Leveling Up Your Green Mojo: The Benefits of Beneficent Investment*

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Abstract

Using a manually collected dataset on project investment and exploiting the staggered designation of the major cities for the environmental protection (MCEP) scheme in China, we show that firms increase their environmental investments after their city experiences heightened pollution prevention and control by the government. The effect is mostly driven by "beneficent investments" – environmental projects that not only benefit the firm but also directly spill over to society at large. Following the MCEP establishment, media coverage of environmental issues in local cities increases. City officials are more likely to be promoted if they meet pre-set environmental targets or reduce pollution. Firms spending more on green investments pay less taxes, garner more subsidies, and secure more bank loans. State-owned enterprises (SOEs) lead non-SOEs in green investment, whereas the latter exceeds the former eventually. MCEP cities with larger corporate environmental spending reduce pollution, improve local employment, and attract more high-quality new firms to a larger extent. Heavily polluting firms contribute less to the city's tax revenues and speed up their expansion to non-polluting sectors. Firms investing more in environmental projects – especially the beneficent ones – have larger value gains, produce more green patents, and experience greater labor productivity than other firms in the same MCEP city. Our findings highlight the role of regulatory mechanisms in enabling E&S investment to be both value- and welfare-enhancing.

JEL classifications: G31, G38, O13, Q5

Key words: Project investment; Climate finance; ESG; Corporate social responsibility; Environment; Pollution; China

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It may well be in the long-run interest of a corporation that is a major employer in a small community to devote resources to providing amenities to that community or to improving its government. That may make it easier to attract desirable employees, it may reduce the wage bill or lessen losses from pilferage and sabotage or have other worthwhile effects.

– Milton Friedman

1. Introduction

Despite a dramatic increase in investor demand for environmentally responsible investments and widespread public attention on environmental and social (E&S) issues, how to align socially optimal investments with privately optimal investments remains a significant challenge. Conceptually, it is difficult for the traditional corporate governance paradigm based on shareholder value maximization to explain shareholders' E&S engagement (Hart and Zingales 2022). Empirically, researchers have proposed various external mechanisms to facilitate corporate E&S adoption, including institutional ownership, limited liabilities, taxes, and various stakeholders (e.g., Akey and Appel 2021; Chen et al. 2020; Dai et al. 2021; Dyck et al. 2019; Krueger et al. 2020; Gantchev et al. 2022). Nevertheless, we have limited knowledge on the scope and effectiveness of these mechanisms.

In this paper, we explore the role of regulations on corporate environmental investments. Our goal is to understand to what extent regulatory mechanisms are effective in triggering changes in corporate policies on environmental projects, and under what conditions the regulation-induced environmental investment can be both sustainable and welfare-enhancing.

We exploit a regulatory event in China that has significantly elevated the intensity and compliance of environmental regulations in different cities at different times. In 2007, the State Council of China approved the National 11th Five-Year Plan for Environmental Protection. A critical element of the plan is to formally designate 113 cities as "major cities for environmental protection" (MCEPs). These cities are distributed across 31 provinces and account for 60% of the country's urban population. The list of MCEPs was revised in 2010 and then expanded to all 337 prefecture-level cities in mainland China in 2012.

The MCEPs are put forward as sample cities to improve local environment protection and enforcement, to participate in a nationwide environment supervision system, and to meet various environmental targets. These cities are also subject to stringent public scrutiny and periodic assessments from the central government. As a result, compared to other Chinese cities, the MCEPs are especially targeted for integrated pollution prevention and control, and are under tremendous pressure to achieve environmental protection goals.

To explore the effect of heightened environmental regulations on corporate investment policies, we construct a large sample of environmental projects conducted by Chinese listed companies during the period of 2001-2014. We manually collect data on project descriptions from firms' annual reports and perform textual analyses to identify whether a project is related to environmental protection. Among all the environment-related projects, we further distinguish between those solely benefiting firms' shareholders – mostly through sales expansion or cost reduction – without adding direct economic value to the society, and those also generating social externalities that benefit the local community to a larger extent.

