Online Appendix for *Informed Enforcement: Lessons from Pollution Monitoring in China*

by Sebastian Axbard and Zichen Deng

Appendix A Data Details

A.1 Enforcement Data Processing

The analysis in this paper relies on new geo-coded data on the enforcement actions carried out by local officials. This data is constructed in two steps. First, information from all enforcement records in a city is extracted and categorised. Second, these records are matched to the annual survey of industrial firms, which we have geo-referenced. The following two sections describe the procedure in detail.

Data Collection and Validation

We rely on enforcement records collected by The Institute of Public & Environmental Affairs (IPE) from local environmental bureaus in China. There are two main reasons why we think these records accurately reflect the actions of local governments and are subject to limited misreporting. First, these records are only used for local administrative purposes and are not tied to central government performance evaluations. IPE collect records directly from local government agencies, since they are not held by the central government. Hence, local governments do not face incentives to misreport enforcement actions. Second, any misreporting is made difficult by the nature of the records since they capture public information on actual punishments imposed on local firms.

Environmental bureaus are mandated by law to publicise all enforcement actions since 2008 (two years before our sample period starts).[42] IPE have compiled records from environmental bureaus at all levels of government using several different sources.[43] To validate the IPE data, we have conducted a manual validation using information that we have collected directly from local environmental bureaus. To perform this validation, we randomly select 1000 firms from our baseline sample (consisting of all firms in the Annual Survey of Industrial Firms in the cities that we study). We focus on enforcement records issued between 2015 and 2017, as bureaus are only required to keep records for 5 years. Our team manually went through all relevant websites of local environmental bureaus as well as their social media accounts. Using this approach, we were not able to identify a single enforcement action that was not already captured in the IPE data. We ended up classifying 957 (year 2015), 979 (year 2016), 992 (year 2017), firms in the same way as IPE (year 2015: 41 with any air

[42] Specified in the regulations for disclosure of environmental information, adopted at the first executive meeting of the State Environmental Protection Administration in 2007, available on this website.

[43] IPE collect information directly released by environmental bureaus in provinces, prefecture-level cities and counties. They also compile information communicated by government bodies in Chinese media and crawl official government Weibo accounts.

pollution enforcement, 916 without any enforcement; year 2016: 49 with any air pollution enforcement, 930 without any enforcement; year 2017: 88 with any air pollution enforcement, 904 without any enforcement). For the remaining 43 (year 2015), 21 (year 2016), 8 (year 2017) firms, the IPE identifies air pollution enforcement records that we are not able to identify manually. This could be due to the fact that the IPE cover a wider range of sources than we are able to check manually or because records had been removed from government websites at the time for our manually check in 2022. The fact that we are primarily missing records from years for which the archival requirement had passed at the time of our manual check suggests that the latter explanation may play an important role.

Encoding of Records

Figure A1 provides an example of what these records look like and the type of information they contain. In the record, we can identify which regulation the firm has violated and the local government's response to that violation. For each record, we extract whether the violation refers to air pollution, water pollution, solid-waste pollution, or procedural issues[44]; and the punishment imposed by the local government. Our algorithm follows this step-wise procedure:

1. We first check whether the record contains multiple firms:
   - if the record only contains one firm, we extract the whole record;
   - if the record contains multiple firms, we extract only the relevant block.
2. Once the relevant information has been extracted, our categorization by type first distinguishes between enforcement related to air pollution and three other type of violations: water, solid waste, and procedure. The categorization is done by identifying the keywords listed below:[45]
   - keywords for air pollution: NO, PM, SO2, 气, 烟, 尘, 脱硝, 脱硫, 炉, 颗粒, 焚烧;
   - keywords for water pollution: COD, 污水, 水污染, 沉淀, 沟, 渠;
   - keyword for solid waste pollution: 固体;
   - keywords for procedural violation: 未批先建, 批建不符, 未验先投, 清理明细表, 开工, 环评, 手续, 三同时, 未经验收;
3. For records related to air pollution, we separately identify the following punishment types: suspension, equipment replacement/upgrading, fine, and warning. The categorization is done by identifying the keywords listed below:

[44] The violation of a procedure usually refers to installation or production before receiving the required license.

[45] Note that one record could contain several different violations.

- keywords for suspension: 停;
- keywords for upgrading: 改, 维修;
- keywords for fine: 罚款, 经济处罚, 万元;
- keywords for warning: 国控, 监督性, 结果发布

For the vast majority of records, we use a python algorithm to extract the above information. However, about 1500 records are stored as pictures. For these we have manually extracted the information.

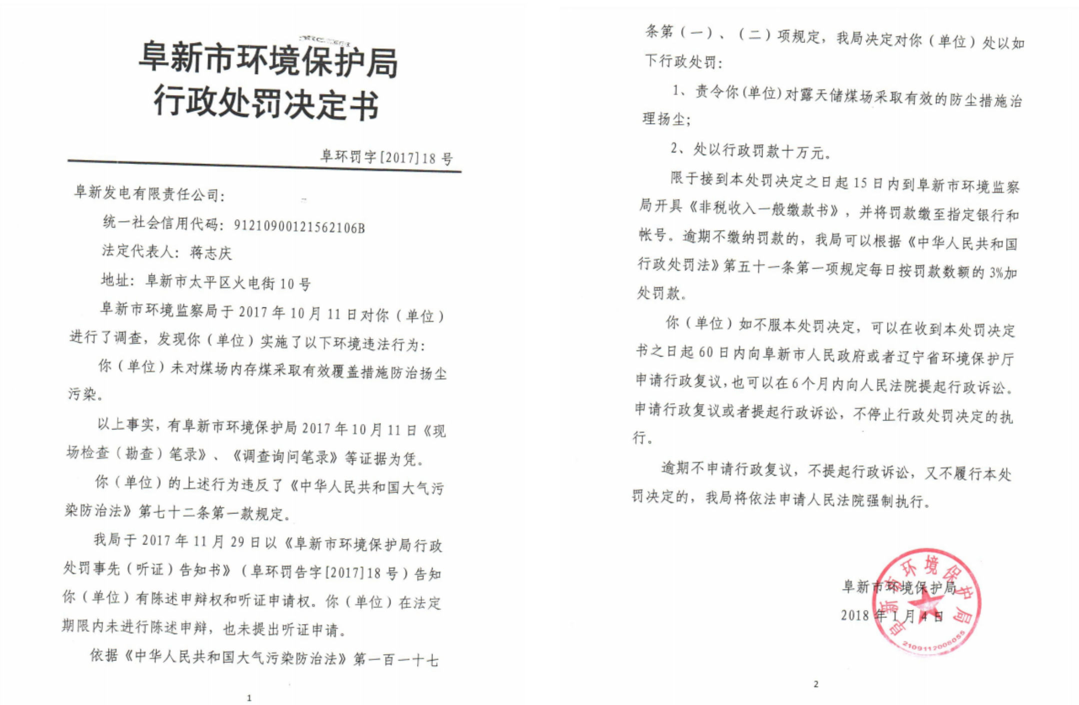
Geo-coding Firm Location

We collect information on all active manufacturing firms using the Annual Survey of Industrial Firms in 2013, the most recent wave. The ASIF data includes private industrial enterprises with annual sales exceeding 5 million RMB and all the state-owned industrial enterprises (SOEs). The data is collected and maintained by the National Bureau of Statistics and contains a rich set of information obtained from these firms' accounting books, such as inputs, outputs, sales, taxes, and profits. Essential for our analysis, the data also includes information about the address of the firm. However, this address information is not always detailed enough to identify an exact geographic location. If this is the case, we rely on two additional sources to complement the ASIF data. First, we follow the recent literature (Beraja, Yang and Yuchtman, 2020) and use the Tianyancha firm registration database to identify the precise coordinates. If the precise coordinates are not available in the Tianyancha database, we use the Google Maps API to identify the coordinates by using the firm's full name. We then cross-reference the information generated by Google Maps to ensure that it corresponds to the general location provided in the Tianyancha database. For around 4,000 firms, we are unable to pinpoint the exact geographic location using the above approach. For these firms, we manually collect the address information from other internet sources. In the end, we have the precise geographic information for 98.7% of firms.

A.2 Representativeness of Main Analysis Sample

Our sample contains the 177 cities that installed monitors for the first time in 2015. The majority of the remaining cities had some type of pollution monitoring before the reform and were simultaneously targeted by other policies as discussed in Section 2. In Table A1 in the appendix we compare the descriptive statistics of our sample with the average across all cities in China. We see that our cities are small by Chinese standards, with the urban population and the size of the built-up area being close to one third of the Chinese average.

