

# Firm Size, Political Connections, and the Value Relevance of Environmental Enforcement in China

by

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## Abstract

Curbing environmental pollution is a key priority in China as reflected in the adoption of policies such as “New Normal” and the takeover of environmental enforcement by the top leadership of the central government in 2015. In this paper, we use a dataset of publicly-traded firms in the Shanghai and Shenzhen stock exchanges and the event study methodology to gauge the reaction of the investor class to the new environmental enforcement regime. Our results indicate that, together, the announcement and implementation of the new enforcement regime spurred a significant decline of over \$29 billion in shareholder value of polluting companies, suggesting that capital market participants expect increased regulatory costs for targeted companies. We also find that neither political connections nor firm size mitigated the severity of the market losses. Instead, larger firms and state-owned enterprises with excess capacity experienced bigger declines in market value.

**Keywords:** environmental enforcement, value relevance, firm size, political connections

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## 1 Introduction

Four decades of high economic growth have spurred rapid economic transformation in China but also dramatically high levels of environmental pollution. China became the largest emitter of heat-trapping carbon dioxide in 2006 (Gregg, et al. 2008), even before becoming the world's second largest economy. Pollution in China has become so severe that only 1% of urban dwellers breathe air that would be considered safe (Kahn and Yardley 2007; Han et al. 2015). Between 1990 and 2000, life expectancy in northern China fell 5.5 years thanks to cardiorespiratory-related mortality triggered by air pollution (Chen, et al. 2013). According to Lim, et al. (2012) and Yang, et al. (2013), ambient PM<sub>2.5</sub> (particulate matter less than 2.5 µm in diameter) is responsible for 1.2 million premature deaths in China in 2010, or nearly 35% of such deaths worldwide. Pollution emitted from China carries significant negative spatial externalities on neighboring countries as well; emissions originating from China accounted for approximately 50 to 60% of total deposition of nitrate in South Korea and Japan (Kajino, et al. 2013).

For the central government, environmental pollution poses serious challenges both politically and economically. On one hand, high pollution levels are a direct result of overreliance on the manufacturing sector, which has lifted millions of Chinese citizens out of poverty (Vennemo, et al. 2009). On the other hand, elevated pollution raises public anxiety over its adverse health consequences and even the prospect of social unrest.<sup>1</sup> Large-scale international accords, such as the Paris agreement, which are

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<sup>1</sup> <https://www.bloomberg.com/news/articles/2013-03-06/pollution-passes-land-grievances-as-main-spark-of-china-protests>

designed to provide a coordinated global response to climate change have provided further impetus to rein in pollutant emissions in China.

For these reasons, environmental pollution has become a key priority for the top political leadership as evidenced by the increased focus on the issue of pollution in recent national congresses of the Communist Party of China (CPC). In these congresses, environmental protection evolved from being treated as a marginal agenda item--part of social development goal (in 2002)--to a springboard for sustainable economic growth (in 2012), occupying a central role in the economic development strategy (in 2012). The new emphasis placed on environmental stewardship in China is reflected in President Xi's slogan "Lucid waters and lush mountains are invaluable assets." In 2014, Premier Li Keqiang announced that China is declaring war on pollution.<sup>2</sup>

The relationship between high economic growth and increased pollution is obviously not unique to China. The Environmental Kuznets Curve implies an inverted-U shape relationship between growth and environmental protection (Grossman and Krueger 1991). Grossman and Krueger (1995) show that environmental pollution worsens as an economy grows until per capital gross domestic product (GDP) reaches around \$8,000. Beckerman (1992) argues that the "way to attain a decent environment in most countries is to become rich." GDP per capita in China reached \$8,000 in 2015.<sup>3</sup>

Although an environmental regulatory framework has existed for years<sup>4</sup>, it was ineffectually enforced by the Ministry of Environmental Protection (hereafter MEP).

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<sup>2</sup> "China to 'declare war' on pollution, Premier says" <https://www.reuters.com/article/us-china-parliament-pollution/china-to-declare-war-on-pollution-premier-says-idUSBREA2405W20140305>

<sup>3</sup> <https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=CN>

<sup>4</sup> [http://www.mep.gov.cn/gkml/zj/bgt/200910/t20091022\\_173965.htm](http://www.mep.gov.cn/gkml/zj/bgt/200910/t20091022_173965.htm)

The Minister of MEP called his own department one of the “four major embarrassing departments” in the world.<sup>5</sup> Both political and economic considerations have stood in the way of rigorous enforcement environmental laws for fear that the shutdown of polluting companies may cause a rise in unemployment and a slowdown in economic growth. In the Chinese bureaucratic system, these potential outcomes are undesirable for local officials who are responsible for enforcing environmental policy but whose prospects of being promoted to higher office depend on a good stewardship of the local economy (high growth and employment).

To address this conflict of interest, a number of changes have been made to improve the effectiveness of regulatory oversight. First, environmental inspections are conducted under direct supervision of the central government and conducted by Central Environment Inspection Teams (hereafter “Inspection Teams”) that report directly to a vice-premier--who is higher in rank than the Minister of MEP. Second, both the administrative governor and party secretary are held responsible for environmental protection at the province level. However, it remains unclear whether the takeover of the environmental inspections by central government (which we refer to as the “new enforcement regime”) will result in a more effective enforcement.

In this paper, we examine the effectiveness of inspections under the new enforcement regime using stock market reactions to said inspections. There is evidence that corporate environmentalism is value relevant, e.g. (Crifo, et al. 2015; Ramiah, et

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<sup>5</sup> China's environment ministry among world's most 'embarrassing'  
<https://www.theguardian.com/environment/chinas-choice/2013/jul/15/china-environment-ministry-embarrassing-pollution>

al. 2013; Tang and Zhang 2018). If the inspections are effective, there would be significant regulatory costs (operating and capital costs) imposed on polluting companies to mitigate emissions (Hamilton 1995). If so, we expect an adverse market reaction for the targeted firms per the Efficient Market Hypothesis which posits that the market price quickly and correctly impounds value-relevant information. We expect that increasing regulatory costs will cause a significant drop of the market value of companies in polluting industries.

To further understanding the effectiveness of the new enforcement regime, we also examine its impacts in light of economic concerns about growth and employment (Chen, et al. 2014) and rent seeking by politically connected companies to insulate themselves against costly inspections (Fisman and Wang, 2015; Maung, et al. 2016). Our empirical results show that political and economic concerns do not moderate the market reaction to central government inspections.

The remaining of paper is organized as follows. The second section reviews the literature and provides an institutional background on environmental enforcement in China. The third section formalizes hypothesizes to be empirically tested. The empirical methodology is explained in the fourth section. Data and descriptive analysis are in the fifth section. The sixth section presents the results. The last section concludes.

## **2 Literature Review and Institutional Background**

### **2.1 Literature Review**

The most cited relationship between economic growth and environmental pollution is the Environmental Kuznets Curve (hereafter EKC) by Grossman and Krueger (1991). Several studies have sought to ascertain the existence of the EKC in different countries

and regions such as China (He and Wang 2012; Li, et al. 2016; Xu 2018), India (Managi and Jena 2008), Europe (Atici 2009), using different proxies of pollutant emissions such as sulfur (Stern and Common 2001), suspended particulate matter, sulfur dioxide, oxides of nitrogen, and carbon monoxide (Selden and Song 1994), carbon dioxide (Galeotti, et al. 2006), and deforestation (Koop and Tole 1999). Li, et al. (2016) find robust empirical evidence in support of the EKC hypothesis in China using three different proxies of pollutants. In the same realm, He and Wang (2012) show that pollution in China varies across economic and political structures, development strategy and environmental regulation. Using disaggregated data, Xu (2018) finds evidence in favor of the EKC only in six of China's provinces.<sup>6</sup>

In China, fiscal decentralization is believed to be a major driver of the economic miracle and attendant pollution (Qian and Weingast 1997). Under fiscal decentralization, autonomy is given to local officials with the premise that local knowledge improves decision-making while the central government maintains strong oversight over local officials (Li and Zhou 2005). Since the 1980s, local governments are entitled to make fiscal decisions by themselves and the benefits of economic growth are shared between central and local governments (Lin and Liu 2000; Oi 2011). Fiscal decentralization hence creates incentives for local officials to focus on economic growth which results in increased tax revenue. Among others, Lin and Liu (2000), Jin, et al. (2005) and Montinola, et al. (1995) provide empirical evidence that fiscal

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<sup>6</sup> Our empirical analysis is not designed to test the validity of the EKC hypothesis in China; rather we review the EKC literature as background to explain the serious environmental challenges faced by China that are spurred by sustained high levels of economic growth.

decentralization contributed significantly to economic growth in China. However, when it comes to environmental regulation, fiscal decentralization might lead to a race-to-bottom (Wilson 1996) as it incentivizes local officials to focus on short-term economic gains at the expense of environmental protection.

The promotion of local officials is still determined by the central government thanks to political centralization. Hence local officials who aspire to be promoted to higher office are motivated to follow guidance from central government. In the past, promotion of local officials was tied to their management of the local economy with little regard to environmental outcomes. With the new emphasis being placed by the central government on environmental improvement, we expect the new enforcement regime to be more effective than old regime when environmental inspections were under the umbrella of the MEP (Zheng, et al. 2014; Chen, et al. 2018).