We find that local firms increase their investments in environmental projects after their city becomes one of the MCEPs and thus subject to heightened environmental regulations. Interestingly, the effect is mostly driven by the "beneficent investments" – environmental projects that also directly yield positive externalities to stakeholders and local municipalities.

Our analysis controls for a host of firm-specific and city-specific time-varying characteristics. In addition, the ability to saturate the empirical models with high-dimensional fixed effects allows us to control non-parametrically for industry- and province-specific shocks and firm time-invariant characteristics. We also construct matched samples using various matching techniques, which allow us to narrow the comparison of environmental investments among firms with similar characteristics but differing in their exposure to the local regulatory shocks at different times.

Next, we explore potential mechanisms through which regulations may promote firms' engagement in environmental protection. We first collect news articles published by 485 major newspapers during the sample period. When conducting the textual analysis on media coverage of environmental issues in local cities, we distinguish between state-affiliated and market-oriented media, as well as between national and local newspapers. We find a significant increase in coverage intensity across all types of newspapers after the city's MCEP assignment, suggesting rising public attention and media scrutiny on the city's environmental issues.

Second, we investigate the career path of local bureaucrats. City mayors and party chiefs are more likely to be promoted if their cities achieve a larger proportion of pre-set environmental targets or reduce pollution. Lastly, after the establishment of MCEP, the city deploys more environmental subsidies, cuts taxes, and provides more debt credits. These policy changes provide financial incentives for local firms. Accordingly, firms spending more on green investments pay less taxes, garner more subsidies, and secure more bank loans. There is also limited evidence that state-owned enterprises (SOEs) lead green investments whereas non-SOEs follow.

Importantly, cities experiencing larger corporate environmental investments reduce pollution, improve local employment, and attract high-quality new firms to a greater extent after being selected to be the MCEPs. There is also a meaningful change in the composition of local firms. In MCEP cities with increased corporate spending on beneficent environmental projects, heavily polluting firms contribute a smaller fraction of tax revenues to their fiscal sources. These cities also rely less upon the sales revenues of polluting firms relative to those of non-polluting ones. Amid more stringent environmental regulations, heavily polluting firms expand into non-polluting sectors rather than staying within the existing polluting industries. Such a transition arguably further contributes to the improvement in these cities' environment.

Local firms spending more on environmental projects – especially the beneficent ones – have larger value gains and produce more green patents. They also improve labor investment efficiency and experience higher labor productivity than other firms in the same MCEP city. These findings imply that both short-term incentives and long-term benefits are at play in inducing sustainable corporate commitment to environmental investment.

Our paper adds to the growing literature exploring the determinants of corporate E&S policies. Existing studies establish that institutional investors are essential in shaping corporate environment policies (e.g., Chen et al. 2019; Dyck et al. 2019; Akey and Appel, 2020; Krueger et al. 2020). Others document the crucial roles played by stakeholders such as news media, customers, and employees (e.g., Dai et al. 2021; Gantchev et al. 2022). The real outcome and sustainability of corporate E&S engagement, however, have been subject to intensive debate. In particular, there is robust evidence on the agency problems associated with corporate E&S activities. For instance, Masulis and Reza (2015) find that corporate philanthropy advances executives' personal interests and leads to misuse of corporate resources. Bertrand et al. (2020) highlight its role in securing political favors and seeking influence on politicians. Duchin et al. (2022) show that firms use the asset divestiture market for greenwashing. Using granular data on project investment instead of relying upon E&S rankings or CSR scores, we focus on the role of regulation in promoting corporate E&S adoption and assess the short-term and long-term consequences of environmental investment. In this respect, our paper is closely related to recent work exploring the effectiveness and consequences of environmental regulations. On one hand, localized climate policies induce regulatory arbitrage by firms, increasing total firm emissions and undermining the effectiveness of the policy (e.g., Bartram et al. 2022). On the other hand, environmental regulations can curb firm-level toxic emissions, induce corporate innovation, and promote social externalities (e.g., Aghion et al. 2016; Brown at el. 2021; Najjar and Cherniwchan 2021; Chhaochharia et al. 2022). Our findings suggest that incentives are also at play in inducing E&S investments, and that the design of an effective regulatory mechanism can ensure a sustainable E&S engagement that is welfare-enhancing.