Figure A1. An Enforcement Issued by Fuxin Government



阜新市环境保护局
行政处罚决定书

阜环罚字[2017]18号

阜新发电有限责任公司：

统一社会信用代码：91210900121562106B

法定代表人：蒋志庆

地址：阜新市太平区火电街10号

阜新市环境监察局于2017年10月11日对你（单位）进行了调查，发现你（单位）实施了以下环境违法行为：

你（单位）未对煤场内存煤采取有效覆盖措施防治扬尘污染。

以上事实，有阜新市环境保护局2017年10月11日《现场检查（勘查）笔录》、《调查询问笔录》等证据为凭。

你（单位）的上述行为违反了《中华人民共和国大气污染防治法》第七十二条第一款规定。

我局于2017年11月29日以《阜新市环境保护局行政处罚事先（听证）告知书》（阜环罚告字[2017]18号）告知你（单位）有陈述申辩权和听证申请权。你（单位）在法定期限内未进行陈述申辩，也未提出听证申请。

依据《中华人民共和国大气污染防治法》第一百一十七条第（一）、（二）项规定，我局决定对你（单位）处以如下行政处罚：

1、责令你(单位)对露天储煤场采取有效的防尘措施治理扬尘；

2、处以行政罚款十万元。

限于接到本处罚决定之日起15日内到阜新市环境监察局开具《非税收入一般缴款书》，并将罚款缴至指定银行和帐号。逾期不缴纳罚款的，我局可以根据《中华人民共和国行政处罚法》第五十一条第一项规定每日按罚款数额的3%加处罚款。

你（单位）如不服本处罚决定，可以在收到本处罚决定书之日起60日内向阜新市人民政府或者辽宁省环境保护厅申请行政复议，也可以在6个月内向人民法院提起行政诉讼。申请行政复议或者提起行政诉讼，不停止行政处罚决定的执行。

逾期不申请行政复议，不提起行政诉讼，又不履行本处罚决定的，我局将依法申请人民法院强制执行。

阜新市环境保护局
2018年1月4日

The decision on administrative penalties from Environmental Protection Agency in Fuxin City

[2017] No. 18

To
Fuxin Electricity Company Limited
Social credit code: 91210900121562106B
Legal representative: Zhiqing Jiang
Address: Huodian Street No. 10, Taiping district, Fuxin city

The Fuxin Environmental Monitoring Bureau investigated you (Fuxin Electricity Company Limited) on the 11th of Oct. in 2017, and found below violations:

You (Fuxin Electricity Company Limited) didn't take effective measure to prevent dust pollution.

Above facts can be verified and checked by the evidences such as site survey record and inquiry record made by Environmental Protection Agency of Fuxin City on the 11th of Oct. in 2017.

Above facts violated the first paragraph of Article 72 of the Law of the People's Republic of China on Prevention and Control of Air Pollution.

We notified you about your right to state, defend and apply for hearing by sending you "The Prior Notice of Administrative Penalties from Environmental Protection Agency in Fuxin City" ([2017] No. 18) on the 29th of Nov. in 2017. You didn't provide any defense and application for hearing within legal period.

According to Regulations (1) and (2) of Article 117 of the Law of the People's Republic of China on the Prevention and Control of Air Pollution, we decided to impose below administrative penalties on you:

1. Order you to take effective measures to prevent dust pollution in open-pit coal storage yard;
2. Administrative fine up to 100,000 yuan.

You must present yourself at the Fuxin Environmental Monitoring Bureau to receive "General Non-Tax Income Payments" and pay the fine to the designated bank and account number within 15 days from the date of receipt of this penalty decision. If the fine is not paid within the time limit, the Office may impose an additional fine of 3% of the original fine amount on a daily basis in accordance with the first paragraph of Article 51 of the Administrative Punishment Law of the People's Republic of China.

If you refuses to accept this penalty decision, you may apply to the Fuxin Municipal People's Government or the Liaoning Provincial Environmental Protection Department for administrative reconsideration within 60 days from the date of receipt of this penalty decision. You may also file an administrative lawsuit with the People's Court within 6 months. Applying for administrative reconsideration or filing an administrative lawsuit does not stop the execution of the administrative penalty decision.

If you do not apply for administrative reconsideration within the time limit, do not file an administrative lawsuit, and fail to perform the decision on this penalty, the bureau will apply to the people's court for compulsory execution according to law.

The Environmental Protection Agency in Fuxin City
4th of Jan, 2018

While the level of pollution in the cities that we focus on (as measured by AOD) is also lower in our main sample, it is closer to the average city AOD in China.

Table A1. Summary Statistics

	Our Sample	All Cities
AOD	0.333	0.394
	(0.177)	(0.191)
# Monitors	2.751	4.056
	(1.085)	(2.405)
Size of Built-up Area (km2)	44.82	125.0
	(27.64)	(229.0)
Urban Population (10,000)	33.92	91.49
	(22.03)	(191.9)
	177	338

Notes: Author's tabulations.

A.3 Additional Data

Local Leader Characteristics (Jiang, 2017) Information on local officials is collected from the database compiled by Jiang (2017). The database contains extensive demographic and career information for over 4,000 key cities, and provincial and national leaders in China from the late 1990s until 2015. For each leader, the database provides standardized information about the time, place, organization, and rank of every job assignment listed in their curriculum vitae. The data is collected from government websites, yearbooks, and other trustworthy Internet sources. We use the database to calculate the age of city mayors in our sample, which can be used to infer the promotion incentives faced by the mayor, as discussed above. Since our analysis stretches beyond 2015, we expand the database and collect information about the characteristics of mayors up until 2017.

Baidu Search Index (Baidu, 2017) To study the impact of new air pollution information, we collect data about local awareness of air pollution information from the Baidu Search Index. Similar to Google Trends (GT), Baidu Search Index provides a measurement of the search volume of a keyword in a given period from both computers and mobile devices. The Index is constructed by summing the weighted frequencies of all search queries for a specific keyword by city and by day. However, the exact algorithm of the Baidu Index is confidential and unknown to the public. Previous studies (Qin and Zhu, 2018; Barwick et al., 2020) argue that the correlation between the Index and actual online search volume is linear. To match the frequency of our analysis on the air pollution data, we collect the monthly search volume from the Baidu Search Index of each city for the following keywords (in Chinese): air pollution, haze/smog, PM2.5, air mask, and air purifier.[46]

[46]The Chinese translation of these five keywords are 空气污染, 雾霾, PM2.5, 口罩, 空气净化器.

Weather Variables To control for local weather conditions, which are important determinants of the concentration of air pollution in prior work, we collect temperature and precipitation data (CMA, 2017) from the China Meteorological Administration. The data combines observations from 496 weather stations across China. We match this data to our prefecture-level cities to get a local measure of weather conditions.

Wind Direction To investigate whether firms upwind from a monitor face differential enforcement, we collected information about the dominant quarterly wind direction in each city. This data (CMA, 2017) is from the China Meteorological Administration and is based on readings from 496 weather stations across China. We calculate the angle between the locations of the firm and the quarterly prevailing direction of the wind vector passing through the closest monitor. As illustrated in Figure D4, a firm is defined as upwind of the closest monitor if the firms is within 45 degrees of the vector.

Appendix B Discontinuity Specifications

B.1 Regression Discontinuity

To explicitly consider the potential confounding effects of city size, we explore discontinuities in the number of monitoring stations assigned by the central government. We pool all observations post the introduction of monitors and rely on the local linear approach to estimate the following equation within the optimal bandwidth suggested by (Calonico, Cattaneo and Titiunik, 2014):

$$y_{cgt} = \gamma_g + \alpha r_c + a_c(\beta_0 + \beta_1 r_c) + \lambda X_c + \xi_{cgt} \tag{6}$$

where r_c is the value of the running variable for city c, which is the distance in sq km to the closest geographical size cutoff g listed in Table C2. The variable γ_g is a threshold fixed effect and a_c is an indicator variable for cities being above their closest cutoff. To improve precision, we follow Cattaneo, Keele and Titiunik (2021) and control for baseline characteristics indicated by X_c above. We include a control for average AOD in 2010-2011 in the pollution specification and for the 2010-2011 number of firms facing any enforcement related to air pollution for the enforcement specification. The coefficient of interest is therefore β_0, which captures the reduced form effect of being assigned to a group with a larger number of monitors. Standard errors are clustered at the city level.

To make the RD estimates comparable with the DiD/DiD+IV estimates, we normalize the estimates to the effect of one additional monitor by dividing β_0 by the first-stage RD estimates.[47] Our baseline estimates are reported in Column (3) of Table 3.

B.2 Difference-in-Discontinuities

We also exploit the longitudinal nature of our data using a "difference-in-discontinuities" (or Diff-in-Disc) design (Grembi, Nannicini and Troiano, 2016).[48] This design essentially combines a difference-in-differences (comparing the outcomes in cities with a different number of monitors, before and after 2015) with a regression discontinuity design (comparing the outcomes of cities just above or below certain cutoffs). To estimate the Diff-in-Disc model, we follow the common practice of using local linear regression. More specifically, we estimate

[47] This is essentially a fuzzy regression discontinuity design, and the estimates are implemented following Calonico, Cattaneo and Titiunik (2014).