## **2.2. Institutional Background**

As mentioned above, prior to the takeover of environment inspections by the central government, the MEP was in charge and operationalized its inspections via six bureaus that partitioned all the provinces in mainland China. The major mission of the inspection bureaus was to undertake local enforcement of central government policies on environmental protection. However, the political rank of the leaders of the inspection bureaus made the accomplishment of this task onerous. In the Chinese political hierarchy, the top officers (either administrative governor or CPC secretary) of provinces have the same rank as Ministers. So the bureaus of inspection from MEP

were run by agents of inferior rank to the province leaders whom they were supposed to supervise. Hence the system was ripe for administrative interventions that hinder stringent regulatory oversight (Fisman and Wang, 2015; Tao and Zhu, 2001).

On July 1st 2015, the 14th meeting of “Central Leading Group for Comprehensively Deepening Reforms” (hereafter “Leading Group”) approved the “Plan and Supervision and Inspection of Environmental Protection” (hereafter “Plan”).<sup>7</sup> The Leading Group is chaired by President Xi Jinping and deputy-chaired by the Premier Li Keqiang with members among the top ranking officials in China. Given the high profile of the Leading Group members, its decisions are expected to have extensive nationwide effects. Under the “Plan,” inspections are conducted by the central government with a vice-Premier in charge rather than the MEP. The central government sends Inspection Teams to different provinces; these teams are led by current or recently retired provincial leaders with the same or higher administrative rank as leaders in target inspection areas. Furthermore, the Central Discipline Committee of the CPC (hereafter “CDC”), the enforcer of anti-corruption policies, is also involved in the inspections thereby strengthening the political capital of the Inspection Teams.<sup>8</sup> The “Plan” stipulates that both the administrative governor and CPC secretary of province are jointly responsible for local environmental protection.

From 2016 to 2017, 4 rounds of environmental inspections were conducted covering all the provinces in mainland China. According to official reports, 1,527

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<sup>7</sup> [http://www.xinhuanet.com/politics/2015-07/01/c\\_1115787597.htm](http://www.xinhuanet.com/politics/2015-07/01/c_1115787597.htm)

<sup>8</sup> [http://hbdc.mep.gov.cn/hbyq/201612/t20161219\\_371625.shtml](http://hbdc.mep.gov.cn/hbyq/201612/t20161219_371625.shtml)



people were taken into custody and 18,199 officials were publicly named for violations of environmental laws.<sup>9</sup> Although the start date of inspections in provinces varied within each round, the inspection period was always 1 month. The Inspection Team then summarizes the results into reports and submits them to the central government and the central committee of the CPC. After approval of the reports by the central government, basic information about the inspections (fines and criminal cases) is released to the public within a short period. Take Zhejiang province for example, environmental inspections ran from Aug 11 to Sep 11, 2017. On Dec 24, 2017, the feedback was made public: several entities were fined a total of 35 million dollars; 95 cases were under criminal investigation and 144 suspects were held under custody.<sup>10</sup> Once feedback is made available, the inspected province is expected to develop a plan to improve environmental outcomes within six months.

While all the mainland provinces have been inspected by the Inspection Teams, the effectiveness of said inspections has yet to be investigated. It is still unclear whether the inspections have been effective given both economic and political impediments discussed above.

### **3 Hypotheses**

The direct involvement of the central government suggests that Inspection Teams have sufficient resources, both economic and political, to carry out their mission. Furthermore, structural reform of the economy has become a top priority, as reflected

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<sup>9</sup> [http://www.newschinamag.com/newschina/articleDetail.do?article\\_id=3559&section\\_id=17&magazine\\_id=30](http://www.newschinamag.com/newschina/articleDetail.do?article_id=3559&section_id=17&magazine_id=30)

<sup>10</sup> [http://www.xinhuanet.com/2017-12/24/c\\_1122159102.htm](http://www.xinhuanet.com/2017-12/24/c_1122159102.htm)

in the “New Normal” and “Supply Side Reform” policies championed by President Xi. These policies focus on the quality and sustainability of economic growth rather than achieving high growth at the expense of the environment, which characterized the Chinese economy in recent decades. In particular, the “Supply Side Reform” policy aims to reduce leverage and excessive production capacity (over-investment), both of which are severer in polluting industries (Chen, et al. 2011; Deng, et al. 2017). At the same time, these new policies relieve pressure on local officials to generate high growth rates and may therefore entice them to cooperate with rather than impede environmental inspections.<sup>11</sup> Given both the involvement of the central political authority and the shift to a more sustainable growth path, we posit that the new enforcement regime has more regulatory teeth, hence our first hypothesis:

*H1. Environmental inspections under the new enforcement regime impose more expected regulatory costs on polluting companies and therefore lead to lower market returns.*

The interaction between political connections and regulated firms represents a significant concern for the enforcement of environmental law (Firth, et al. 2009; Li and Zhou 2015; Tu, et al. 2013).<sup>12</sup> Politically-connected officials whose promotion to higher office depends in part on local economic performance may hamper the full enforcement or the severity of inspections in order to protect employers in their

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<sup>11</sup> The Xi administration has been setting either a more flexible or lower growth target indicating that the importance of economic growth as a promotion tool has decreased.

<sup>12</sup> Using an event study methodology, Wang et al (2018) find that politically connected firms in China experience on average a 2% drop in market value when the connected official is dismissed. In the same vein, Guo et al (2014) find that political ties are positively associated with access to resources and the discovery of business opportunities based on a survey of top managers of Chinese enterprises.

province (Fisman and Wang, 2015; Li, et al., 2008) for fear of lower employment and growth. The effectiveness of inspections depends on both the political will of the central government and a change in incentives for promotion of local officials. The involvement of the top leadership enhances the standing of the new enforcement regime and likely ensures its effectiveness compared to the MEP-conducted inspections. Likewise, reduced emphasis on the local economic growth as basis for promotion is likely to increase the willingness of local leaders to cooperate with the Inspection Teams. Moreover, the involvement of the CDC lends further credibility to the Inspection Team given the role the CDC plays in the anti-corruption campaign, which has brought many top officials under investigation and into prison.<sup>13</sup> Respect for central government authority from the local officials is also a related objective of the changes in the conduct of inspections. At the mobilization meeting of each provincial inspection, the Inspection Team emphasizes the necessity to enforce central government policies and decisions to the provincial governor and CPC secretary. In light of this discussion, we posit our second hypothesis:

*H2. Political connectedness has no impact on the effectiveness of the new enforcement regime.*

Firm size and over-investment were perceived as barriers to tough enforcement of environmental laws in China before the new enforcement regime. Bigger companies were protected by local officials because of their contributions to the local economy. Also, due to the preference they enjoy from local governments, polluting companies

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<sup>13</sup> [https://www.washingtonpost.com/news/worldviews/wp/2014/07/03/how-the-communist-party-investigates-its-own/?noredirect=on&utm\\_term=.64a9be665dee](https://www.washingtonpost.com/news/worldviews/wp/2014/07/03/how-the-communist-party-investigates-its-own/?noredirect=on&utm_term=.64a9be665dee)

are inclined to expand capacity based on easier access to credit from local financial institutions and end up with over-investment. Although not consistent with maximization of shareholder value, over-investment benefits both company managers and local officials. The latter enjoy a lower unemployment rate thanks to the over-size capacity of firms. The former gain perquisites associated with large size (Jensen 1986; Stulz 1990; Zwiebel 1996) when compensation is tied to growth in sales (Murphy 1985) and a good rapport with local leaders. In some cases, excess capacity allows companies to achieve lower production costs when the production technology exhibits economies of scale, hence more sales. Both Chen, et al. (2011) and (Deng, et al. 2017) find that over-investment is especially severe in SOEs.

However, size and over-investment insulate companies against tough inspections only when local officials are able to distort enforcement. As discussed above, the takeover of inspections by the central government signals its seriousness to tackle the problem of pollution. In conjunction with the reduced emphasis on high growth, the new enforcement regime should curtail local officials' incentives to meddle with the process of inspections. In fact, given the "Supply Side Reform" policy which aims to clamp down on bloated companies in the manufacturing sector, we anticipate that large size and over-investment are likely to spur more scrutiny from Inspection Teams rather than shield firms against them. We therefore posit our third hypothesis:

*H3: Large firms and firms with excess capacity (over-investment) experience more severe market losses due to the new enforcement regime.*

## 4 Methodology and Empirical Strategy

We implement an event study method based on the actual start date of inspection (hereafter “Actual Inspection”) in each individual province to gauge the drop in market value of publicly-traded firms, which is an estimate of the market’s assessment of the impact of increased regulatory costs on profits (Hamilton 1995). The effectiveness of inspections can be examined either from firm outputs (pollutant emissions) or inputs (increased regulatory costs).<sup>14</sup> To our knowledge, there is no publicly available firm-level data in China on emissions. Hence we turn to the input perspective by measuring the markets’ assessment of increased regulatory costs. If the inspections are effectively administered, we expect there will be additional costs imposed on polluting companies in the form of fines and incentives to invest in less-polluting technologies going forward.

### 4.1 Event Study

If markets are efficient, the difference between the actual return and the expected return (abnormal return) around the date of an event is a reliable indicator of the impact of the event on firm value. To get market abnormal returns, we first use the market model (Eq.1), following MacKinlay (1997) and Chaudhry and Sam (2014) to estimate the correlation between stock returns and market returns, using daily data and the estimation window [-155, -6]. That is from 155 days to 6 days before the start date of the event.

$$R_{it} = \alpha_i + \beta_i \times R_{mt} + \varepsilon_{it} \quad (\text{Eq.1})$$

where  $R_{it}$  and  $R_{mt}$  are the return on date  $t$  for company  $i$  and the market respectively.

