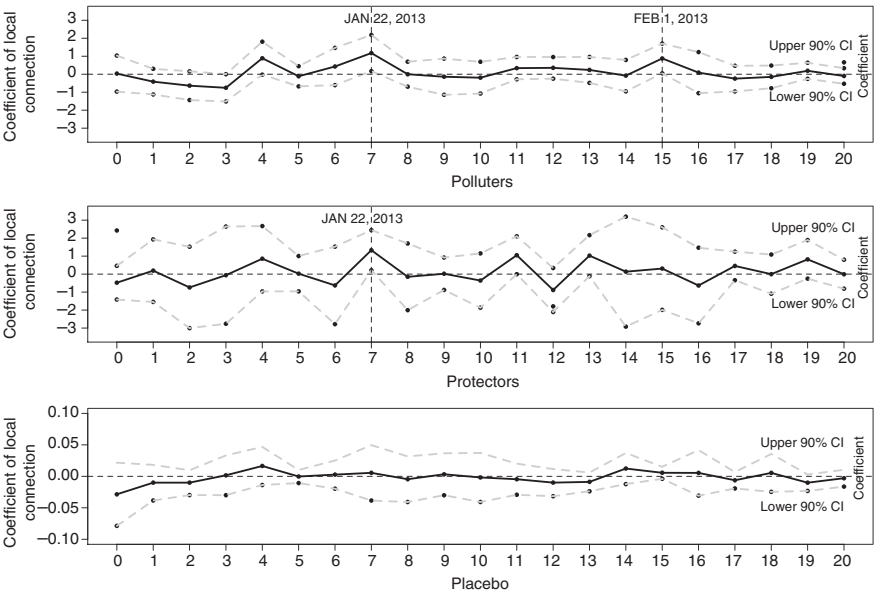

Figure 3 Daily regression coefficients and 90% confidence intervals during the smog. There is a regression for each day from January 11 to February 8, 2013. The dependent variable is the daily abnormal return. The independent variable is CONNECTION – an indicator that measures whether a firm had at least one board member who used to work in the local government where the firm is registered. SOE – an indicator with value of 1 if a firm's STATE-OWNED SHARE is >50% and 0 otherwise – is controlled for. The upper panel shows the results using polluters, the middle panel using protectors, and the lower panel using firms in communication-related industries as the placebo test. The solid lines are the estimated OLS coefficients of CONNECTION on abnormal return, and the dotted lines are the 90% confidence intervals calculated using robust standard errors. Tables 6–8 in the web appendix present the results that generate this graph.

results for the polluters, while the middle panel shows the results for the protectors. In ten out of 21 days during the smog, CONNECTION has a positive effect on polluters' abnormal return, and in 2 days – January 22 and February 1 – the effect is statistically significant at the 0.1 level. The marginal effect of CONNECTION in these 2 days is around 1.00, implying that connections saved polluters $1.98 billion (1.00%×*total market capitalization*) per day from the loss imposed by the smog. Connections also helped protectors. As shown in the middle panel, in 11 out of the 21 days, CONNECTION has a positive effect on protectors' abnormal return, and on 1 day – January 22 – the effect is statistically significant at the 0.1 level. The marginal effect of CONNECTION on that day is 1.33, suggesting that connections helped protectors gain $219.42 million (1.33%×*total market capitalization*) more during the smog. The distributional effects of the smog are substantial.

SOE's effect is inconsistent.[71] In 13 out of the 21 days, SOE's effect is positive, suggesting that SOEs were less susceptible to the pollution shock than their private counterparts. On five of those days, SOE's effect is statistically significant. However, on January 15 and February 8, SOE has a significantly negative effect on abnormal return, implying that SOEs were financially harmed more than privately owned enterprises. The mixed results do not fully support the popular view that Chinese SOEs have always been shielded from environmental regulations.[72] The findings show that it might not be the state-owned status *per se*, but the connections built between corporations and the government that distort environmental compliance.

This finding challenges the previous focus on SOEs in the Chinese politics literature[73] and shows that state ownership is not a good proxy for a firm's political standing with the local government. Many private firms hire former government officials and become more politically connected than SOEs.[74]

5 Robustness checks

I conduct three robustness checks. First, I use a placebo test to reject the possibility that the effect we observe in the data is purely due to a weather effect for listed firms – that is, that whenever there is a pollution shock, firms suffer and connected firms suffer less, whether or not the shock affects compliance with environmental standards. To reject this weather effect, I select firms in an industry that is not sensitive to pollution and examine whether political connections make a difference. I choose to focus on firms in communication-related industries, including communication service, communications equipment manufacturing, and communications and related equipment manufacturing. The lower panel in Figure 3 shows the results using firms in the communication industry as a placebo test. For the 21 days in the sample, none of the coefficients on CONNECTION is significant, which implies that there is not a weather effect.