[48] Several studies in the literature have exploited the longitudinal nature of the data in an RD framework, such as the fixed-effect RD estimator in Pettersson-Lidbom (2012), the first-difference RD estimator in Lemieux and Milligan (2008), or the dynamic RD design in Cellini, Ferreira and Rothstein (2010).

the following equation within the optimal bandwidth suggested by Calonico, Cattaneo and Titiunik (2014) and using data for all time periods:

$$y_{cgt} = \gamma_g + \mu_t + \alpha r_c + a_c(\beta_0 + \beta_1 r_c) + Post_t \times [\delta r_c + a_c(\theta_0 + \theta_1 r_c)] + \xi_{cgt}, \tag{7}$$

where $Post_t$ is an indicator for the period after 2015 and μ_t represent time fixed effects. All other variables are the same as in Equation 6. Standard errors are clustered at the city level. Treatment is captured by $Post_t \times a_c$ and the coefficient of interest is therefore θ_0. This is the Diff-in-Disc estimate and identifies the reduced-form effect of being just above the cutoff. We normalize the estimates to the treatment effect of one additional monitor by dividing θ_0 by the first-stage RD estimates. Results of the Diff-in-Disc regressions are shown in Column (4) of the Table 3.

Appendix C Additional Tables

Table C1. Summary Statistics

	Mean	Std. dev.	Obs.	Periods	Freq.
Panel A: Firm-Level Data					
Any Air Pollution Enforcement	0.0046	0.068	1155296	2010-2017	Quarterly
Suspension	0.0024	0.049	1155296	2010-2017	Quarterly
Fine	0.0022	0.047	1155296	2010-2017	Quarterly
Upgrading	0.0025	0.050	1155296	2010-2017	Quarterly
Warning	0.00070	0.027	1155296	2010-2017	Quarterly
# Air Pollution Enforcement	0.0051	0.082	1155296	2010-2017	Quarterly
Any Water Pollu. Enforc.	0.0029	0.054	1155296	2010-2017	Quarterly
Any Solid Waste Pollu. Enforc.	0.00094	0.031	1155296	2010-2017	Quarterly
Any Procedure Pollu. Enforc.	0.0052	0.072	1155296	2010-2017	Quarterly
Upwind	0.25	0.44	1155296	2010-2017	Quarterly
Monitor within 10 km	0.40	0.49	36103	2013	Cross Sec.
Distance to Monitor (km)	19.2	15.4	36103	2013	Cross Sec.
Year Started	2003	7.92	36103	2013	Cross Sec.
Owner: SOEs	0.100	0.30	36103	2013	Cross Sec.
Owner: Private	0.81	0.39	36103	2013	Cross Sec.
Owner: Foreign	0.041	0.20	36103	2013	Cross Sec.
Owner: Other	0.048	0.21	36103	2013	Cross Sec.
Employment	434.8	1076.5	36103	2013	Cross Sec.
Revenue	278736.4	1656898.7	36103	2013	Cross Sec.
Panel B: City-Level Data					
# Monitors	2.76	1.09	16335	2010-2017	Monthly
Size of Built-up Area (km2)	44.8	27.3	16335	2010-2017	Monthly
Urban Population (10,000)	33.9	22.0	16335	2010-2017	Monthly
Age of the Mayor	50.7	3.46	16335	2010-2017	Monthly
Precipitation (mm)	77.0	93.2	16335	2010-2017	Monthly
Mean Temperature	13.8	10.3	16335	2010-2017	Monthly
Aerosol Optical Depth	0.34	0.23	16335	2010-2017	Monthly
# Firms Any Air Pollu. Enfor.	1.53	3.23	5664	2010-2017	Quarterly
# Firms Any Air Pollu. Enfor. (incl non-ASIF)	4.18	10.9	5664	2010-2017	Quarterly
Search Index: air pollution	2.01	4.24	14610	2011-2017	Monthly
Search Index: haze/smoke	18.2	28.4	14610	2011-2017	Monthly
Search Index: PM25	0.22	1.90	14610	2011-2017	Monthly
Search Index: air mask	5.97	9.36	14610	2011-2017	Monthly
Search Index: air purifier	23.4	26.5	14610	2011-2017	Monthly
Panel C: Monitor-Level Data					
Particulate Matter 2.5 ($PM_2.5$)	45.7	26.5	17535	2015-2017	Monthly
Particulate Matter 10 (PM_10))	81.1	51.4	17522	2015-2017	Monthly
Air Quality Index (AQI)	72.4	32.6	17541	2015-2017	Monthly

Notes: The table presents summary statistics for the samples used in our analyses. The data cover the 177 cities that installed monitors in 2015. Panel A reports the summary statistics for the firm-level data. We rely on the Annual Survey of Industrial Firms (ASIF) 2013 and restrict the sample to include only firms set up before 2010 and located within 50 km of an air quality monitor. Panel B reports the summary statistics for the city-level analysis. Panel C reports the summary statistics for the monitor-level data, which is monthly averages of the real-time readings from the monitors.

Table C2. Monitor Assignment Criteria

Group	Population (10,000)	Size of Built-Up Area (sq. km)	Min # Monitors	# Cities
1	< 25	< 20	1	26
2	$25 - 50$	$20 - 50$	2	86
3	$50 - 100$	$50 - 100$	4	57
4	$100 - 200$	$100 - 200$	6	8

Notes: Author's tabulations. **Source**: Technical regulation (2013) for selection of ambient air quality monitoring stations (Ministry of Environmental Protection, see www.mee.gov.cn/ywgz/fgbz/bz/bzwb/jcffbz/201309/t20130925_260810.htm)

Table C3. Targets by Province

Targeted Pollutants	Target	Provinces
$PM_{2.5}$	-25%	Beijing, Tianjin and Hebei
$PM_{2.5}$	-20%	Shagxi, Shandong, Shanghai, Jiangsu, Zhejiang
$PM_{2.5}$	-15%	Guangdong, Chongqing
$PM_{2.5}$	-10%	Inner mongolia
PM_{10}	-15%	Henan, Shannxi, Qinghai, Xinjiang
PM_{10}	-12%	Gansu, Hubei
PM_{10}	-10%	Sichuan, Liangning, Jilin, Hunan, Anhui, Ningxia
PM_{10}	-5%	Guangxi, Fujian, Jiangxi, Guizhou, Heilongjiang
PM_{10}	Keep improving	Hainan, Tibet, Yunnan

Notes: This table reports the pollution reduction targets stipulated by the central government for each province. The reduction targets correspond to the percentage reduction that should be achieved by the end of 2017 compared to 2012. **Source**: The Ministry of Environmental Protection

Table C4. Validating Satellite Data

	(1)	(2)	(3)
Outcome:	log($PM_{2.5}$)	log(PM_{10})	log(AQI)
AOD	0.30***	0.26***	0.20***
	(0.031)	(0.031)	(0.023)
Mean Outcome	3.68	4.26	4.20
Observations	17535	17522	17535

Notes: This table reports the relationship between AOD and three monitor-based measures of air pollution: $PM_{2.5}$, PM_{10}, and the combined AQI. Each column is from a separate regression. All regressions control for average temperature, rainfall, mayor's age, and fixed effects specific to monitor and time (month by year). Robust standard errors clustered on the city in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

Table C5. Industry Composition

Name of the Industry	Code (two digits)	Freq.	Pct.
Mining and Washing of Coal	6	1588	4.40
Extraction of Petroleum and Natural Gas	7	38	0.11
Mining and Processing of Ferrous Metal Ores	8	568	1.57
Mining and Processing of Non-Ferrous Metal Ores	9	244	0.68
Mining and Processing of Nonmetallic Mineral	10	560	1.55
Mining Support	11	23	0.06
Other Mining	12	4	0.01
Agricultural and Sideline Food Processing	13	3872	10.72
Fermentation	14	1241	3.44
Beverage Manufacturing	15	994	2.75
Tobacco Manufacturing	16	25	0.07
Textile Mills	17	1457	4.04
Wearing Apparel and Clothing Accessories Manufacturing	18	855	2.37
Leather, Fur and Related Products Manufacturing	19	654	1.81
Wood and Bamboo Products Manufacturing	20	994	2.75
Furniture Manufacturing	21	365	1.01
Products Manufacturing	22	768	2.13
Printing and Reproduction of Recorded Media	23	437	1.21
Education and Entertainment Articles Manufacturing	24	603	1.67
Petrochemicals Manufacturing	25	168	0.47
Chemical Products Manufacturing	26	2625	7.27
Medicine Manufacturing	27	999	2.77
Chemical Fibers Manufacturing	28	42	0.12
Rubber Products Manufacturing	29	1404	3.89
Plastic Products Manufacturing	30	3977	11.02
Non-Metallic Mineral Products Manufacturing	31	1449	4.01
Iron and Steel Smelting	32	450	1.25
Non-Ferrous Metal Smelting	33	1224	3.39
Fabricated Metal Products Manufacturing	34	1543	4.27
General Purpose Machinery Manufacturing	35	1537	4.26
Special Purpose Machinery Manufacturing	36	1268	3.51
Transport Equipment Manufacturing	37	238	0.66
Electrical machinery and equipment Manufacturing	38	1437	3.98
Electrical Equipment Manufacturing	39	553	1.53
Computers and Electronic Products Manufacturing	40	218	0.60
General Instruments and Other Equipment Manufacturing	41	134	0.37
Craft-works Manufacturing	42	118	0.33
Renewable Materials Recovery	43	26	0.07
Electricity and Heat Supply	44	1003	2.78
Gas Production and Supply	45	178	0.49
Water Production and Supply	46	222	0.61
Total		36103	100.00

Notes: Industrial classification for national economic activities (GB/T 4754—2002). The sample is from the 2013 Annual Survey of Industrial Firms and includes firms that were set up before 2010 and located within 50 km from an air quality monitor.