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<sup>14</sup> We recognize that previous work (e.g. Innes and Sam 2008, Sam et al (2009), Sam (2010), Bi and Khanna 2012, Carrion-Flores et al 2013, and Chang and Sam 2015) has used more direct metrics such as industry, firm or facility level emissions. Unfortunately pollution data at such level of disaggregation is not publicly available in China the way it is in many developed countries.

Then using  $\hat{\alpha}_i$  and  $\hat{\beta}_i$  estimated from Eq.1, we compute the abnormal returns as in Eq.2 below during the event window. The abnormal return for company  $i$  on date  $t$ :

$$AR_{it} = R_{it} - \bar{R}_{it} = R_{it} - (\hat{\alpha}_i + \hat{\beta}_i \times R_{mt}) \quad (\text{Eq.2})$$

where  $\bar{R}_{it}$  is the expected return for company  $i$  on date  $t$  using estimates from Eq.1.

We then calculate the cumulative abnormal return ( $CAR_i$ ) for each company  $i$  during the event window, using Eq.3.

$$CAR_i = \sum_{j=0}^t AR_{ij} \quad (\text{Eq.3})$$

For the “Actual Inspection,” the companies are connected to inspections by the registered province. The start date of inspections for each province is recognized as the event date for companies registered in the province. The “Actual Inspection” includes the 4 rounds.

However, the impact of the new environmental inspection regime on firm value is the combination of the effects of the public announcement and the actual enforcement which may shed further light on its seriousness relative to the previous regime (Coffee 2007; Mahoney 2009; Porta, et al. 1997). We therefore also perform an event study for the announcement of the “Plan” to get a sense of the comprehensive effects of the inspections. The announcement of the “Plan” is the date on which it is approved (July 1, 2015), hereafter “Plan Approved” date. On the “Plan Approved” date, the information about regulatory enforcement changes reached the market for the first time. Fig.1 presents the “Plan Approved” date and the start date for every round of inspection for each province.

## 4.2 Empirical Design

In order to measure the effectiveness of the central government-run inspections, we regress CAR on a dummy variable indicating if company  $i$  is a member of polluting industry ( $Poll_{it}$ ), controlling for from both company and province level covariates in Eq.4. We use the Directory of Industrial Classifications for Listed Firms Subject to Environmental Protection Inspections to construct the variable  $Poll_t$  which equals one if a company belongs to an industry listed in the Directory; zero otherwise. If investors believe that inspections from the central government increase regulatory costs of inspected firms, a negative market reaction is expected. We estimate two equations (Eq. 4 and Eq.5) in order to compute cumulative abnormal returns induced by the new inspection regime and to evaluate the effects of political connections and economic concerns (firm size and over-investment) on said returns (hypotheses 2 and 3). The variable names and definitions can be found on Table 1.

$$CAR_i = \beta_0 + \beta_1 \times Poll_{it} + \beta_2 \times Size_{it-1} + \beta_3 \times Lev_{it-1} + \beta_4 \times ROA_{it-1} + \beta_5 \times Sales_{it-1} - Growth_{it-1} + \beta_6 \times Age_{it-1} + \beta_7 \times Sale2GDP_{it-1} + \beta_8 \times Emiss\_Rdc_{it-1} + \beta_9 \times GDP\_Growth_{it-1} + \sum_{j=1}^3 Round_j + \sum_{p=1}^{29} Province_p + \varepsilon \quad (Eq.4)$$

$$CAR_{it} = \beta_0 + \beta_1 \times Poll_{it} + \beta_2 \times Size_{it-1} + \beta_3 \times Poll_{it} \times Size_{it-1} + \beta_4 \times Over_{it-1} + \beta_5 \times Poll_{it} \times Over_{it-1} + \beta_6 \times PC\_Central_{it-1} + \beta_7 \times Poll_{it} \times PC\_Central_{it-1} + \beta_8 \times PC\_Local_{it-1} + \beta_9 \times Poll_{it} \times PC\_Local_{it-1} + \beta_{10} \times Lev_{it-1} + \beta_{11} \times ROA_{it-1} + \beta_{12} \times Sales\_Growth_{it-1} + \beta_{13} \times Age_{it-1} + \beta_{14} \times Sale2GDP_{it-1} + \beta_{15} \times Emiss\_Rdc_{it-1} + \beta_{16} \times GDP\_Growth_{it-1} + \sum_{j=1}^3 Round_j + \sum_{p=1}^{29} Province_p + \varepsilon_{it} \quad (Eq.5)$$

To test hypothesis 3, we control for a measure of firm size and over-investment in productive assets. In the new inspection regime, firm size and over-investment are likely to increase regulatory cost on pollution companies rather than act as shields against enforcement. Both the variables and their interactions with  $Poll_{it}$  are included in Eq.5. Firm size is measured by  $Size_{it-1}$ , which is the natural logarithm of total assets

in the previous year to the event. Following Richardson (2006), we use the positive residual from estimation of Eq.6 as proxy for over-investment,  $Over_{it-1}$ . Eq.6 estimates the expected optimal level of investment in year  $t-1$  after controlling for past investment level and company characteristics. In Eq.6,  $Invest_{it-1}$  is new investment in Plant Property and Equipment and measures the expansion of productive capacity which is also related to pollutant emissions. When the residual from Eq.6 is positive, there is over-investment beyond the optimal level.

$$Invest_{it-1} = \beta_0 + \beta_1 \times Sales\_Growth_{it-2} + \beta_2 \times Lev_{it-2} + \beta_3 \times Cash_{it-2} + \beta_4 \times Age_{it-2} + \beta_5 \times Size_{it-2} + \beta_6 \times Return_{it-2} + \beta_7 \times Invest_{it-2} + \sum Industry + \varepsilon_{it-1} \quad (Eq.6)$$

To test hypothesis 2, political connections are measured at both central government and provincial government levels since environmental inspections are initiated by the central government with provinces as target.  $PC\_Central_{it-1}$  ( $PC\_Local_{it-1}$ ) is a dummy that equals one if either the chairman or CEO of the company is/was an official in the central (local) government or central (local) government-affiliated agencies. We control for both variables and their interactions with  $Poll_{it}$  in Eq.5.

Eq.4 is run for “Actual Inspection” and “Plan Approved” events since the effect of inspections on returns likely depends on both the announcement of the new inspection regime and its enforcement in practice. Eq.5 is run for the “Actual Inspection” event only since political connections and firms size affect returns through actual enforcement.

We also run Eq.4 and Eq.5 for state-owned-enterprises (SOEs) and non-SOEs separately to gain more insight into the differential effects of the new inspection regime by ownership type. SOEs still dominate the business landscape in China due to the legacy of the planned economy. Since SOEs are more closely connected to the



government, they may be treated differently in the process of inspections. All the continuous variables are winsorized at 1% and 99% level to attenuate the impact of outliers.

## **5 Data, Descriptive Statistics, and Univariate Analysis of Market Reaction**

### **5.1 Data and Descriptive Statistics**

Our sample consists of all publicly traded non-financial companies in the Shanghai and Shenzhen security exchanges except central SOEs which are controlled by the central government--instead of the provincial government--and whose date of actual inspection is hard to determine. Financial companies are excluded due to different accounting and regulatory principles and companies with initial public offerings (IPOs) in the same year as the event date are removed from the sample because many of the control variables do not exist for these companies (no lagged data). After these filters, we are left with samples of 1,710 firms and 2,050 firms, respectively, for “Plan Approved” and “Actual Inspection” events. The increase in the sample for the “Actual Inspection” event results from the accelerated IPO process between the two events.

Table 2 provides descriptive statistics of control variables. The profitability of the sample is not high; on average  $ROA_{it-1}$  is 3.7%. Companies in the sample grow fast with average sales growth of 26.3% during the study period. Less than 6% of companies are connected with central government compared to 12% that are connected to local governments.

Table 3 shows the descriptive statistics of control variables categorized by company types. We find a significant difference between polluting companies and non-

polluting companies for a number of variables. For example, polluting companies are older, have smaller sales growth, and have more political ties with central government.

Among polluting companies, there are significant differences between SOEs and non-SOEs. SOEs are larger, more levered, but also less profitable and with slower growth. It is interesting to note that political connections with the central government are stronger for non-SOEs than SOEs. It is possible that non-SOEs build strong connections with government to seek a competitive advantage. The most common explanation of over-investment is the agency problem (Jensen 1986; Stulz 1990); it is not surprising to find that there is more over-investments in SOEs where the agency costs are higher (Chen, et al. 2011; Deng, et al. 2017).

## **5.2 Univariate Analysis of Market Reaction**

Fig.2 and Fig.3 depict the market return around the start of “Actual Inspection” in a 10-day event window. In Fig.2, polluting companies are compared with non-polluting companies. After the start of inspections, there is a significant downturn for polluting companies while the market return for non-polluting companies remains stable above zero. We conjecture that the change is due to the start of inspections since there is no significant difference between the two types of companies prior to the event. The drop in market value indicates that environmental inspections are perceived by market participants as effective in imposing meaningful regulatory cost on pollution companies. The cumulative abnormal return is about -1% up to 5 days. These abnormal returns are expected to grow larger when more fine-tuned information about the inspections--such

as amount of fines and criminal prosecutions--is revealed. Panel A in Table 4 confirms Fig.2. The CARs are significantly negative after the start of inspection for polluting companies. For non-polluting companies, there is a positive cumulative return, possibly reflecting investor rebalancing away from polluting companies into non-polluting companies. The difference between polluting and non-pollution companies is significant across all event windows.