Our paper is also related to a nascent literature in finance highlighting the importance of regulatory environmental risks. For instance, environmental regulatory costs can significantly impact firms' operating costs and cash flows (Karpoff et al. 2005). Regulatory climate risks increase tail risks in stock prices (Ilhan et al. 2019), help price the cross-section of portfolio returns of polluting firms (Hsu et al. 2022), and are rated highly by institutional investors for the financial materiality for their portfolio firms (Krueger et al. 2020). Firms located in states with stricter environmental regulations suffer lower credit ratings and higher bond yield spreads for poor environmental performance (Seltzer et al. 2022). We contribute to this strand of the literature by centering on a regulatory event that allows for better identification and assessment of a firm's response to such changes.

The rest of the paper is organized as follows. Section 2 introduces the institutional background. Section 3 describes the data and methodology. Section 4 explores the effect of heightened environmental regulations on corporate environmental investments. Section 5 investigates potential mechanisms. Section 6 compares the economic and environmental implications of corporate environmental investments. Section 7 concludes. Variable definitions are in Appendix A. Detailed descriptions of the textual analysis are in the Internet Appendices.

2. Institutional Background

China's rapid economic growth has been accompanied by a high level of environmental degradation. The conflicts between economic growth and environmental protection have become increasingly prominent in recent decades. Recognizing that ecological deterioration poses a severe threat to human health and impedes sustainable economic growth, starting in 1996, the Chinese central government incorporated environmental protection targets in its Five-Year Plans (FYPs). Since the 1950s, these FYPs have provided guidance for national projects and set intermediate- and long-term economic and social goals of the government. They have profoundly influenced China's national economy and social life.

Nevertheless, China failed to reach the environmental protection targets specified in the 9th FYP (1996-2000) and 10th FYP (2001-2005). Although both central and local governments advocate environmental protections in their reports and policies, local politicians still prioritize GDP growth at the expense of deteriorating environment. One main reason behind the lack of desire to pursue costly environmental protection is the career concern of local bureaucrats (Li and Zhou 2005). Since the economic reform in the 1970s, GDP growth has been the most critical evaluation criterion for Chinese local bureaucrats. Consequently, to move up the hierarchical leadership ladder, they favor boosting local economic growth over spending recourses to clean up local environment.

In recognizing the local resistance to adhering to the national environmental protection policies, the 11th FYP (2006-2010) formally installed a number of measures intended to increase compliance with environmental targets and intensify environmental regulations. For instance, the Central Committee of the Communist Party issued new rules on the promotion of local politicians. Starting in December 2005, local government leaders, including city mayors and party secretaries, are held accountable for reaching the ecological protection goals in their administrative region set by the central government. The top-down, target-based approach ensures that local bureaucrats are tied to meeting higher-level mandates in order to advance their careers. For the first time, environmental performance became an integral part of the performance evaluation scheme of local politicians (Chen et al., 2018). New projects are to be examined to see if they meet environmental standards. The State Environmental Protection Agency (SEPA) was elevated to full ministry status in 2008, strengthening its position for ensuring compliance with environmental regulations and laws.

As a critical part of the 11th FYP, the state council also approved the National 11th Five-Year Plan for Environmental Protection in 2007, aiming at expounding the objectives, tasks, investments, and key policy measures in the field of environmental protection during the 11th FYP period. The plan identifies the responsibilities and tasks of the government and the environmental protection departments at all levels, guiding and mobilizing the participation of enterprises and local communities to contribute to an environmentally friendly society.