Table C6. Rainfall Shocks and Monitor Recordings

	(1)	(2)	(3)	(4)
Outcome:				Share of Days
	log($PM_{2.5}$)	log(PM_{10})	log(AQI)	AQI>200
$Rain_{>\tilde{x}}$	-0.091***	-0.091***	-0.078***	-0.024***
	(0.018)	(0.015)	(0.012)	(0.0061)
Mean Outcome	3.63	4.24	4.16	0.11
Observations	2099	2099	2099	2099

Notes: This table reports the effect of precipitation shocks on monitor recordings of pollution. $Rain_{>\tilde{x}}$ is an indicator variable identifying time periods when precipitation is above the median rainfall in a city during the main sample period. We document the impact on four monitor-based measures of air pollution: $PM_{2.5}$, PM_{10}, the combined air quality index (AQI), and the share of days when the monitor reaches an air quality index that is above the critical value for heavily polluted (200). All regressions control for city fixed effects, time fixed effects, and average temperature. Robust standard errors clustered on the city are reported in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level.

Table C7. Firm-level Robustness: Other Enforcement Actions and Additional Controls

	(1)	(2)	(3)	(4)
Panel A: Different Enforcement Actions				
Outcome	Air	Water	Solid Waste	Procedure
$\text{Mon}_{<10km} \times \text{Post}$	0.0033***	0.00055	0.00026	0.00082
	(0.00056)	(0.00041)	(0.00025)	(0.00066)
Mean Outcome	0.0046	0.0029	0.00094	0.0052
Observations	1155296	1155296	1155296	1155296
Firm FE	Yes	Yes	Yes	Yes
Industry-Time FE	Yes	Yes	Yes	Yes
Province-Time FE	Yes	Yes	Yes	Yes
Panel B: Additional Controls				
Outcome	Any Air Pollution Related Enforcement			
$\text{Mon}_{<10km} \times \text{Post}$	0.0033***	0.0034***	0.0032***	0.0031***
	(0.00056)	(0.00056)	(0.00057)	(0.00060)
Mean Outcome	0.0046	0.0046	0.0046	0.0046
Observations	1155296	1155296	1155296	1155296
Distance to coast-Time FE	No	Yes	Yes	No
Firm characteristics-Time FE	No	No	Yes	Yes
City-Time FE	No	No	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Industry-Time FE	Yes	Yes	Yes	Yes
Province-Time FE	Yes	Yes	Yes	No

Notes: All regressions in both panels control for fixed effects specific to firm, industry-by-time interactions, and province-by-time interactions. Panel A reports results from estimating Equation 2 on the probability of being subject to different types of environmental enforcement. Panel B reports additional sensitivity analysis, by adding additional controls to Equation 2. Column (1) reports the baseline estimate from Table 1 as a point of reference. Column (2) adds distance to coast by time fixed effects to the estimation equation. Column (3) further includes interactions between the number of employees and firm ownership status (6 categories) with time fixed effects. Column (4) introduces city by time fixed effects (this drops distance to coast and province by time fixed effects since these are collinear). Robust standard errors clustered on the city are reported in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level.

Table C8. Number of Monitors and Coverage of High Pollution Activity

	(1)	(2)	(3)	(4)
Outcome	Share of high polluters			
Distance	Within 10 km		Within 5 km	
Measure	Revenue	Employment	Revenue	Employment
Panel A: DiD Estimates				
# Monitors	0.11***	0.084***	0.097***	0.073***
	(0.023)	(0.024)	(0.023)	(0.024)
Mean Outcome	0.37	0.36	0.26	0.26
Observations	160	160	160	160
Panel B: DiD + IV Estimates				
# Monitors	0.13***	0.11***	0.13***	0.11***
	(0.034)	(0.031)	(0.032)	(0.031)
Mean Outcome	0.37	0.36	0.26	0.26
Observations	160	160	160	160

Notes: This tables shows the results from a regression of different measures of the share of high pollution activity that occurs close to a monitor on the number of monitors in the city. This analysis is limited to the 160 cities for which we have at least one high polluter according to the ESR database. Panel A reports results on the actual number of monitors, while Panel B reports results on the assigned number of monitors. Columns (1)/(3) shows the relationship between the number of monitors and the share of a city's high polluter's revenue that is within 10/5km from a monitor. Columns (2)/(4) shows the relationship between the number of monitors and the share of a city's high polluter's employment that is within 10/5km from a monitor. Robust standard errors clustered on the city in parenthesis. *, **, *** indicates significance at the 10%, 5% and 1% level respectively.

Table C9. City-level Robustness: Additional Controls

	(1)	(2)	(3)	(4)	(5)	(6)
	DiD	DiD+IV	DiD	DiD+IV	DiD	DiD+IV
Panel A: Outcome - Aerosol Optical Depth						
# Monitors	-0.031***	-0.046***	-0.031***	-0.044***	-0.037***	-0.049***
	(0.0069)	(0.013)	(0.0070)	(0.013)	(0.0065)	(0.013)
Observations	16335	16335	16335	16335	16335	16335
Panel B: Outcome - log(# firms receiving any air pollution enforcement)						
# Monitors	0.15***	0.19**	0.15***	0.19*	0.11**	0.17
	(0.046)	(0.098)	(0.046)	(0.099)	(0.050)	(0.11)
Observations	5664	5664	5664	5664	5664	5664
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Target-Time FE	Yes	Yes	Yes	Yes	Yes	Yes
City size × Post	Yes	Yes	No	No	No	No
City size-Time FE	No	No	Yes	Yes	Yes	Yes
City char.-Time FE	No	No	No	No	Yes	Yes
Weather	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports estimates from adding additional controls to our baseline city-level specification. Columns (1) and (2) report our baseline estimate from Table 3. Columns (3) and (4) report estimates from a slightly more demanding specification where we interact baseline city population and the geographical size of the built-up area with time fixed effects instead of the post variable. Columns (5) and (6) add interactions between baseline GDP as well as an indicator for whether a city installed a background monitor with time fixed effects. Robust standard errors clustered on the city in parenthesis. *, **, *** indicates significance at the 10%, 5% and 1% level respectively.

Table C10. City-level Robustness: Sample Restrictions

	(1)	(2)	(3)	(4)
	DiD	DiD+IV	RD	Diff-in-Disc
Panel A: Outcome - Aerosol Optical Depth				
# Monitors	-0.030***	-0.041***	-0.032**	-0.026
	(0.0069)	(0.013)	(0.016)	(0.019)
Observations	14646	14646	2853	7566
Panel B: Outcome - log(# firms receiving any air pollution enforcement)				
# Monitors	0.14***	0.16*	0.26**	0.23
	(0.047)	(0.097)	(0.11)	(0.16)
Observations	5056	5056	984	2624
Kernel			Uniform	Uniform
Bandwidth			11.3	11.3

Notes: This table reports the results from estimating our four baseline specifications using a restricted sample that excludes data from the provinces Xinjiang and Tibet, which cover much larger geographical areas than other cities. All controls are the same as in Table 3. Robust standard errors clustered on the city in parenthesis. *, **, *** indicates significance at the 10%, 5% and 1% level respectively.