Fig.3 provides comparison between SOEs and non-SOEs among in the polluting sector. Both polluting SOEs and polluting non-SOEs experience a significant drop after the start of inspections but the market returns for the former decline significantly faster than the latter. Panel B in Table 4 is consistent with Fig.3. For polluting-SOEs, CARs are significantly negative across all windows with a maximum of -1.7% in 5 days. For polluting non-SOEs, CARs become negative from the third day after actual inspection with a maximum that is less than -1% in 5 days. The difference between SOEs and non-SOEs is significant at 1% level. This suggests that SOEs are perceived to be the major target of environmental inspections.

Table 5 presents the cumulative abnormal returns using the date of “Plan Approved” instead. The results are directionally the same but with more economic significance. It is not surprising that the market reactions are larger for “Plan Approved” since this was the first time that the new enforcement regime was publicly disclosed. Taken together, the negative cumulative returns on the announcement of the “Plan” and “Actual inspection” dates suggest that environmental inspections were perceived by market participants as significantly raising regulatory costs.

Although the magnitude of the market response seems small percentage-wise, the estimated CARs of -1.6% and -0.9% in [0,4] for “Plan Approved” and “Actual Inspection” translate into large equity losses, respectively, of \$19.05 billion and \$10.22 billion for polluting companies.<sup>15</sup> The CARs are larger (in absolute value) than findings in similar studies in China. For example, Du (2015) studies the effect of corporate environmental performance (captured by a score on seven environmental indicators) on market returns and finds small but significant CARs ranging between 0.0002 and 0.0008 based on different event windows. Likewise, Lyon, et al. (2013) estimate the CAR for winning a green award to be only 0.3% and not statistically significant in a five day event. The estimated market reaction herein is also comparable or larger than investor reactions to environmental news outside of China. For example, Hamilton (1995) estimates a CAR of -1.2% over a five-day event window when analyzing the market reaction to the public release by the US Environmental Protection Agency of firm-specific toxic release reports. Jacobs et al (2010) find a smaller impact (statistically insignificant CAR of 0.02%) of the announcement of corporate environmental initiatives on market equity. Using worldwide data on explosions at chemical plants and refineries over the 1990-2005 period, Capelle-Blancard and Laguna (2010) estimate a CAR of -1.02% five days following a major industrial accident. On the other hand, Lee et al (2015) report a much larger (adverse) market reaction to the voluntary release of carbon emissions through the carbon disclosure project by a sample of Korean firms in 2008-2009 period.

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<sup>15</sup> The market capitalization of polluting companies is large; just before announcement of the plan (actual inspections), it stood at \$1.1907 trillion (\$1.3577 trillion).

## 6 Discussion of Empirical Results

Table 6 presents the regression results of CARs on the dummy  $Poll_{it}$  and other controls for all companies, SOEs and non-SOEs, respectively. The table provides evidence about the perceived effectiveness of the inspections. Panels A and B are based on “Actual Inspection” and “Plan Approved” dates respectively. The evidence is consistent with the univariate analysis discussed above. After controlling for other relevant variables, the market value of polluting companies dropped by a combined 3%.<sup>16</sup> This provides evidence in support of our first hypothesis (*H1*) in that environmental inspections are viewed by the investor class as increasing environmental protection costs to polluting companies in a significant way. When the results are disaggregated by ownership structure, we find that the magnitudes of the decline in returns (Panel A) are comparable between SOEs and non-SOEs unlike what we found in the univariate analysis (Fig 3), suggesting that both SOEs and non-SOEs are impacted equally when it comes to the “Actual inspection” event. For the “Plan Approved”, Panel B in Table 6 reports similar results. The major difference is that negative effects are mostly statistically insignificant for the non-SOEs, which indicates that SOEs bore the brunt of the market reaction to the announcement of the “Plan.”

Table 7 provides evidence in support of our third hypothesis (*H3*), namely that both size and over-investment exacerbate the adverse impact of inspections. The coefficient on the interaction between firm size and the pollution dummy in Table 7 shows that

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<sup>16</sup> We obtain this figure by adding the CARs for the event dates of the “Trial Plan” and “Actual Inspection” using the [0,4] window.

larger firms experience steeper declines in market value than smaller firms. The estimated level of over-investment (positive residual in Eq. 6) is also interacted with the pollution dummy to examine the extent to which having excess production capacity affects the severity of the market reaction in light of the central government's enactment of the "Supply Side Reform" policy which aims to reduce excessive production capacity. The results of the regression for all companies show no additional adverse effect of over-investment on returns. However, when the results are disaggregated by ownership structure, it can be seen that polluting-SOEs with over-investment experienced steeper declines in market value. The coefficient of the interaction term  $Poll_{it} \times Over_{it-1}$  is significant and negative in regressions of SOEs but not significant in the regressions of non-SOEs. These results can be explained by the fact that the inspectors are more likely to be aware of excess production capacity of government-owned firms than private firms and more successful in pressing the local government to shut down inefficient facilities under their managerial control. As owner of SOEs, the local government is involved in major decision-making and is able to choose projects in accordance with central government's policies. It is more difficult for the central government to intervene in the management of non-SOEs which may lead to concerns about government interference with market forces.

T also shows the estimated effects of political connections of the company CEO to local and central government officials for polluting companies. Neither interaction ( $Poll_{it} \times PC\_Central_{it-1}$  and  $Poll_{it} \times PC\_Local_{it-1}$ ) carries a significant for the regressions, indicating that political connections are not an effective shield against the central

government inspections, validating our hypothesis  $H2$ . Overall, the results show that market investors view the enforcement of inspections as a credible signal of the central government's determination to curb environmental pollution in China.

## 7 Conclusion

China has become the world's second economic power thanks to a remarkably successful manufacturing strategy that has boosted its share of the world's manufacturing output from 3 to 25% between 1990 and 2015.<sup>17</sup> While this strategy has enabled China to climb the ladder of economic prosperity, it has done so at a staggering cost of environmental degradation. Social welfare has been threatened by pollution and people have had to alter their life pattern to cope with the change in the environment.<sup>18</sup> Pollution-related deaths have reduced life expectancy in northern China by 5.5 years according to a study by Chen, et al. 2013.

To curb the nefarious effects of environmental pollution, a more stringent environmental inspection regime was put in place in 2015, whereby inspections are conducted under the direct control of the central government with a vice-Premier in charge rather than the MEP. From 2016 to 2017, all provinces in mainland China were inspected. To measure the effectiveness of the new inspection regime, we use the market's reaction as proxy for imposed regulatory cost.

Our results show that there is a significant negative market reaction for listed

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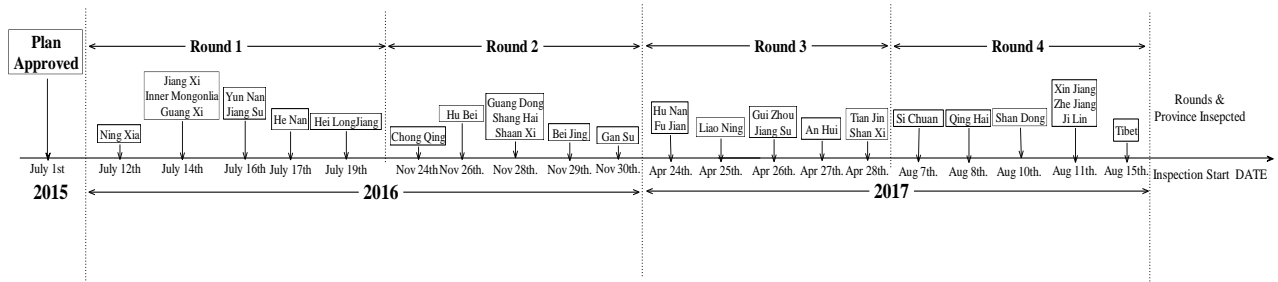
<sup>17</sup> <https://www.economist.com/leaders/2015/03/12/made-in-china>

<sup>18</sup> Some provinces have instituted traffic restrictions based on the last digit of license plate numbers and lottery-style issues of license plate to reduce vehicle emissions. See <https://www.independent.co.uk/news/world/asia/china-cities-smog-red-alert-crisis-beijing-restrict-cars-air-pollution-a7484011.html> and <https://www.nytimes.com/2016/07/29/world/asia/china-beijing-traffic-pollution.html>

companies in polluting industries when the province of registration is inspected. Our results also suggest that neither firm size, over-investment, nor political connectedness were detrimental to the perceived effectiveness of the inspections. In fact, we find that larger polluting companies experienced larger market losses as a result of inspections. Overall, our results suggest that the new environmental inspection regime under the control of the central government has the potential to improve environmental protection in China. One way to enhance the effectiveness of environmental regulation is by making promotion of local officials explicitly contingent on meeting local environmental performance targets as is the case for occupational safety with “No Safety No Promotion” policies enacted in many provinces (Fisman and Wang 2015). Doing so will align incentives of local officials with the central government’s new focus on improving environmental outcomes in China.