There are some other factors that also determine firm values in the face of a pollution crisis but may not directly signify rent seeking. Studies have shown that firms care about their reputations because market transactions internalize the costs of bad behavior such as cheating and polluting.[75] Media coverage is

71 The SOE results are presented in the web appendix.

72 This popular view has been especially advocated by journalists. *Forbes*, 31 January 2013, "Why China Cannot Solve Its Pollution Problem."

73 For example, Steinfeld (2000) and Hsueh (2011).

74 I thank an anonymous reviewer for pointing this out.

75 Klein and Leffler (1981).

identified as an important vehicle for disclosing environmental violations, and firms singled out by the media often experience greater losses in their market values compared to their under-the-radar counterparts.[76]

The second robustness check is to control for the "shaming" effect of public media. I construct an indicator variable SHAMING, which takes the value of 1 if a firm was singled out or criticized as a source of air pollution during the smog, and 0 otherwise.[77] Below are two examples of media shaming:

> Beijing's smog is caused by Shougang (Capital Steel)!!!! Local officials have known this for a while, but they hid it; they could not do this any more. Steel is the biggest industry, and Shougang harms the country and the people – from a netizen on tieba.baidu.com.

> To support Beijing's fight against smog, we strongly ask Jidong Cement to cease production for 50 years – from a netizen on guba.sina.com.cn.

I expect that SHAMING has a negative effect on polluters' firm values. Because media shaming is irrelevant for protectors, it is not included in the model for protectors.

Another concern is that it is size rather than connection that drives the results. As a third robustness check, I therefore include SIZE (measured by the natural log of a firm's total assets) to control for firm size. I expect that bigger polluters were less affected by the pollution shock because they were "too big to fail," and that bigger protectors benefited more from the shock because they were more likely to obtain government procurement contracts.

Figure 4 shows the results after controlling for SHAMING and SIZE in the polluter model and SIZE in the protector model. Including more controls does not change the original result: CONNECTION still has a positive effect, and the effect is significant on January 22 and February 1 for polluters and on January 22 for protectors.

As expected, SHAMING largely has a negative effect on firm value in 13 out of 21 days of the sample.[78] In seven of those days, SHAMING's effect is significantly negative. The substantive effect of SHAMING can be as large as 2%; that is, being singled out by the media could cause the firm's value to drop by 2%. In addition, SIZE's effect is largely positive for polluters (15 out of 21 days) but less so for protectors (10 out of 21 days). For polluters, on 6 days, SIZE's effect was significantly positive, suggesting that larger firms were less disrupted by the smog than their

76 Xu, Zeng, and Tam (2012); Laguna (2009).

77 A baidu.com search was conducted using two keywords: the name of each of the polluters and smog. I included a wide range of media outlets, from official newspapers to online forums. For a full list of media reports, firms, and outlets, please see Table 3 in the web appendix.

78 The full results are available in the web appendix.

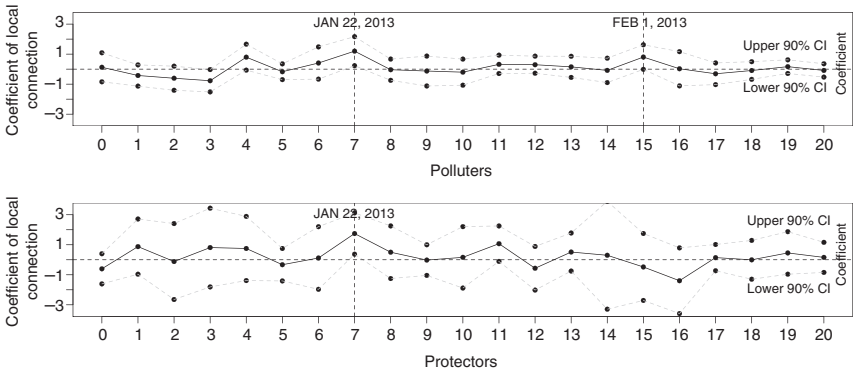

Figure 4 Robustness checks: daily regression coefficients and 90% confidence intervals during the smog.