Table C11. City-level Robustness: Including Non-ASIF Firms

	(1)	(2)	(3)	(4)
	DiD	DiD+IV	RD	Diff-in-Disc
Outcome	log(# firms receiving any air pollution enforcement)			
Panel A: All firms (including Non-ASIF)				
# Monitors	0.13***	0.25**	0.29**	0.37**
	(0.049)	(0.11)	(0.14)	(0.14)
Observations	5664	5664	1116	2976
Panel B: Only Non-ASIF firms				
# Monitors	0.13***	0.27**	0.31**	0.40***
	(0.049)	(0.11)	(0.15)	(0.13)
Observations	5664	5664	1116	2976

Notes: This table reports the results from estimating our four baseline specifications for two alternative enforcement definitions: Panel A includes all firms in a city (i.e. also those that are not in the ASIF database) and Panel B focuses only on enforcement against firms that are not covered in the ASIF database. All controls are the same as in Table 3. Robust standard errors clustered on the city in parenthesis. *, **, *** indicates significance at the 10%, 5% and 1% level respectively.

Table C12. City-level Robustness: RD Kernels and Covariates

	(1)	(2)	(3)	(4)
Panel A: Outcome - Aerosol Optical Depth				
# Monitors	-0.039***	-0.038**	-0.036**	-0.028
	(0.015)	(0.015)	(0.015)	(0.050)
Observations	3209	3735	3807	4224
Bandwidth	11.3	12.3	12.5	13.8
First stage	1.28***	1.31***	1.28***	1.11***
	(0.23)	(0.22)	(0.22)	(0.32)
Panel B: Outcome - log(# firms receiving any air pollu. enforce.)				
# Monitors	0.26**	0.29***	0.28***	0.24
	(0.10)	(0.10)	(0.10)	(0.16)
Observations	1116	1392	1296	1116
Bandwidth	11.3	13.1	12.4	11.4
First stage	1.28***	1.28***	1.28***	1.16***
	(0.23)	(0.21)	(0.22)	(0.33)
Kernel	Uniform	Epanechnikov	Triangle	Uniform
Covariates	Yes	Yes	Yes	No

Notes: This table reports additional regression discontinuity results. Columns (1)-(3) report baseline estimates, controlling for cutoff fixed effects and baseline (2010-2011) AOD/log(# firms), using different kernel weighting methods. Column (4) reports results from our baseline specification, but without any controls. The discontinuities are estimated using local linear regressions and the MSE-optimal bandwidth proposed by Calonico, Cattaneo and Titiunik (2014) for respective kernel weighting method. Robust standard errors clustered on the city in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

Table C13. RD Estimates by Cutoff

	(1)	(2)	(3)	(4)
Outcome	AOD		log(# firms...)	
Method	RD	Diff-in-Disc	RD	Diff-in-Disc
Panel A: Cutoff 1				
# Monitors	-0.041**	-0.019	0.28	0.14
	(0.021)	(0.029)	(0.21)	(0.21)
Observations	1508	3992	528	1408
Bandwidth	11.3	11.3	11.3	11.3
First stage	0.87***	0.87***	0.87***	0.87***
	(0.27)	(0.27)	(0.27)	(0.27)
Panel B: Cutoff 2				
# Monitors	-0.034*	-0.038*	0.29**	0.19
	(0.018)	(0.021)	(0.12)	(0.13)
Observations	1701	4516	588	1568
Bandwidth	11.3	11.3	11.3	11.3
First stage	1.79***	1.79***	1.79***	1.79***
	(0.34)	(0.34)	(0.34)	(0.34)
Kernel	Uniform	Uniform	Uniform	Uniform
Bandwidth	11.3	11.3	11.3	11.3

Notes: This table reports regression discontinuity and difference in discontinuity results separately by threshold. Panel A reports estimates for geographical size cutoff 1 (20 sq. km) and Panel B reports estimates for geographical size cutoff 2 (50 sq. km). The discontinuities are estimated using local linear regressions and the MSE-optimal bandwidth proposed by Calonico, Cattaneo and Titiunik (2014). The RD specification controls for cutoff fixed effects and baseline (2010) AOD/log(# firms), while the Diff-in-Disc control for cutoff and time fixed effects. Robust standard errors clustered on the city in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

Table C14. City-level: Direct Effects vs. Spillover

	(1)	(2)	(3)	(4)
	DiD	DiD+IV	RD	Diff-in-Disc
Panel A: AOD, Monitor (≤ 10km)				
# Monitors	-0.032***	-0.038**	-0.040**	-0.051**
	(0.0068)	(0.015)	(0.019)	(0.021)
Observations	14180	14180	2680	7115
Mean Outcome	0.39	0.39	0.33	0.33
Panel B: AOD, City Center (10-50km)				
# Monitors	-0.032***	-0.044***	-0.031**	-0.037*
	(0.0069)	(0.014)	(0.015)	(0.019)
Observations	14180	14180	2680	7115
Mean Outcome	0.35	0.35	0.31	0.31
Panel C: AOD, Surrounding Area (> 50km)				
# Monitors	-0.028***	-0.037***	-0.031**	-0.027
	(0.0068)	(0.013)	(0.014)	(0.017)
Observations	14180	14180	2680	7115
Mean Outcome	0.32	0.32	0.28	0.28
Panel D: Enforcement, Monitor (≤ 10km)				
# Monitors	0.15***	0.22**	0.21***	0.30***
	(0.034)	(0.088)	(0.071)	(0.098)
Observations	5664	5664	1116	2976
Mean Outcome	0.26	0.26	0.23	0.23
Panel E: Enforcement, City Center (10-50km)				
# Monitors	0.068*	0.039	0.12	0.20
	(0.037)	(0.086)	(0.094)	(0.12)
Observations	5664	5664	1116	2976
Mean Outcome	0.26	0.26	0.22	0.22
Panel F: Enforcement, Surrounding Area (> 50km)				
# Monitors	0.0065	0.0021	0.12	0.020
	(0.033)	(0.053)	(0.089)	(0.083)
Observations	5664	5664	1116	2976
Mean Outcome	0.21	0.21	0.20	0.20
Kernel			Uniform	Uniform
Bandwidth			11.3	11.3

Notes: This table reports results for our main outcomes calculated separately for: the monitoring station (outcomes observed within 10km from a monitor, panels A and D), the city centre (outcomes observed 10-50km from a monitor, panels B and E) and the surrounding areas (outcomes observed beyond 50km from a monitor, panels C and F). Estimates from the four different empirical strategies used in the city-level analysis are reported. Panels A-C report results for aerosol optical depth and panels D-F for the log number of firms receiving any enforcement action related to air pollution. To ensure that estimates are comparable across the first three panels, we restrict the AOD analysis to cities for which we can consistently observe AOD across the three outcomes. The specifications used are the same as those reported in Table 3. Robust standard errors clustered on the city in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

Table C15. Mechanism: Promotion Incentives

	(1)	(2)	(3)	(4)
Age bandwidth:	Full	±7 Years	±5 Years	±3 Years
Panel A: Outcome - Aerosol Optical Depth				
# Monitors	-0.020***	-0.022***	-0.021***	-0.026***
	(0.0069)	(0.0072)	(0.0075)	(0.0081)
# Monitors × Below 58	-0.015***	-0.015***	-0.014***	-0.017***
	(0.0046)	(0.0046)	(0.0048)	(0.0050)
Mean Outcome	0.34	0.33	0.32	0.32
Observations	16335	13805	12048	8835
Panel B: Outcome- log(# firms receiving any air pollution enforcement)				
# Monitors	0.089**	0.088**	0.086*	0.078
	(0.041)	(0.043)	(0.048)	(0.057)
# Monitors × Below 58	0.077***	0.067***	0.067***	0.060***
	(0.021)	(0.021)	(0.022)	(0.022)
Mean Outcome	0.58	0.55	0.55	0.55
Observations	5664	4800	4192	3072

Notes: This table reports heterogeneous effects of monitoring by promotion incentives on aerosol optical depth (Panel A) and the log number of firms receiving any enforcement action related to air pollution (Panel B). Each column reports the estimate from Equation (4) with an additional interaction for mayors being below 58 years at the time of the National Peoples' Congress. All specifications control for city fixed effects, time by pollution reduction target fixed effect, population and the geographical size of the built-up area at baseline interacted with the post variable, and time varying controls for total precipitation, average temperature and the age of the mayor. Robust standard errors clustered on the city in parenthesis. *, **, *** indicates significance at the 10%, 5% and 1% level respectively.