One key element of the plan is the formal establishment of 113 cities as "major cities for environmental protection" (MCEPs).[2] Located across 31 provinces and covering 60% of the urban

[2] See, for instance, http://www.chinanews.com.cn/gn/news/2007/11-26/1087489.shtml.

population in mainland China, these cities were put forward as sample cities to construct a nationwide environment supervision system and to promote air regulation and pollution prevention.

Targeted for integrated pollution prevention and control, these cities are required to improve local environment protection and enforcement, closely monitor air quality, establish the Photochemical Smog Pollution Early Warning System, and meet various environmental targets. They are also subject to public scrutiny and periodic assessments from the central government. As a result, compared to cities excluded from the list, the MCEPs face elevated political pressure and incentive to achieve environmental protection goals. Their environmental performance is also closely watched every year by the public and the central government.

The selection criteria of the MCEPs follow two separate tracks. Among the 113 MCEPs, 43 are selected according to Article 17 of China's 2000 Air Pollution Prevention and Control Act, most of which are municipalities, provincial capitals, coastal cities in special economic zones, and key tourism cities. The remaining 70 cities are selected if (1) they are located in provinces with a greater chance to meet the air quality target set in 2005, (2) they are subject to requirements mandated by the 10^{th} Five-Year Plan on Acid Rain and Sulfur Dioxide Pollution Control to meet the target standard in 2005, and/or (3) air pollutions of the cities are currently high but the cities are likely to meet the air quality target set in 2005 during the course of the 11^{th} FYP.

The list of MCEPs is modified in 2010, with 7 more cities added and 7 removed from the list. In February 2012, the National 12^{th} Five-Year Plan for Environmental Protection expanded the list of 113 MCEPs to all 337 prefectures and municipalities in mainland China.

Appendix B provides the distribution of the MCEPs, collected from the Notice of the State Council on Issuing and Distributing the National Environmental Protection "Eleventh Five-Year Plan". Figure 1 presents the spatial distribution of the MCEPs. It is evident that the distribution of the MCEPs does not cluster in certain specific regions, and that the selection of the MCEPs is not correlated with their pre-existing pollution level.

3. Data Sources and Sample Construction

3.1 Environmental and Non-Environmental Projects

From the China Stock Market and Accounting Research (CSMAR) database, we compile a sample of 2,740 firms (24,854 firm-year observations) publicly listed on the Shanghai and Shenzhen Stock Exchanges during the 2001–2014 period. We then remove 375 firm-year observations that are financial firms and 3,085 firm-year observations with missing information on the variables used in our empirical analyses. The final sample consists of 2,484 firms (21,394 firm-year observations).

For each sample firm in each year, we obtain its annual report from the CSMAR database and manually extract the Appendix of On-going Projects, which describes new projects that the firm has invested in that year, including the name and amount of investment of each project.[3] Our project sample thus includes 196,700 projects during the sample period.

To identify environmental projects, we conduct textual analyses by first building a bag of words and phrases related to the environment. Widely used in the finance literature, this dictionary-based method is suitable when researchers have good prior knowledge about what they are looking for (Fisher et al. 2022; Sheng et al. 2022). In this paper, the dictionary-based method is proper because our focus is environment-related keywords.

[3] As part of the annual report for a listed company, the Appendix of On-going Projects is subject to the same mandate disclosure standard and audit requirement. There is still significant heterogeneity in project descriptions, as some would present much more granular information.

In general, extracting environment-related information from text sources can be challenging. As highlighted in Sauter et al. (2022), discussions on climate- or environment-related issues employ niche language and often involve substantial ambiguity, and the vocabulary used is fast moving. These challenges are further amplified in the context of our analysis, as words used to name and describe a project are often technical and project specific. For this reason, we rely on human classifications to assemble environment-related keywords.