**Fig 1. Timeline of Plan Approved and Inspection(Round 1-Round 4)**



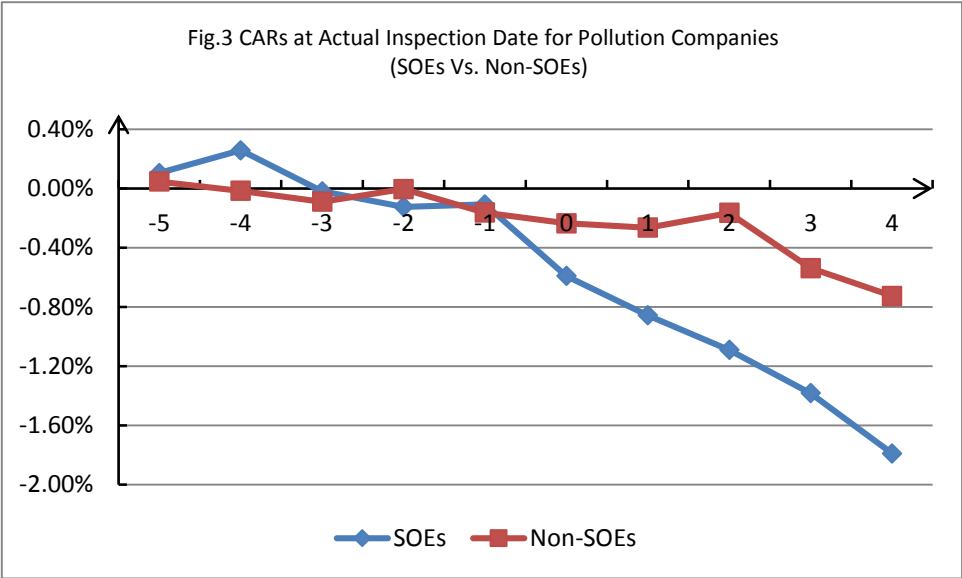
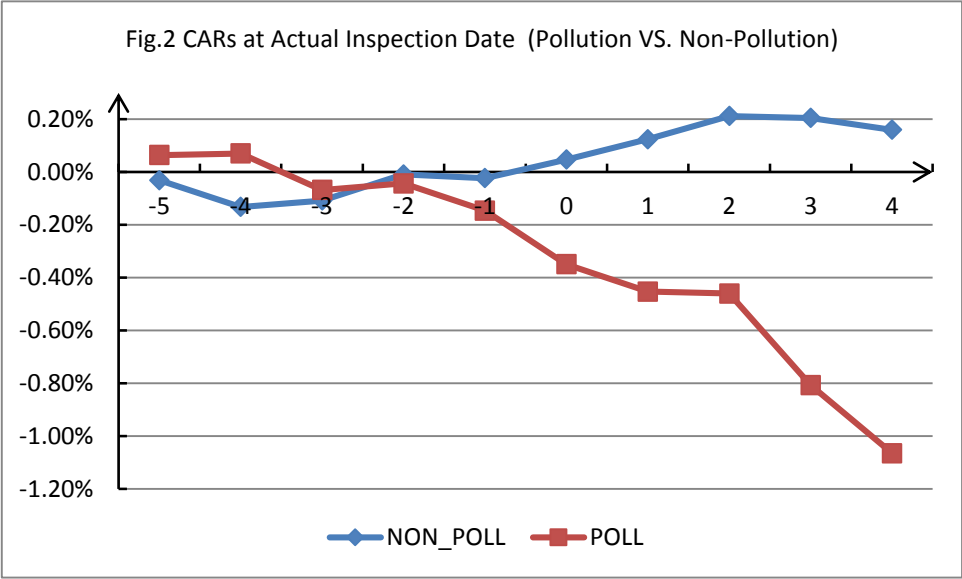


Table 1. Definition of Variables

| Variable Name                | Definition   |
|------------------------------|--|
| Dependent Variables          |  |
| CAR <sub>i</sub>             | Cumulative abnormal return around event date using market model.   |
| Independent Variables        |  |
| Poll <sub>it</sub>           | Dummy variable, equals to 1 if companies <i>i</i> in the pollution Industry in year <i>t</i> . The polluting industries, classified by the Environmental Protection Administration in China, include the following: (1) metallurgical, (2) chemical, (3) petrochemical, (4) coal, (5) thermal power, (6) building materials, (7) paper, (8) brewing, (9) pharmaceutical, (10) fermentation, (11) textiles, (12) leather, and (13) mining industries. |
| SOE <sub>it-1</sub>          | A dummy variable equals to 1 if the ultimate controlling owner of the company <i>i</i> (based on the required disclosure in the annual report) is the local government in year <i>t</i> -1, otherwise 0.   |
| Size <sub>it-1</sub>         | Natural logarithm of total assets (in RMB) for company <i>i</i> in year <i>t</i> -1.   |
| PC_Central <sub>it-1</sub>   | A dummy equals one if either the chairman or CEO of company <i>i</i> is/was the official in the central government or central government-affiliated agencies.  |
| PC_Local <sub>it-1</sub>     | A dummy equals one if either the chairman or CEO of company <i>i</i> is/was the official in the local government or local government-affiliated agencies.  |
| Over <sub>it-1</sub>         | Residuals from Eq.6 following (Richardson, et al. 2006) if positive; otherwise 0   |
| Sales2GDP <sub>it-1</sub>    | Importance of companies to local government. The sales of company <i>i</i> divided by provincial GDP in year <i>t</i> -1 where company <i>i</i> is registered.   |
| Lev <sub>it-1</sub>          | Total liabilities divided by total assets of company <i>i</i> in year <i>t</i> -1.   |
| ROA <sub>it-1</sub>          | Net income divided by total assets of company <i>i</i> in year <i>t</i> -1.  |
| Age <sub>it-1</sub>          | Number of years listed of company <i>i</i> in year <i>t</i> -1   |
| Sales_Growth <sub>it-1</sub> | Percentage of changes in total assets of company <i>i</i> in year <i>t</i> -1.   |
| Emiss_RdC <sub>it-1</sub>    | Gas emission reduction over the past 3 years for the province where company <i>i</i> is registered in year <i>t</i> -1.  |
| GDP_Growth <sub>it-1</sub>   | GDP growth for province where company <i>i</i> is registered in year <i>t</i> -1.  |
| Inspection Round effects     | Indicator variables for each round of environmental inspection   |
| Province effects             | Indicator variables for each province inspected  |
|                              |  |
| Invest <sub>it-1</sub>       | Capital expenditure divided by lag total sales for company <i>i</i> in year <i>t</i> -1  |
| Sales_Growth <sub>it-2</sub> | Growth of sales from year <i>t</i> -3 to year <i>t</i> -2 for company <i>i</i> indicating growth opportunity   |
| Lev <sub>it-2</sub>          | Total debt divided by total assets for company <i>i</i> in year <i>t</i> -2  |
| Cash <sub>it-2</sub>         | Level of cash divided by lagged total assets for company <i>i</i> in year <i>t</i> -2  |
| Age <sub>it-2</sub>          | Number of listed years for company <i>i</i> in year <i>t</i> -2  |
| Size <sub>it-2</sub>         | Natural logarithm of total assets (in RMB) for company <i>i</i> in year <i>t</i> -2  |
| Return <sub>it-2</sub>       | Annual stock return for company <i>i</i> in year <i>t</i> -2   |
| Invest <sub>it-2</sub>       | Capital expenditure divided by lag total assets for company <i>i</i> in year <i>t</i> -2   |
| Industry effects             | Indicator variables for industry for company <i>i</i>  |

Table 2. Descriptive Statistics of Control variables

| Variables                    | # of observations (N) | minimum | maximum | mean   | standard deviation |
|------------------------------|-----------------------|---------|---------|--------|--------------------|
| Size <sub>it-1</sub>         | 2,050                 | 19.723  | 25.494  | 22.163 | 1.161              |
| Lev <sub>it-1</sub>          | 2,050                 | 0.000   | 0.433   | 0.084  | 0.098              |
| ROA <sub>it-1</sub>          | 2,050                 | -0.170  | 0.191   | 0.037  | 0.052              |
| Sales_Growth <sub>it-1</sub> | 2,050                 | -0.566  | 6.439   | 0.263  | 0.844              |
| Age <sub>it-1</sub>          | 2,050                 | 1.000   | 23.000  | 10.568 | 6.914              |
| Sales2GDP <sub>it-1</sub>    | 2,050                 | 0.000   | 0.036   | 0.002  | 0.005              |
| Emiss_RDC <sub>it-1</sub>    | 2,050                 | -0.142  | 0.177   | 0.036  | 0.105              |
| GDP_Growth <sub>it-1</sub>   | 2,050                 | -0.224  | 0.109   | 0.070  | 0.055              |
| PC_Central <sub>it-1</sub>   | 2,050                 | 0.000   | 1.000   | 0.055  | 0.228              |
| PC_Local <sub>it-1</sub>     | 2,050                 | 0.000   | 1.000   | 0.123  | 0.328              |
| Over <sub>it-1</sub>         | 1,904                 | 0.000   | 0.163   | 0.011  | 0.028              |