Table C16. Balance Table: Mayor's Age and City Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Mean			Difference			
	Full	58+	57-	Full	±7 Years	±5 Years	±3 Years
# Monitors	2.75	2.48	2.80	0.32	0.30	0.27	0.0033
	(1.08)	(1.33)	(1.03)	(0.22)	(0.22)	(0.23)	(0.25)
Size of buildup area	44.8	35.6	46.6	11.0**	10.2*	10.8*	6.31
	(27.6)	(20.1)	(28.6)	(5.57)	(5.55)	(5.82)	(5.86)
Urban population	33.9	28.9	34.9	6.06	5.86	6.44	2.53
	(22.0)	(18.8)	(22.5)	(4.46)	(4.47)	(4.65)	(4.56)
AOD before 2015	0.36	0.29	0.38	0.084**	0.076*	0.067*	0.064
	(0.20)	(0.17)	(0.20)	(0.040)	(0.040)	(0.040)	(0.045)
Night light before 2015	-1.17	-1.16	-1.17	-0.0045	-0.036	-0.022	-0.048
	(0.73)	(0.91)	(0.70)	(0.15)	(0.15)	(0.16)	(0.16)
log(# Firms) before 2015	0.35	0.33	0.36	0.026	0.0032	0.0097	-0.0100
	(0.27)	(0.28)	(0.26)	(0.054)	(0.052)	(0.053)	(0.058)
Observations	177	29	148	177	150	131	96
Joint Test (p-value)				0.19	0.15	0.29	0.37

Notes: This table reports the balance of baseline characteristics for cities with mayors of different age at the time of the National People's Congress. Column (1) reports averages for the full sample, while columns (2) and (3) split the sample into cities with mayors above and below the age cutoff. Columns (4)-(7) report differences between cities above and below the threshold for different bandwidths ranging from the full sample to cities with mayors 3 years above to 3 years below the threshold. *, **, *** indicates significance at the 10%, 5% and 1% level respectively.

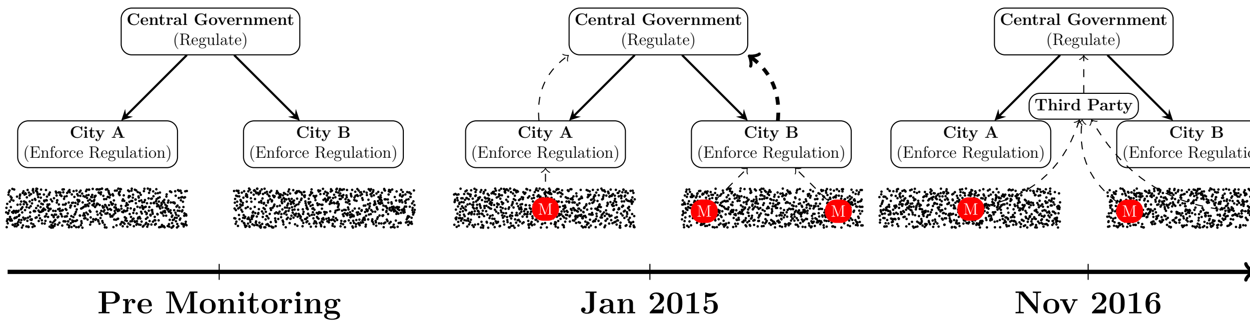
Table C17. Mechanism: Monitors and Online Searches

	(1)	(2)	(3)	(4)	(5)
Outcome:	log(key word)				
Key words:	air pollution	haze/smog	$PM_{2.5}$	air mask	air purifier
# Monitors	0.0097	0.011	0.0011	0.022	0.0064
	(0.0064)	(0.028)	(0.0016)	(0.018)	(0.029)
Mean Outcome	0.049	0.33	0.0052	0.13	0.43
Observations	14596	14596	14596	14596	14596

Notes: This table reports estimates from Equation (4) on city-level outcomes for online searches for pollution related keywords. All specifications control for city fixed effects, time by pollution reduction target fixed effect, population and the geographical size of the built-up area at baseline interacted with the post variable, and time varying controls for total precipitation, average temperature and the age of the mayor. Each column is from a separate regression estimating the impact on a specific keyword. Robust standard errors clustered on the city in parenthesis. *, **, *** indicates significance at the 10%, 5% and 1% level respectively.

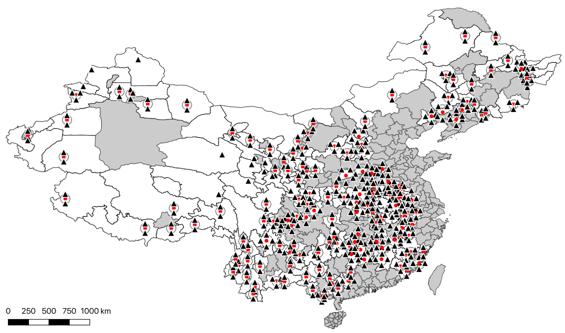
Appendix D Additional Figures

Figure D1. Monitors, Coverage and Flow of Information

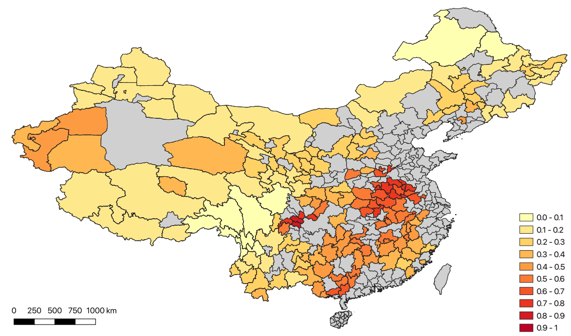


Notes: This figure describes how the flow of information changes with the introduction of monitors. While responsibilities are unchanged – the central government regulates and the local government enforces these regulations – the quality of information changes differently between cities. Starting in January 2015, a different number of monitors transfer pollution recordings via the cities to the central government. Following the retraction of the monitors in November 2016, the recordings from the monitors are transferred to the central government via external third parties.

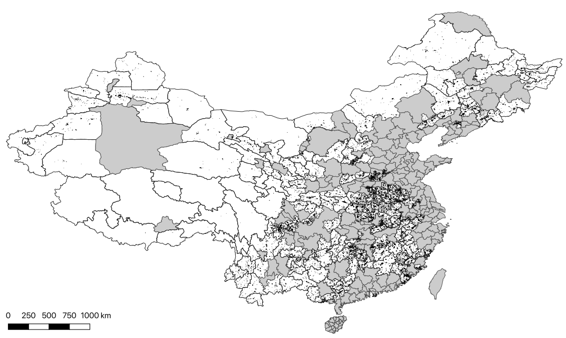
Figure D2. Geographical Distribution of Data



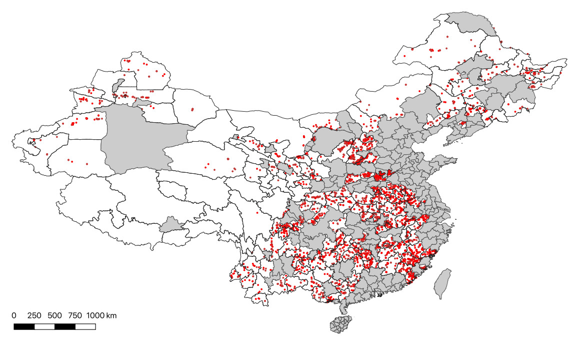
(a) Location of Pollution Monitors



(b) Distribution of AOD in 2010



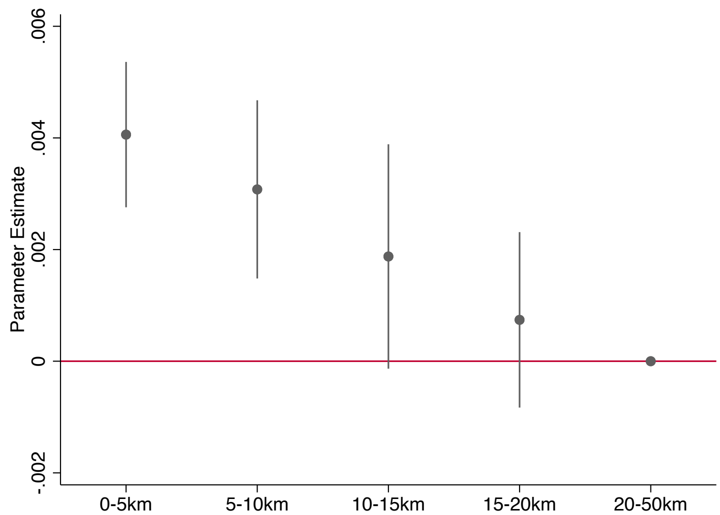
(c) Location of Firms



(d) Location of Enforcement Activities

Notes: This figure shows the geographical distribution of the data used for analysis in this study. Panel A shows the location of pollution monitors (black triangles). To facilitate the reading of the map, overlapping monitors have been displaced, and the centroid of the overlapping monitors is displayed with a red circle. Panel B shows the average AOD for each prefecture-level city in 2010. Panel C shows the exact geographic location of manufacturing firms in the 2013 Annual Survey of Industrial Firms, and Panel D shows air-pollution related enforcement activities against these firms.