We start with a random sample of 30,000 projects. A team of 5 research assistants (RAs) read the project name descriptions and perform internet searches if necessary, extracting environmentally meaningful words and short phrases. This allows us to compile a bag of words consisting of 467 unique environment-related words and phrases. Internet Appendix IA.1 tabulates the list of these words and phrases.

Next, we build an initial sample of environmental projects out of the 196,700 projects, classifying a project to be an environmental one if its name description contains at least one of these words/phrases. Note that while this approach potentially allows a non-environmental project to be included in the sample, it minimizes the likelihood that an environmental one is excluded.

Two common concerns associated with textual analysis involving manual classification are classification errors and (systematic) human judgement biases.[4] To address these challenges, we randomize by deploying two new teams of RAs. The first team of 5 RAs audit the projects already included in the above initial sample. The goal is to reduce the Type I error and weed out those misclassified as environmentally related investments. The RAs read each project name description and perform internet searches, validating those identified by the bag of words to be indeed environment-related and removing those that are misclassified.

[4] See related discussions in Bhattacharya et al. (2009).

The second team of 26 RAs audit the remaining projects from the 196,700 sample that are excluded from the above initial sample. The goal is to reduce the Type II error and pick up those misclassified as unrelated to environmental investment. Through reading project name descriptions and conducting internet searches, they identify any projects that are in fact environmental projects.

The final sample consists of 18,756 environmental projects from 1,489 firms. This accounts for 9.54% of total projects invested during the sample period. Other data sources are described as we introduce them in the analysis.

3.2 Firm-Specific and Non-Firm-Specific Environmental Projects

Firms may engage in environmental projects because they solely benefit the shareholders through sales expansion or cost reduction without directly adding economic and social value to society. An example would be that a firm installs new water-saving systems or solar panel roofing in its production plants or invests in energy-saving and thermal insulation bricks for the exterior walls of its factories. These projects generate cost savings within the firm that directly benefit the firm's shareholders. We label these shareholder-oriented ones to be *firm-specific* environmental projects.

An environmental project may also be a "beneficent" one, bringing in a prominent spillover to stakeholders or local communities. An example would be that the firm invests into a sewage treatment plant, which produces direct social benefits for the local citizens. We label these to be *non-firm-specific* environmental projects.

We acknowledge that there is no clear-cut way to distinguish whether a project is indeed beneficent. For instance, a firm installing solar panel roofing not only directly reduces its utility bills, but also indirectly leads to a cut in the coal-mining related pollution by lowering its demand for electricity. We note that what we employ is a bottom-line approach, separating these two types of environmental investments by judging if the project generates *direct* societal consequences.

To classify whether an environmental project is beneficent, we employ another team of 14 RAs. For each of the 18,756 environmental projects, we assign two RAs to read the project description and, through internet searches and cross-references, independently judge whether the nature of the project results in a direct benefit to the firm's shareholders (such as cutting the costs or expanding the sales) or also spill over to the society at large. Examples of the former would include the launch of an energy-saving fluorescent lamp production line, the installation of high-efficiency boilers and furnaces, or the construction of a solvent recovery and recycle plant. Examples of the latter include sewage treatment stations, anti-corrosion water and floor works, and exhaust gas treatment system. In cases where two RAs disagree on the classification, a third RA serves as a tiebreaker, reading independently the project description and forming his or her own classification.

Out of 18,756 environmental projects, 11,037 are stakeholder-oriented from 1,200 firms and 7,719 are shareholder-oriented from 1,045 firms, and 756 sample firms have invested in both types of environmental projects. Appendix C presents the industry distributions of firm-specific and non-firm-specific environmental projects as well as firms engaging in such projects. The last column tabulates the number of firms in each industry that invest in both firm-specific and non-firm-specific environmental projects during our sample period.