There is a regression for each day from January 11 to February 8, 2013. The dependent variable is the daily abnormal return. The independent variable is CONNECTION – an indicator that measures whether a firm had at least one board member who used to work in the local government where the firm is registered. SOE (an indicator with a value of i if a firm's STATE-OWNED SHARE is >50% and 0 otherwise), SHAMING (an indicator that measures whether a firm was singled out by the media during the smog as a contributor to air pollution), and SIZE (measured by the natural log of a firm's total assets) are controlled for (SHAMING is not included in the protector model). The upper panel shows the results using polluters as the sample, while the lower panel uses protectors as the sample. The solid lines are the estimated OLS coefficients of CONNECTION on abnormal return, and the dotted lines are the 90% confidence intervals calculated using robust standard errors. Tables 9 and 10 in the web appendix present the results that generate this graph.

smaller counterparts. The effect of SIZE for protectors is inconsistent, implying that bigger protectors did not necessarily benefit from the smog.

6 Discussions

I have shown that, during a pollution crisis, polluters with political connections were less susceptible to the shock, and that protectors with connections benefited more from the shock. Although identifying causal mechanisms – a task that requires detailed data on firm activities before, during, and after the smog – is beyond the scope of this study, I would like to speculate about what might be going on based on the existing literature.

For polluters, possible mechanisms include higher compliance costs, damage to fixed assets, business interruption, and revealing a firm's riskiness to the

market.[79] In this case, because we observe an immediate effect of political connections on firm value, it is safe to say that some of the mechanisms that impose long-term costs, such as rising insurance prices and advertising expenditures, might not be relevant. Clients' exit might be another reason, but most contracts had been signed before the smog. This leaves us with environmental enforcement as a plausible mechanism. Imagine the following scenario: during the smog, because of public pressure, the Chinese government strengthened the enforcement of environmental regulations. However, politically connected polluters exploited their ties with the local governments to shirk their responsibilities to reduce emissions, and because of political connections, these polluters were not (or less severely) punished. This is then reflected in investors' investment decisions to react to information about firms' political connectedness and strengthened regulations.

Subsequent events are consistent with this speculation. After the smog, the Chinese government publicly announced that they would toughen the enforcement of environmental standards during the smog, and the MEP passed a plan to reduce emissions that targeted polluting industries.[80] According to a speech given by Governor of Hebei Province, one of the most polluted provinces in China, Hebei government shut down 8347 factories in 2013 to tackle air pollution.[81] And Beijing government announced to close over 200 factories in polluting industries.[82]

Another possible mechanism is that investors considered connected firms to be less efficient than unconnected firms, and thus less likely to be able to adapt to new business conditions.[83] However, as shown earlier, connected and unconnected firms do not differ on profitability. And the 2013 smog did not create a new business condition, because investors were well aware of China's pollution problems before the smog. It was the government policy response during the smog that triggered investor behavior.

For protectors, during and after the smog, more customers (including ordinary citizens and governmental organizations) purchased environmental products for self-protection, such as air purifiers, and stakeholders and investors updated their beliefs about the profitability of environmentally friendly firms. Government procurement is probably the most obvious reason why we see an immediate effect of political connections on the firm value of protectors:

79 Capelle-Blancard and Laguna (2010: p. 197).

80 *Gov.cn*, 4 February 2013, "Zhou Shengxian's Speech in the 2013 National Working Conference on Environmental Protection."

81 *Chinanews.com*, 8 January 2014, Hebei Shut Down 8347 Heavily Polluting Factories to Tackle Smog and Prevent Pollution.

82 *Hexun.com*, 6 February 2013, "Beijing Plans to Shut Down 200 Polluting Factories to Tackle Smog."

83 I thank an anonymous reviewer for pointing this possibility out.

connected protectors obtained more contracts from the government than their unconnected competitors.[84]

Empirically examining these possible causal mechanisms is a topic for future research, when detailed information on firm activities (such as sales, contracts, and accounting) is available.

7 Conclusion

By studying an exogenous pollution shock – smog in the Winter of 2013 in China – and its impact on the stock market, I show that an environmental crisis has distributional effects: while polluters were financially harmed by the shock, protectors benefited. However, unknown in the existing literature, political connections mediate these distributional effects. Connected polluters, those at least one board member who was a former local bureaucrat, were less disturbed by the shock. Conversely, connected protectors benefited more from the shock.

The findings support the theoretical argument that environmental problems in developing countries are related to the rent-seeking behavior of firms and politicians. With widespread political connections in these countries, firms engage in rent-generating activities that bias governments' calculation of social welfare such that connected firms are favored at the expense of unconnected firms.[85]

The findings challenge the conventional wisdom that as long as "the prices" are right, firms will automatically comply with environmental regulations. I seek to shift the focus from the "economics" of environmental policies to the "politics" of environmental enforcement. For many developing countries that face the conundrum of balancing economic growth and environmental protection, it is more difficult to "get the *politics* right" than "get the prices right" because special interests are strong and the state is often "embedded" in the economy.[86]

This study also casts doubt on the well-known argument that environmental quality will follow a "Kutznet curve" – improving as the level of economic development crosses a turning point.[87] The findings imply that this turning point is more a function of *political* circumstances than the level of economic

84 Government procurement of environmental products dramatically increased during and after the smog. In 2014, Beijing government announced that they have a 50 billion yuan ($8 billion) budget to tackle air pollution. *Xinhuanet.com*, 8 July 2014, "Beijing Will Invest About 50 Billion Yuan to Remedy Smog in 5 Years."