Table 3. Between-Group Analysis of Control Variables

| Variables                   | Full-Sample   |       |           |     |                 | Polluting Companies |     |        |     |                 |
|-----------------------------|---------------|-------|-----------|-----|-----------------|---------------------|-----|--------|-----|-----------------|
|                             | Non-Polluting |       | Polluting |     | Mean-difference | Non-SOEs            |     | SOEs   |     | Mean difference |
|                             | Mean          | N     | Mean      | N   |                 | Mean                | N   | Mean   | N   |                 |
| Size <sub>t-1</sub>         | 22.135        | 1,344 | 22.216    | 706 | -0.081          | 21.953              | 482 | 22.781 | 224 | -0.828***       |
| Lev <sub>t-1</sub>          | 0.085         | 1,344 | 0.084     | 706 | 0.000           | 0.063               | 482 | 0.129  | 224 | -0.065***       |
| ROA <sub>t-1</sub>          | 0.036         | 1,344 | 0.038     | 706 | -0.002          | 0.048               | 482 | 0.018  | 224 | 0.030***        |
| Sales_Growth <sub>t-1</sub> | 0.328         | 1,344 | 0.139     | 706 | 0.190***        | 0.174               | 482 | 0.063  | 224 | 0.111**         |
| Age <sub>t-1</sub>          | 10.317        | 1,344 | 11.045    | 706 | -0.728**        | 8.932               | 482 | 15.594 | 224 | -6.662***       |
| Sales2GDP <sub>t-1</sub>    | 0.002         | 1,344 | 0.002     | 706 | -0.001**        | 0.001               | 482 | 0.005  | 224 | -0.003***       |
| Emiss_RDC <sub>t-1</sub>    | 0.033         | 1,344 | 0.041     | 706 | -0.008*         | 0.046               | 482 | 0.031  | 224 | 0.016**         |
| GDP_Growth <sub>t-1</sub>   | 0.071         | 1,344 | 0.068     | 706 | 0.003           | 0.071               | 482 | 0.062  | 224 | 0.009*          |
| PC_Central <sub>t-1</sub>   | 0.050         | 1,344 | 0.065     | 706 | -0.015          | 0.079               | 482 | 0.036  | 224 | 0.043**         |
| PC_Local <sub>t-1</sub>     | 0.126         | 1,344 | 0.118     | 706 | 0.008           | 0.118               | 482 | 0.116  | 224 | 0.002           |
| Over <sub>t-1</sub>         | 0.011         | 1,244 | 0.012     | 660 | 0.000           | 0.013               | 440 | 0.008  | 220 | 0.005**         |

Notes: \*statistically significant at the 10% level, \*\* statistically significant at the 5% level, and \*\*\* statistically significant at the 1% level.

Table 4. Between-Group Analysis of CARs (Actual Inspection)

| Panel A: Non-Polluting vs. Polluting Companies         |                         |           |          |         |                     |           |          |         |          |
|--|-------------------------|-----------|----------|---------|---------------------|-----------|----------|---------|----------|
| CAR  | Non-Polluting Companies |           |          |         | Polluting Companies |           |          |         | Diff     |
|  | N                       | Mean      | T ratio  | P value | N                   | Mean      | T ratio  | P value |          |
| [ 0 1 ]  | 1,344                   | 0.001*    | (1.719)  | 0.086   | 706                 | -0.004*** | (-3.214) | 0.001   | 0.005*** |
| [ 0 2 ]  | 1,344                   | 0.002***  | (2.598)  | 0.009   | 706                 | -0.003**  | (-2.551) | 0.011   | 0.006*** |
| [ 0 3 ]  | 1,344                   | 0.002**   | (2.178)  | 0.030   | 706                 | -0.007*** | (-4.784) | 0.000   | 0.009*** |
| [ 0 4 ]  | 1,344                   | 0.002*    | (1.676)  | 0.094   | 705                 | -0.009*** | (-6.067) | 0.000   | 0.012*** |
| Panel B: SOEs vs. Non-SOEs within Polluting Industries |                         |           |          |         |                     |           |          |         |          |
| CAR  | Non-SOEs Companies      |           |          |         | SOEs Companies      |           |          |         | Diff     |
|  | N                       | Mean      | T ratio  | P value | N                   | Mean      | T ratio  | P value |          |
| [ 0 1 ]  | 482                     | -0.002    | (-1.142) | 0.254   | 224                 | -0.008*** | (-3.858) | 0.000   | 0.007*** |
| [ 0 2 ]  | 482                     | -0.000    | (-0.246) | 0.806   | 224                 | -0.010*** | (-3.923) | 0.000   | 0.009*** |
| [ 0 3 ]  | 482                     | -0.004**  | (-2.507) | 0.012   | 224                 | -0.012*** | (-4.697) | 0.000   | 0.008*** |
| [ 0 4 ]  | 481                     | -0.006*** | (-3.264) | 0.001   | 224                 | -0.017*** | (-5.836) | 0.000   | 0.011*** |

Notes: \*statistically significant at the 10% level, \*\* statistically significant at the 5% level, and \*\*\* statistically significant at the 1% level.

Table 5. Between-Group Analysis of CARs (Plan Approved)

| Panel A: Non-Polluting vs. Polluting Companies |                         |        |          |         |                     |           |          |         |            |
|--|-------------------------|--------|----------|---------|---------------------|-----------|----------|---------|------------|
| CAR  | Non-Polluting Companies |        |          |         | Polluting Companies |           |          |         | Difference |
|  | N                       | Mean   | T ratio  | P value | N                   | Mean      | T ratio  | P value |            |
| [ 0 1 ]  | 1,103                   | -0.001 | (-0.490) | 0.624   | 607                 | -0.009*** | (-4.042) | 0.000   | 0.008***   |
| [ 0 2 ]  | 1,093                   | -0.000 | (-0.062) | 0.950   | 605                 | -0.013*** | (-3.910) | 0.000   | 0.013***   |
| [ 0 3 ]  | 1,085                   | -0.003 | (-0.856) | 0.392   | 600                 | -0.014*** | (-3.063) | 0.002   | 0.011*     |
| [ 0 4 ]  | 1,064                   | 0.003  | (0.727)  | 0.468   | 594                 | -0.016*** | (-3.082) | 0.002   | 0.019***   |

| Panel B: SOEs vs. Non-SOEs within Pollution Industries |          |        |          |         |      |           |          |         |            |
|--|----------|--------|----------|---------|------|-----------|----------|---------|------------|
| CAR  | Non-SOEs |        |          |         | SOEs |           |          |         | Difference |
|  | N        | Mean   | T ratio  | P value | N    | Mean      | T ratio  | P value |            |
| [ 0 1 ]  | 386      | -0.003 | (-0.959) | 0.338   | 221  | -0.021*** | (-6.418) | 0.000   | 0.018***   |
| [ 0 2 ]  | 384      | -0.002 | (-0.510) | 0.610   | 221  | -0.031*** | (-7.067) | 0.000   | 0.029***   |
| [ 0 3 ]  | 380      | 0.001  | (0.106)  | 0.915   | 220  | -0.040*** | (-6.104) | 0.000   | 0.041***   |
| [ 0 4 ]  | 375      | 0.002  | (0.297)  | 0.767   | 219  | -0.046*** | (-6.092) | 0.000   | 0.048***   |

Notes: \*statistically significant at the 10% level, \*\* statistically significant at the 5% level, and \*\*\* statistically significant at the 1% level.