3.3 Variable Definitions

We consider three types of environmental investments by a sample firm. First, we define *EI*(*Total*) as the amount of corporate investment in new environmental protection projects, scaled by sales and multiplied by 100. In a nutshell, we aim to capture the extent to which a firm is willing to allocate the revenue it earned to environmental investments. We further break down such investments into projects that also likely benefit the society at large (*EI*(*Non-Firm-Specific*)) and those that more specifically direct the value to the firm's shareholders (*EI*(*Firm-Specific*)).

To compare corporate environmental investment behaviors before and after the tightened environmental regulation and compliance, we construct *Post*, a dummy variable set to one if the firm is headquartered in a city in the years after the city is designated to be an MCEP, and zero otherwise.

3.4 Summary Statistics

Panel A of Table 1 summarizes sample firm characteristics. All continuous variables are winsorized at the 1% and 99% levels. To facilitate the interpretation, we report both unscaled and scaled forms of our variables for environmental investments. On average, a firm spends 29.242 million RMB on environmental projects per year, accounting for 1.014% of its revenue. This is equivalent to 7.381% of its Capex, and 17.15% of its on-going project investments (untabulated). An average sample firm spends 14.535 million RMB – or 0.551% of its revenue – on beneficent projects, accounting for 4.006% of its Capex and 8.026% of its on-going project investments. It spends 9.732 million RMB – or 0.32% of its revenue – on projects that directly boost values for its shareholders, accounting for 2.927% of its Capex and 5.85% of its on-going project investments.

Among those firms that have made environmental investments at least once during our sample period, on average environmental spending accounts for 3.227% of their revenue, 23.34% of their Capex, and 48.61% of their on-going projects per year. Beneficent environmental projects account for 1.752% of their revenue, 12.86% of their Capex, and 22.75% of their on-going projects per year. Firm-specific ones, on the other hand, account for 1.019% of their revenue, 9.524% of Capex, and 16.58% of on-going projects per year.

An average sample firm has 6.8 billion RMB assets, and a leverage ratio of 47.9%. Institutional investors hold 38.7% of firm shares. These are similar to those documented in the prior literature on Chinese listed companies (e.g., Giannetti et al. 2015).

Panel B of Table 1 compares corporate environmental investments before and after the establishment of MCEPs. On average, a sample firm spends 16.148 million RMB on environmental projects before the MCEP designation, which accounts for 0.867% of its revenue. Post MCEP, an average firm spends 37.591 million RMB, accounting for 1.07% of its revenue. Though untabulated, 53% of the sample firms engage in environmental investments prior to the MCEP assignment. The percentage increases to 57.1% after the MCEP establishment. In particular, while 40.7% of the sample firms contribute to non-firm-specific projects before the MCEP, a greater percentage – 46% of them – do so after the MCEP. The differences are significant at the 1% level.

4. MCEP Assignment and Corporate Environmental Investment

4.1 Corporate Reactions to Intensified Environmental Regulations

To explore how the staggered establishments of the MCEP affect corporate environmental investment, we estimate the following regression model:

$$y_{i,t} = \beta Post_{i,c,t} + \boldsymbol{\gamma X_{i,c,t}} + \alpha_i + \theta_{b,t} + \delta_{p,t} + \tau_t + \epsilon_{i,t},$$

where $y_{i,t}$ captures firm i's investments in environmental projects during year t. The dependent variables are *EI*(*Total*), *EI*(*Non-Firm-Specific*), and *EI*(*Firm-Specific*), respectively. $\boldsymbol{X_{i,c,t}}$ includes controls for time-varying firm characteristics, such as firm size, defined as the natural logarithm of total assets; leverage, calculated as total liabilities divided by total assets; profitability, captured by the firm's ROA; cash holdings, defined as cash and cash equivalent scaled by total assets;

growth opportunities as captured by market to book value of assets; firm age; and a dummy for state ownership. We also consider the firm's governance characteristics, such as board independence and institutional ownership (Krueger et al. 2020) as well as the extent of local economic development, as captured by the city's GDP growth.