Figure D3. Firm-level: Enforcement Gradient

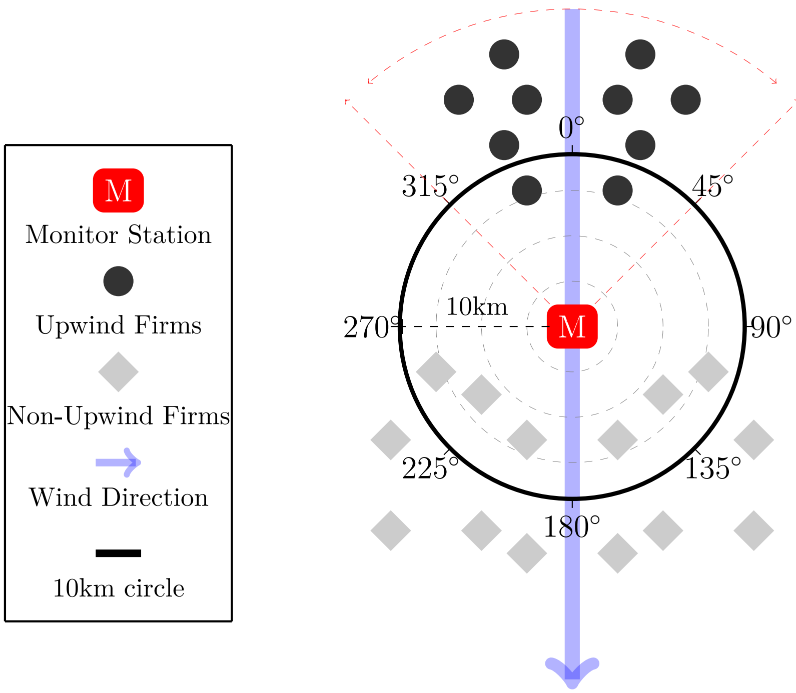


Notes: This figure shows the relative increase in enforcement for each distance bin after 2015. Error spikes represent 95 percent confidence intervals. Formally, we estimate the following equation:

$$y_{ijpt} = \delta_i + \theta_{jt} + \eta_{pt} + \sum_{d=0-5km}^{15-20km} \beta_d m_{it}^d + \epsilon_{ijpt}$$

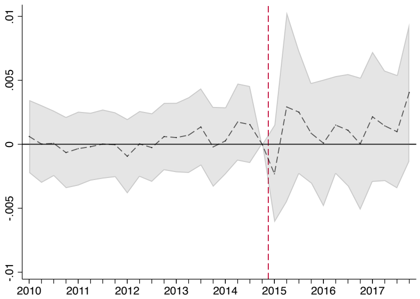
where m_{it}^d is an indicator for there being a monitor within distance d from firm i in quarter t; and all other variables are the same as in Equation 1. Hence, we are here estimating the average change in enforcement in the post-period relative to the pre-period.

Figure D4. Classifying Upwind Firms

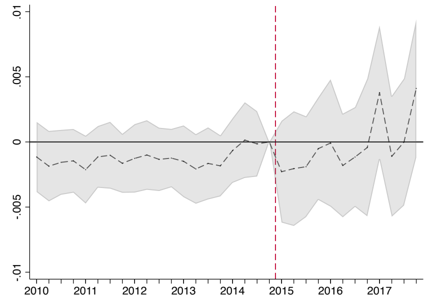


Notes: This figure illustrates our procedure for classifying whether a firm is upwind or not (i.e. whether the wind moves emissions towards the monitor or not). The thick blue arrow illustrates the dominant wind direction in a quarter. We follow previous work (Freeman et al., 2019) and define all firms that are within 45 degrees of the wind vector that passes through the monitor (i.e. the area confined by the dashed red lines) as upwind. Upwind firms are identified by black dots in the figure, while non-upwind firms are identified as grey diamonds. The 10km solid black circle illustrates the criteria used in the baseline specification to identify firms close to a monitor.

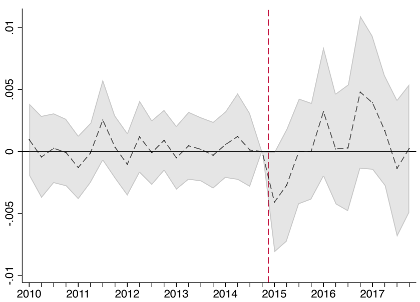
Figure D5. Firm-level: Placebo Nonparametric Event Study



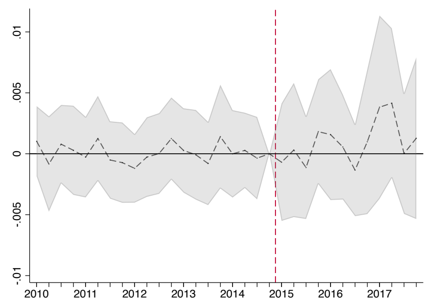
(a) 0–5 km (envir. bureau)



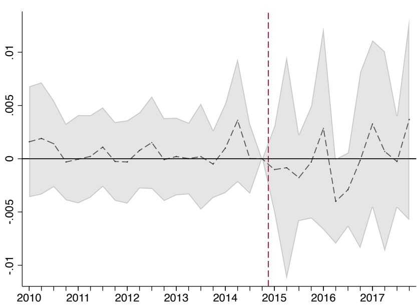
(b) 5–10 km (envir. bureau)



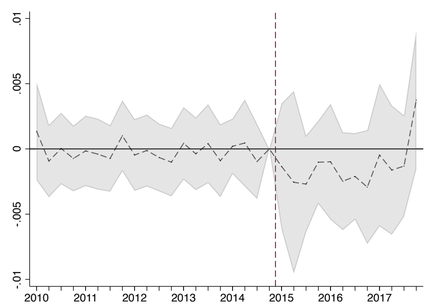
(c) 10–15 km (envir. bureau)



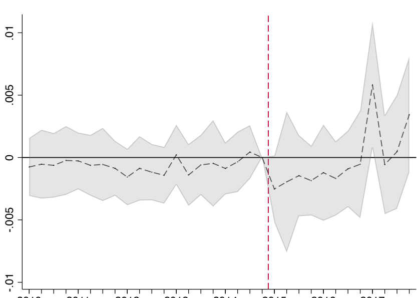
(d) 15–20 km (envir. bureau)



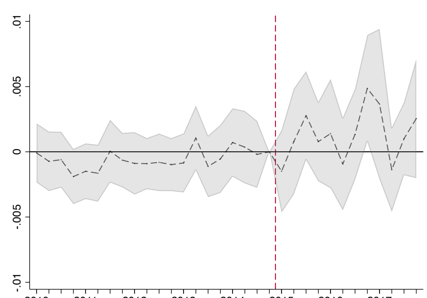
(e) 0–5 km (firm centroid)



(f) 5–10 km (firm centroid)



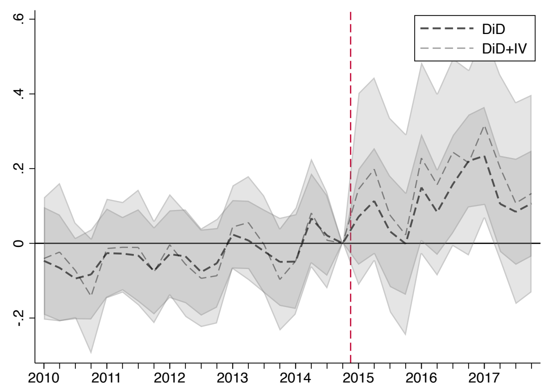
(g) 10–15 km (firm centroid)



(h) 15–20 km (firm centroid)

Notes: This figure shows the estimates of the nonparametric event study using Equation 1 for two placebo firm distances: kilometers to the local environmental bureau (figures a-d) or the kilometers to the city's firm centroid (figures e-h). The shaded area represents 95 percent confidence intervals calculated using robust standard errors clustered at the city level.

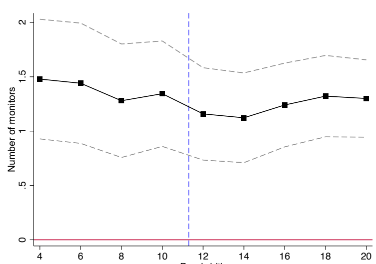
Figure D6. City-level: Enforcement Event Study



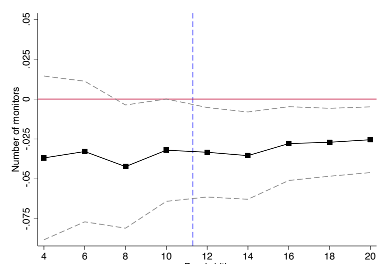
(a) DiD

Notes: This figure present the estimates from Equation 3 of city-level enforcement (log(# firms)) using two different specifications (DiD, DiD+IV). The shaded area represents 95 percent confidence intervals based on standard errors clustered on the city.