Table 6. Market Reaction to Environmental Inspections

| VARIABLES<br>Event Window    | (1)                   | (2)                   | (3)                   | (4)                   | (5)                   | (6)                   | (7)                   | (8)                   | (9)                   | (10)                  | (11)                  | (12)                  |
|------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
|                              | [0 1]                 | [0 2]                 | [0 3]                 | [0 4]                 | [0 1]                 | [0 2]                 | [0 3]                 | [0 4]                 | [0 1]                 | [0 2]                 | [0 3]                 | [0 4]                 |
|                              | ALL                   | ALL                   | ALL                   | ALL                   | SOEs                  | SOEs                  | SOEs                  | SOEs                  | Non-SOEs              | Non-SOEs              | Non-SOEs              | Non-SOEs              |
| Panel A: Actual Inspection   |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |
| Poll <sub>it</sub>           | -0.005***<br>(-3.731) | -0.005***<br>(-3.383) | -0.008***<br>(-4.768) | -0.011***<br>(-5.477) | -0.006**<br>(-2.275)  | -0.007**<br>(-2.295)  | -0.008**<br>(-2.395)  | -0.011***<br>(-3.105) | -0.005***<br>(-2.842) | -0.005***<br>(-2.609) | -0.009***<br>(-4.157) | -0.011***<br>(-4.499) |
| Size <sub>it-1</sub>         | 0.003***<br>(3.248)   | 0.002**<br>(2.539)    | 0.002**<br>(2.091)    | 0.003**<br>(2.567)    | 0.002<br>(1.378)      | -0.000<br>(-0.096)    | 0.000<br>(0.166)      | 0.000<br>(0.014)      | 0.003***<br>(2.735)   | 0.003***<br>(2.824)   | 0.003**<br>(2.225)    | 0.004***<br>(3.014)   |
| Lev <sub>it-1</sub>          | -0.017**<br>(-2.324)  | -0.014<br>(-1.643)    | -0.015<br>(-1.547)    | -0.021**<br>(-1.981)  | -0.013<br>(-1.124)    | -0.011<br>(-0.787)    | -0.013<br>(-0.877)    | -0.016<br>(-0.984)    | -0.018*<br>(-1.814)   | -0.011<br>(-0.939)    | -0.009<br>(-0.673)    | -0.014<br>(-0.930)    |
| ROA <sub>it-1</sub>          | 0.024*<br>(1.882)     | 0.029*<br>(1.833)     | 0.030*<br>(1.770)     | 0.031*<br>(1.693)     | 0.079***<br>(2.918)   | 0.094***<br>(2.717)   | 0.095**<br>(2.472)    | 0.102***<br>(2.658)   | 0.004<br>(0.270)      | 0.005<br>(0.265)      | 0.006<br>(0.341)      | 0.004<br>(0.196)      |
| Sales_Growth <sub>it-1</sub> | 0.001<br>(1.209)      | 0.001<br>(1.233)      | 0.002<br>(1.555)      | 0.003**<br>(2.345)    | -0.001<br>(-0.365)    | -0.001<br>(-0.733)    | -0.001<br>(-0.598)    | -0.001<br>(-0.432)    | 0.001<br>(1.182)      | 0.001<br>(1.323)      | 0.002<br>(1.574)      | 0.003**<br>(2.015)    |
| Age <sub>it-1</sub>          | -0.000**<br>(-2.456)  | -0.000**<br>(-2.178)  | -0.000**<br>(-2.203)  | -0.000**<br>(-2.026)  | -0.000<br>(-1.436)    | -0.000<br>(-0.791)    | -0.000<br>(-0.490)    | -0.000<br>(-0.639)    | -0.000<br>(-1.046)    | -0.000<br>(-1.179)    | -0.000<br>(-1.449)    | -0.000<br>(-0.937)    |
| Sales2GDP <sub>it-1</sub>    | -0.404***<br>(-2.705) | -0.559***<br>(-3.431) | -0.639***<br>(-3.360) | -0.916***<br>(-4.615) | -0.375*<br>(-1.755)   | -0.321<br>(-1.369)    | -0.383<br>(-1.484)    | -0.614**<br>(-2.294)  | -0.053<br>(-0.246)    | -0.333<br>(-1.395)    | -0.402<br>(-1.380)    | -0.560**<br>(-2.008)  |
| Emiss_RDC <sub>it-1</sub>    | 0.032<br>(1.247)      | 0.007<br>(0.176)      | 0.023<br>(0.573)      | 0.039<br>(0.911)      | 0.037<br>(0.677)      | 0.008<br>(0.126)      | 0.051<br>(0.685)      | 0.036<br>(0.420)      | 0.026<br>(0.920)      | 0.002<br>(0.044)      | -0.006<br>(-0.108)    | 0.019<br>(0.378)      |
| GDP_Growth <sub>it-1</sub>   | 0.205<br>(1.069)      | 0.071<br>(0.306)      | 0.066<br>(0.319)      | 0.037<br>(0.149)      | -0.005<br>(-0.019)    | -0.230<br>(-0.712)    | -0.071<br>(-0.237)    | -0.102<br>(-0.285)    | 0.452<br>(1.593)      | 0.475*<br>(1.918)     | 0.329<br>(1.336)      | 0.305<br>(1.053)      |
| Constant                     | -0.065***<br>(-2.600) | -0.050*<br>(-1.683)   | -0.041<br>(-1.427)    | -0.049<br>(-1.496)    | -0.034<br>(-0.850)    | 0.030<br>(0.608)      | 0.010<br>(0.203)      | 0.021<br>(0.369)      | -0.091***<br>(-2.654) | -0.108***<br>(-3.300) | -0.083**<br>(-2.455)  | -0.103***<br>(-2.670) |
| Observations                 | 2,050                 | 2,050                 | 2,050                 | 2,049                 | 580                   | 580                   | 580                   | 580                   | 1,470                 | 1,470                 | 1,470                 | 1,469                 |
| Adj R <sup>2</sup>           | 0.025                 | 0.023                 | 0.030                 | 0.034                 | 0.042                 | 0.031                 | 0.047                 | 0.062                 | 0.020                 | 0.021                 | 0.022                 | 0.020                 |
| Round                        | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   |
| Province                     | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   |
| Panel B: Plan Approved       |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |
| Poll <sub>it</sub>           | -0.007**<br>(-2.286)  | -0.011***<br>(-2.579) | -0.011**<br>(-1.969)  | -0.019***<br>(-2.910) | -0.013***<br>(-2.699) | -0.018***<br>(-2.863) | -0.019**<br>(-2.087)  | -0.024**<br>(-2.327)  | -0.006<br>(-1.455)    | -0.010*<br>(-1.698)   | -0.009<br>(-1.222)    | -0.017**<br>(-2.067)  |
| Size <sub>it-1</sub>         | 0.008***<br>(4.458)   | 0.011***<br>(4.244)   | 0.029***<br>(8.622)   | 0.030***<br>(8.110)   | 0.003<br>(0.961)      | 0.003<br>(0.660)      | 0.020***<br>(3.866)   | 0.022***<br>(3.825)   | 0.013***<br>(5.220)   | 0.017***<br>(5.134)   | 0.035***<br>(7.939)   | 0.037***<br>(7.599)   |
| Lev <sub>it-1</sub>          | -0.037**<br>(-2.139)  | -0.037<br>(-1.546)    | -0.050<br>(-1.525)    | -0.044<br>(-1.176)    | 0.007<br>(0.298)      | 0.013<br>(0.430)      | 0.009<br>(0.209)      | 0.034<br>(0.712)      | -0.061**<br>(-2.321)  | -0.056<br>(-1.480)    | -0.059<br>(-1.151)    | -0.066<br>(-1.113)    |
| ROA <sub>it-1</sub>          | 0.152***<br>(4.044)   | 0.298***<br>(5.534)   | 0.579***<br>(8.225)   | 0.566***<br>(7.436)   | 0.029<br>(0.505)      | 0.118<br>(1.448)      | 0.403***<br>(3.419)   | 0.421***<br>(3.132)   | 0.191***<br>(4.106)   | 0.362***<br>(5.326)   | 0.632***<br>(7.329)   | 0.593***<br>(6.404)   |
| Sales_Growth <sub>it-1</sub> | 0.008*<br>(1.731)     | 0.008<br>(1.374)      | 0.005<br>(0.736)      | 0.007<br>(0.838)      | 0.014**<br>(2.020)    | 0.013*<br>(1.666)     | 0.012<br>(1.062)      | 0.009<br>(0.654)      | 0.003<br>(0.640)      | 0.003<br>(0.399)      | -0.001<br>(-0.148)    | 0.001<br>(0.139)      |
| Age <sub>it-1</sub>          | -0.001***<br>(-2.729) | -0.001***<br>(-3.160) | -0.002***<br>(-4.652) | -0.003***<br>(-5.785) | -0.000<br>(-0.758)    | -0.001<br>(-1.059)    | -0.002**<br>(-2.315)  | -0.003***<br>(-2.943) | -0.001<br>(-1.587)    | -0.001*<br>(-1.804)   | -0.001**<br>(-2.268)  | -0.002**<br>(-2.528)  |
| Sales2GDP <sub>it-1</sub>    | -0.536<br>(-1.536)    | -0.804*<br>(-1.646)   | -0.569<br>(-0.839)    | 0.025<br>(0.033)      | 0.021<br>(0.048)      | 0.009<br>(0.015)      | 0.153<br>(0.186)      | 0.930<br>(0.929)      | -0.406<br>(-0.554)    | -0.453<br>(-0.416)    | 1.077<br>(0.803)      | 1.123<br>(0.815)      |
| Emiss_RDC <sub>it-1</sub>    | 0.221*<br>(1.725)     | 0.232<br>(1.327)      | 0.280<br>(1.142)      | 0.321<br>(1.180)      | 0.153<br>(1.183)      | 0.156<br>(0.944)      | 0.123<br>(0.505)      | 0.307<br>(1.034)      | 0.167<br>(0.547)      | 0.118<br>(0.252)      | 0.021<br>(0.034)      | -0.118<br>(-0.193)    |
| GDP_Growth <sub>it-1</sub>   | -0.113<br>(-0.456)    | -0.311<br>(-1.066)    | -0.357<br>(-0.907)    | -0.469<br>(-1.025)    | 0.024<br>(0.097)      | -0.017<br>(-0.054)    | 0.167<br>(0.340)      | 0.058<br>(0.087)      | -0.081<br>(-0.192)    | -0.376<br>(-0.794)    | -0.406<br>(-0.702)    | -0.575<br>(-0.917)    |
| Constant                     | -0.185***<br>(-4.060) | -0.227***<br>(-3.732) | -0.628***<br>(-7.789) | -0.634***<br>(-7.047) | -0.088<br>(-1.292)    | -0.084<br>(-0.930)    | -0.508***<br>(-4.051) | -0.545***<br>(-3.799) | -0.279***<br>(-4.160) | -0.358***<br>(-3.958) | -0.745***<br>(-6.432) | -0.757***<br>(-6.094) |
| Observations                 | 1,710                 | 1,698                 | 1,685                 | 1,658                 | 573                   | 573                   | 572                   | 569                   | 1,137                 | 1,125                 | 1,113                 | 1,089                 |
| Adj R <sup>2</sup>           | 0.043                 | 0.061                 | 0.144                 | 0.140                 | 0.029                 | 0.039                 | 0.132                 | 0.145                 | 0.052                 | 0.072                 | 0.155                 | 0.141                 |
| Round                        | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   |
| Province                     | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   |

Notes: (i) There are more observations on “Actual Inspection” than “Plan Approved” due to new firms entering the market over time. Standard errors clustered at the firm level. (ii) \*statistically significant at the 10% level, \*\* statistically significant at the 5% level, and \*\*\* statistically significant at the 1% level.