Lastly, we control for a host of fixed effects, including firm fixed effects (α_i), year fixed effects (τ_t), industry × year fixed effects ($\theta_{b,t}$), and in some specifications, province × year fixed effects ($\delta_{p,t}$). The inclusion of industry × year fixed effects helps narrow our comparison of environmental investments among firms operating in the same industry in the same year but located in cities that experience a different intensity of environmental regulations. The province × year fixed effects control nonparametrically for province-specific shocks. Standard errors are clustered by city and year.

In Table 2, we examine how sample firms alter their environmental investment policies after the establishment of MCEP. Following the MCEP assignment, firms in an MCEP city allocate more capital to environmental projects (columns 1-3). There is heterogeneity in their selection of environmental projects: Firms engage more in projects that also bring benefits to society to a larger extent (columns 4-6). The economic magnitude is also sizable. Columns 3 and 6 suggest, respectively, that a local firm increases environmental project investment by 11.375 million RMB and spends 2.627 million RMB more for these beneficent ones after the MCEP establishment. On the other hand, heightened environmental regulation does not lead to a significant change in the firm's investments in shareholder-oriented projects (columns 7-9).

We obtain these estimates with controls for firm and year fixed effects as well as interactions of industry and year fixed effects and province and year fixed effects. This allows us to control non-parametrically industry- and province-specific shocks as well as any shocks associated with the firms' local economic environment. Overall, Table 2 provides evidence that local firms react to a rising intensity of environmental regulations by increasing their investments in environmental projects. The effect is mostly driven by their investment in stakeholder-oriented projects rather than shareholder-oriented ones.

4.2 Robustness

4.2.1 Matched Samples

The results so far indicate that responding to a staggered change in the intensity of environmental regulations brought about by the MCEP designations, firms in these cities spend more on environmental projects. To mitigate the effects driven by omitted variables, we control for firm and year fixed effects, as well as industry × year fixed effects and province × year fixed effects.

To further alleviate the concern that observable differences across firms located inside and outside the MCEP cities explain the differences in environmental investments, we form several matched samples and re-estimate our results in Table 2.

In columns 1-3 of Table 3 Panel A, we apply the propensity score matching method to form a matched control group. Specifically, using the same set of control variables in Table 2, we perform one-to-one nearest neighbor matching to select the control group sample for the treatment group. In columns 4-6, we construct the control sample using coarsened exact matching (CEM), which can improve the estimation of causal effects by reducing imbalance in covariates between treated and control groups. In columns 7-9, we use an entropy balanced matching approach to form a comparable control group, balancing with respect to the first three moments of observable firm characteristics across firms in treated group and control group. This newly balanced data structure ensures that the features of firms located within and outside the MCEPs are similar in terms of mean, standard deviation, and skewness (Hainmueller 2012).

Panel A of Table 3 reports the regression results based on these matched samples. The effect of MCEP assignment on corporate environmental investment remains robust when we closely match firms that are affected by the MCEP to those that do not.

4.2.2 Other Selection Issues

A firm may register its business in one city but elect to operate in another city. In this case, the firm may be misclassified into the treated group if the city where it has registered becomes an MCEP whereas the city where it conducts most of its businesses does not face intensified environmental regulations. To check the robustness of our results, in columns 1-3 of Table 3 Panel B, we exclude firm-year observations whose business locations differ from registration locations.

Alternatively, we exclude firm-year observations in the year of establishing an MCEP (columns 4-6). To limit the potential impact of confounding events over longer horizons, we also restrict our analyses to a rolling window with fixed length – three years before and three years after the MCEP assignment (columns 7-9).