85 Faccio (2006); Wang (2013).

86 Evans (1995).

87 Grossman and Krueger (1995).

development, and to make the turning point, developing countries need to focus not only on economic growth, but also on disentangling the ties between politics and business.

Appendix A: An example of board members' bios

Name	Liuping Xu	Gender	Male	Education	PhD
Position	Chairman of the board	Starting date	2009-01-06	Salary	
Total shares held					
Bio	Liuping Xu, Han nationality, born in October 1964 in Jiangsu and graduated from Beijing Institute of Technology with his PhD degree. He was awarded as Chinese Annual Economic Figure in 2009. He joined China North Industries Group Corporation (CNGC) in 1988 and served as the director of general office in the Commission for Science, Technology and Industry for National Defense (COSTIND). In 2000, he joined China South Industries Group Corporation (CSGC) and served as the director of plannning and development department, director of automobile department, and general manager asistance. He has been a Party member and vice genral manager in CSGC. He served as CSGC executive director and senior vice president from 2005 to 2009. He started to serve as the chairman of the board and Party secretary in Chongqing Changan Automobile Company in December, 2008. In 2009, he served as the director, president and Party secretary in China Chang'an Automobil (Group) Co., Ltd. (CCAG). In July 2010, he started to serve as the deputy chairman, president and Party secretary in CCAG. Mr. Xu is now the deputy secretary of the Party and vice genral manager of CSGC, the chairman and Party secretary in CCAG, as well as the chairman of Chongqing Chang'an Automobil Co., Ltd. Beginning in November, 2002, he has served as the chairman of Jiangling Motors Co., Ltd.				

Name	Baolin Zhang	Gender	Male	Education	M.S.
Position	Director, President	Starting date	2001-05-16	Salary	
Total shares held					
Bio	Mr. Baolin Zhang, M.S., Senior Economist, Senior Political Engineer, was born in 1962. Mr. Zhang is now the general manager asistance in China South Industries Group Corporation (CSGC) and the director of China Chang'an Automobil (Group) Co., Ltd. (CCAG). He used to serve as the deputy secretary and secretary of the Youth League Committee in Southwest Ordance Bureau of China North Industries Group Corporation (CNGC). Mr. Zhang also served as the Party secretary of Chongqing Changfeng Machinery Co., Ltd, the sanding vice manager and general manager of Chengdu Wanyou Co., the director and vice president of Chang'an Automobil (Group) Co., Ltd., the standing vice manager of Chongqing Chang'an Automobil Co., Ltd, the deputy secretary of the Party of CCAG, and the director and president of Chongqing Changfeng Machinery Co., Ltd.				

Figure 5 A snapshot of board members' bios.

Appendix B: Code book for local government connections

Please regard the following organizations/positions as local government organizations/positions. Any organizations/positions outside the list should be coded after consulting with the principal investigator.

Party committee at all levels from province to township (excluding village), general office of Party committee, local organization department of the (CPC), local publicity department of the CPC, local united front work department of the CPC, local international department of the CPC, local committee of political and legal affairs of the CPC.

Vice-chairman of local peoples congress or local Chinese peoples political consultative conference, general office of government at all levels, high/intermediate/basic peoples courts, high/intermediate/basic peoples procuratorates, public security bureau/department, state security bureau, bureau of justice, bureau of supervision, planning commission, economic commission, construction commission, development of reform commission, bureau of finance, bureau of housing and urban-rural development, bureau of geology and mining, bureau of water resources, bureau of agriculture, economic and trade commission, bureau of light industry, bureau of internal trade, bureau of foreign trade and economic co-operation, commission for economic restructuring, Peoples Bank of China branches, audit office, bureau of power industry, bureau of coal industry, bureau of metallurgical industry, bureau of machine industry, bureau of electronics industry, bureau of chemical industry, bureau of forestry/ forestry administration, bureau of transport, bureau of railways, bureau of posts and telecommunications, education commission, science and technology commission, bureau of culture, bureau of radio, film and television, physical culture and sports commission, bureau of health, ethnic affairs commission, national population and family planning commission, bureau of labor, bureau of personnel, bureau of civil affairs, local administration of state-owned assets.

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