Table 7. Political and Economic Concerns in Market Reaction

| VARIABLES                                     | (1)                   | (2)                   | (3)                   | (4)                   | (5)                  | (6)                   | (7)                  | (8)                  | (9)                   | (10)                  | (11)                  | (12)                  |
|---|-----------------------|-----------------------|-----------------------|-----------------------|----------------------|-----------------------|----------------------|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Event Window                                  | [0 1]                 | [0 2]                 | [0 3]                 | [0 4]                 | [0 1]                | [0 2]                 | [0 3]                | [0 4]                | [0 1]                 | [0 2]                 | [0 3]                 | [0 4]                 |
|   | ALL                   | ALL                   | ALL                   | ALL                   | SOE                  | SOE                   | SOE                  | SOE                  | Non-SOEs              | Non-SOEs              | Non-SOEs              | Non-SOEs              |
| Poll <sub>it</sub>                            | 0.072***<br>(2.620)   | 0.121***<br>(3.889)   | 0.111***<br>(3.191)   | 0.121***<br>(3.209)   | 0.111**<br>(2.306)   | 0.176***<br>(3.096)   | 0.141**<br>(2.259)   | 0.136**<br>(1.984)   | 0.043<br>(1.187)      | 0.081**<br>(1.972)    | 0.094**<br>(2.046)    | 0.098**<br>(1.981)    |
| Size <sub>it-1</sub>                          | 0.004***<br>(4.431)   | 0.004***<br>(4.163)   | 0.004***<br>(3.589)   | 0.005***<br>(4.003)   | 0.004**<br>(2.582)   | 0.003*<br>(1.806)     | 0.003*<br>(1.697)    | 0.003<br>(1.423)     | 0.004***<br>(3.311)   | 0.004***<br>(3.465)   | 0.004***<br>(2.976)   | 0.005***<br>(3.703)   |
| Poll <sub>t</sub> ×Size <sub>it-1</sub>       | -0.003***<br>(-2.811) | -0.006***<br>(-4.081) | -0.005***<br>(-3.441) | -0.006***<br>(-3.487) | -0.005**<br>(-2.380) | -0.008***<br>(-3.189) | -0.006**<br>(-2.361) | -0.006**<br>(-2.112) | -0.002<br>(-1.351)    | -0.004**<br>(-2.129)  | -0.005**<br>(-2.261)  | -0.005**<br>(-2.206)  |
| Over <sub>it-1</sub>                          | -0.004<br>(-0.132)    | -0.006<br>(-0.196)    | 0.017<br>(0.461)      | 0.031<br>(0.707)      | -0.008<br>(-0.117)   | -0.077<br>(-1.194)    | -0.069<br>(-0.832)   | -0.112<br>(-1.057)   | -0.009<br>(-0.301)    | -0.005<br>(-0.129)    | 0.026<br>(0.649)      | 0.047<br>(0.979)      |
| Poll <sub>t</sub> ×Over <sub>it-1</sub>       | -0.049<br>(-1.003)    | -0.056<br>(-1.021)    | -0.078<br>(-1.160)    | -0.078<br>(-0.999)    | -0.240**<br>(-2.279) | -0.205*<br>(-1.716)   | -0.272**<br>(-2.143) | -0.246*<br>(-1.689)  | 0.013<br>(0.273)      | -0.007<br>(-0.116)    | -0.023<br>(-0.335)    | -0.026<br>(-0.312)    |
| PC_Central <sub>it-1</sub>                    | -0.002<br>(-0.540)    | 0.003<br>(0.647)      | 0.001<br>(0.272)      | 0.005<br>(1.016)      | 0.009<br>(0.856)     | 0.012<br>(1.156)      | 0.002<br>(0.184)     | 0.011<br>(0.977)     | -0.006*<br>(-1.740)   | -0.000<br>(-0.108)    | 0.000<br>(0.041)      | 0.002<br>(0.392)      |
| Poll <sub>t</sub> ×PC_Central <sub>it-1</sub> | 0.009<br>(1.584)      | 0.004<br>(0.604)      | 0.012*<br>(1.646)     | 0.005<br>(0.664)      | -0.007<br>(-0.527)   | -0.010<br>(-0.665)    | 0.010<br>(0.633)     | 0.001<br>(0.047)     | 0.013**<br>(2.213)    | 0.008<br>(1.060)      | 0.013<br>(1.590)      | 0.006<br>(0.702)      |
| PC_Local <sub>it-1</sub>                      | -0.001<br>(-0.642)    | -0.002<br>(-0.773)    | -0.004<br>(-1.377)    | -0.004<br>(-1.351)    | 0.000<br>(0.047)     | -0.000<br>(-0.016)    | -0.002<br>(-0.406)   | -0.003<br>(-0.582)   | -0.003<br>(-1.073)    | -0.004<br>(-1.118)    | -0.006<br>(-1.490)    | -0.006<br>(-1.406)    |
| Poll <sub>t</sub> ×PC_Local <sub>it-1</sub>   | 0.002<br>(0.566)      | 0.006<br>(1.243)      | 0.006<br>(1.108)      | 0.006<br>(1.041)      | 0.007<br>(0.964)     | 0.005<br>(0.639)      | 0.009<br>(1.025)     | 0.008<br>(0.997)     | 0.001<br>(0.186)      | 0.008<br>(1.291)      | 0.005<br>(0.762)      | 0.006<br>(0.706)      |
| Lev <sub>it-1</sub>                           | -0.017**<br>(-2.211)  | -0.013<br>(-1.452)    | -0.014<br>(-1.352)    | -0.020*<br>(-1.865)   | -0.013<br>(-1.108)   | -0.010<br>(-0.729)    | -0.013<br>(-0.918)   | -0.014<br>(-0.896)   | -0.020*<br>(-1.906)   | -0.012<br>(-0.945)    | -0.010<br>(-0.669)    | -0.017<br>(-1.081)    |
| ROA <sub>it-1</sub>                           | 0.023*<br>(1.788)     | 0.025<br>(1.531)      | 0.024<br>(1.381)      | 0.029<br>(1.545)      | 0.083***<br>(3.008)  | 0.099***<br>(2.854)   | 0.100***<br>(2.590)  | 0.108***<br>(2.765)  | 0.002<br>(0.143)      | -0.002<br>(-0.108)    | -0.001<br>(-0.065)    | 0.002<br>(0.106)      |
| Sales_Growth <sub>it-1</sub>                  | 0.001<br>(1.057)      | 0.001<br>(1.138)      | 0.001<br>(1.268)      | 0.002*<br>(1.854)     | 0.000<br>(0.154)     | -0.000<br>(-0.208)    | 0.000<br>(0.045)     | 0.001<br>(0.347)     | 0.001<br>(0.958)      | 0.001<br>(1.142)      | 0.001<br>(1.076)      | 0.002<br>(1.300)      |
| Age <sub>it-1</sub>                           | -0.000**<br>(-2.253)  | -0.000**<br>(-1.962)  | -0.000**<br>(-2.070)  | -0.000**<br>(-2.100)  | -0.000*<br>(-1.708)  | -0.000<br>(-1.036)    | -0.000<br>(-0.880)   | -0.000<br>(-0.943)   | -0.000<br>(-0.419)    | -0.000<br>(-0.467)    | -0.000<br>(-0.979)    | -0.000<br>(-0.665)    |
| Sales2GDP <sub>it-1</sub>                     | -0.375**<br>(-2.533)  | -0.499***<br>(-3.172) | -0.589***<br>(-3.160) | -0.855***<br>(-4.420) | -0.291<br>(-1.388)   | -0.225<br>(-0.995)    | -0.322<br>(-1.260)   | -0.553**<br>(-2.099) | -0.094<br>(-0.426)    | -0.403*<br>(-1.656)   | -0.470<br>(-1.589)    | -0.649**<br>(-2.260)  |
| Emiss_RDC <sub>it-1</sub>                     | 0.050**<br>(2.138)    | 0.020<br>(0.536)      | 0.041<br>(1.035)      | 0.059<br>(1.498)      | 0.064<br>(1.276)     | 0.023<br>(0.397)      | 0.087<br>(1.349)     | 0.075<br>(1.037)     | 0.034<br>(1.233)      | 0.006<br>(0.119)      | -0.002<br>(-0.040)    | 0.021<br>(0.422)      |
| GDP_Growth <sub>it-1</sub>                    | 0.201<br>(1.005)      | 0.061<br>(0.247)      | 0.074<br>(0.340)      | 0.049<br>(0.190)      | 0.049<br>(0.189)     | -0.205<br>(-0.652)    | -0.004<br>(-0.014)   | -0.021<br>(-0.061)   | 0.426<br>(1.316)      | 0.522*<br>(1.737)     | 0.402<br>(1.448)      | 0.386<br>(1.145)      |
| Constant                                      | -0.092***<br>(-3.532) | -0.090***<br>(-2.821) | -0.080***<br>(-2.626) | -0.092***<br>(-2.651) | -0.083**<br>(-1.999) | -0.046<br>(-0.947)    | -0.057<br>(-1.136)   | -0.045<br>(-0.813)   | -0.110***<br>(-2.831) | -0.142***<br>(-3.603) | -0.122***<br>(-3.133) | -0.149***<br>(-3.286) |
| Observations                                  | 1,904                 | 1,904                 | 1,904                 | 1,903                 | 572                  | 572                   | 572                  | 572                  | 1,332                 | 1,332                 | 1,332                 | 1,331                 |
| Adj R <sup>2</sup>                            | 0.027                 | 0.029                 | 0.033                 | 0.040                 | 0.076                | 0.068                 | 0.078                | 0.092                | 0.015                 | 0.018                 | 0.019                 | 0.018                 |
| Round   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                  | Yes                   | Yes                  | Yes                  | Yes                   | Yes                   | Yes                   | Yes                   |
| Province                                      | Yes                   | Yes                   | Yes                   | Yes                   | Yes                  | Yes                   | Yes                  | Yes                  | Yes                   | Yes                   | Yes                   | Yes                   |

Notes: (i) The decrease in the number of observations is due to the estimation of overinvestment (Over<sub>it-1</sub>) which requires lagged data. Standard errors clustered at the firm level. (ii) \*statistically significant at the 10% level, \*\* statistically significant at the 5% level, and \*\*\* statistically significant at the 1% level.



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