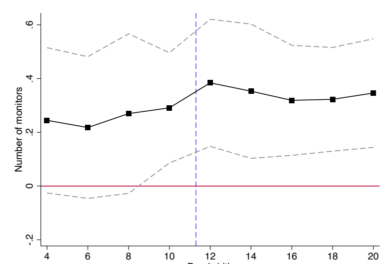
Figure D7. City-level: Alternative RD Bandwidths



(a) RD in Number (First-stage)



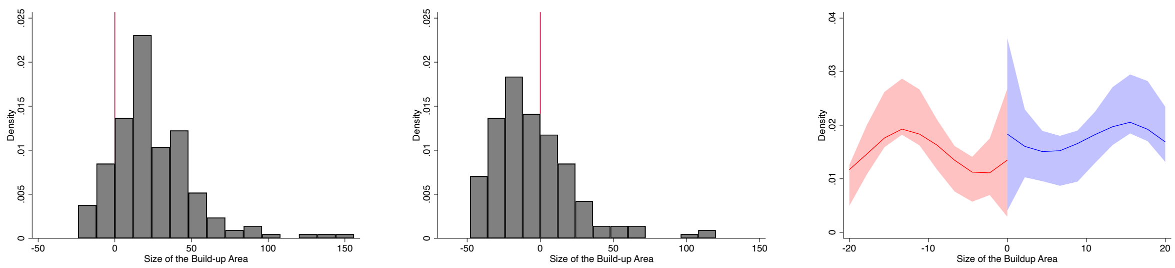
(b) RD in AOD



(c) RD in log(# firms)

Notes: These figures report the sensitivity of the RD coefficients to alternative bandwidths. The vertical axis shows the RD coefficients, while the horizontal axis shows the bandwidth used to estimate the respective coefficient. The blue dashed line marks the optimal bandwidth (11.3) using the approach suggested by Calonico, Cattaneo and Titiunik (2014).

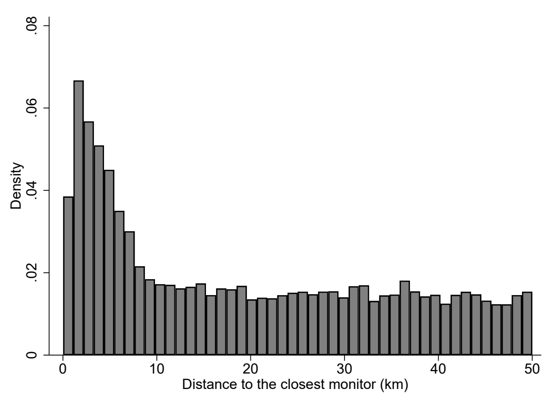
Figure D8. Histogram of Running Variables



(a) Cutoff 1: 20 (km^2) **(b)** Cutoff 2: 50 (km^2) **(c)** Estimated Density

Notes: The figures provide histograms and estimated densities of the size of the built-up area for our sample over the two cutoffs we use in the analysis. The p-value for the null hypothesis that the density of the size of the built-up area is continuous at the threshold is 0.642.

Figure D9. Distance to the Closest Monitor



Notes: This figure shows the distribution of the distance between ASIF firms and the closest monitor. The sample is restricted to firms that are located within 50 km from a monitor.

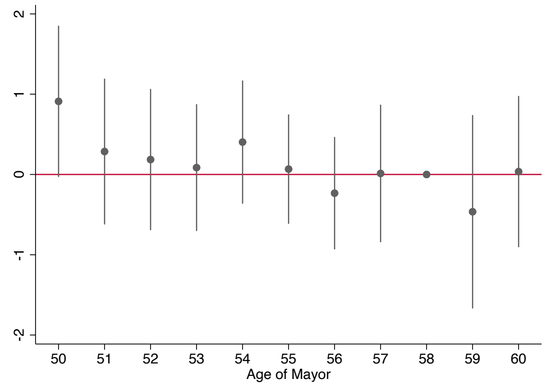
Figure D10. Media Reporting on Enforcement Around Monitors

(a) Search Results in Chinese

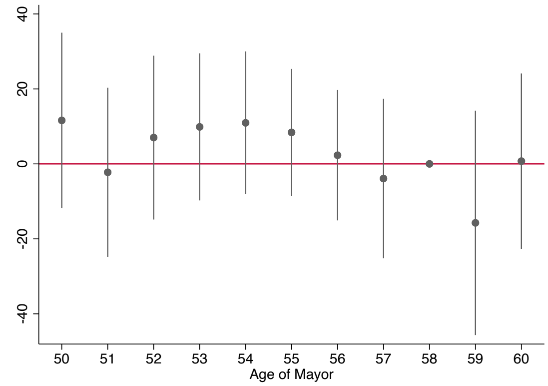
(b) Translation

Notes: This figure includes a screenshot and the corresponding translation of a list of news articles generated from a search on the Chinese search engine Baidu using the keywords “monitors”, “surrounding area”, and “check”. The list includes a large number of articles discussing how local governments step-up their environmental inspections around the monitors. Some examples include cities that draw special zones around their air quality monitors and send teams of inspectors to those zones, whose task it is to ensure that firms comply with national environmental regulations. Other sources mention that city governments hire volunteers from the public to inspect venues (such as restaurants) within a certain distance from the monitors. Finally, several sources suggest that mayors take a special interest in these inspections by, e.g., directly appointing officials to this task or by visit surrounding areas. **Sources**: www.baidu.com

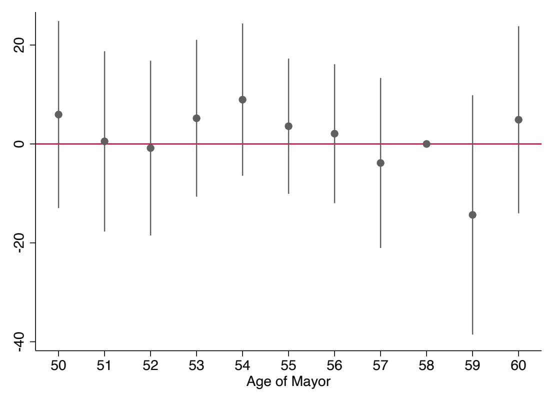
Figure D11. Balance Graphs: Mayor's Age and City Characteristics



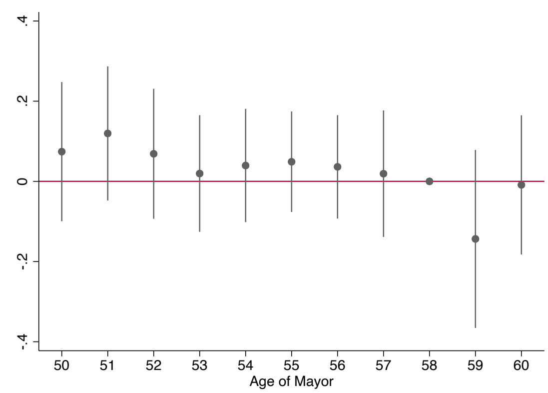
(a) Age vs # Monitors



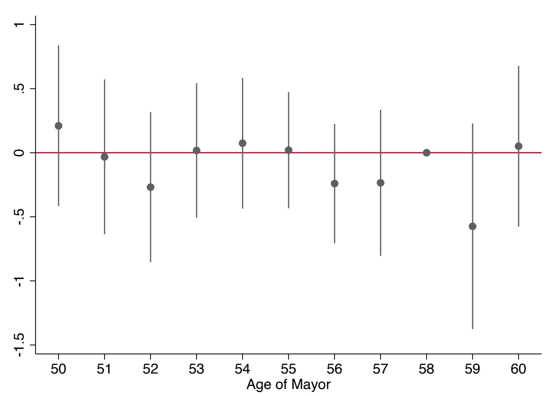
(b) Age vs Size of Buildup Area



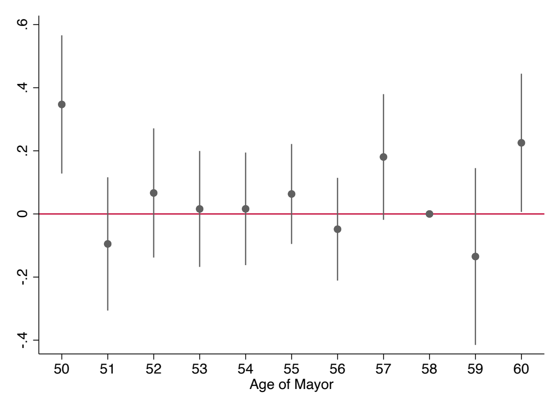
(c) Age vs Urban Population



(d) Age vs PM before 2015



(e) Age vs Night light before 2015



(f) Age vs Enforcement before 2015

Notes: These figures report the balance of cities' baseline characteristics by mayor's age at the time of the NPC, using the same approach as in Figure 6. Reported coefficients are relative to the effect for mayors who would be 58 years old at the time of the NPC. Error spikes represent 95 percent confidence intervals.