Table 3 Panel B reveals that our findings are not sensitive to the sample restrictions nor to the selection of the sample period. We continue to observe that firms boost their environmental investments, especially the beneficent ones that benefit stakeholders to a larger extent, following the establishment of the MCEP.

4.2.3 Alternative Measure for Environmental Investment

Due to the staggered establishment of the MCEPs, our control sample is not limited to firms without environmental investment, but also includes firms that eventually initiated or have already carried out environmental projects. To mitigate the concern that firm-specific shocks correlated with the timing of the MCEP establishment may drive our findings, we exclude firms that have no environmental project investment throughout the sample period. In these tests, the control sample includes only firms that spend or have spent on environmental projects at a different time in comparison to firms that respond to the MCEP establishments. Firms in this restricted control sample are therefore more likely to experience the same shocks as these that are affected by the MCEP designations.

For this set of analyses, we consider indicator versions for our project investment. *Dummy for EI*(*Total*), *Dummy for EI*(*Non-Firm-Specific*) and *Dummy for EI*(*Firm-Specific*) are, respectively, dummy variables set to one if, in a given year, a firm invests in any environmental project, in any environmental project that is valuable to the society, and in any project that directly benefits the firm's shareholders.

Panel C of Table 3 explores the likelihood of sample firms engaging in environmental investments after the establishment of MCEP. We observe that following the MCEP assignment, firms in an MCEP city are more likely to begin investments in environmental projects (columns 1-3). Firms are more likely to select projects that also yield societal benefits to a larger extent (columns 4-6), whereas they do not change their investments in environmental projects that directly benefit their shareholders (columns 7-9).

Overall, the results are consistent with the baseline findings in Table 2.

4.2.4 Falsification Tests

Our empirical design explores the staggered designations of MCEP, which affect differently firms located in a MCEP city and those that are not. In this section, we perform a placebo test to verify that the results are indeed induced by this regulatory event. Specifically, we counterfactually assign three years prior to the actual event ($t-3$) as an artificial enactment time for the MCEP.

We then rerun our regressions and report the placebo test results in columns 1-3 of Panel D of Table 3. We observe no significant loading for the pseudo post dummy, suggesting that the results we obtain from the MCEP assignments are unlikely to be driven by other confounding factors. In untabulated regressions, we find similar results when we falsely assign three years ($t+3$) after the actual event or vary the pseudo post variable by five years instead of three years.

It is also possible that a general trend such as a gradually increasing public awareness drives our findings. After the 2009 Copenhagen Accord, state-owned firms around the world improved their environmental performance more than other firms (Hsu, Liang, and Matos, 2018). As such, the findings that we document may capture a firm's direct reaction to the 2009 Copenhagen Accord instead to the regulatory event establishing the MCEPs. To evaluate this possibility, we redefine our pseudo post dummy as a dummy variable set to one if environment project investment occurred in 2009 or after, and zero otherwise. For this set of tests, we cannot include year fixed effect. Columns 4-6 of Panel D indicate that the change in corporate investments in environmental projects is unlikely driven directly by the 2009 Copenhagen Accord.

4.2.5 Alternative Estimators

Our empirical approach exploits the staggered MCEP establishments, which allow us to compare over time investment strategies of firms located in different cities with exposure to the heightened environmental regulations at different times. Such two-way fixed effects (TWFE) regressions are the most-commonly used approach in economics to estimate the policies' effects. Nevertheless, recent studies argue that the TWFE estimates may be biased, and the causal inference compromised, if the effect of the policy is heterogeneous among groups or over time, even under random assignment of treatment (e.g., Baker et al. 2022; de Cahisemartin and D'Haultfoeuille 2022).[5]

To mitigate the concern for biases in the estimators from TWFE staggered DiD regressions, we follow Baker et al. (2022) and re-estimate our baseline tests using the standard TWFE and stacked regression without time-varying covariates. This approach helps "understand the robustness of the effect estimates and the degree to which they rely on the inclusion of controls."[6]

We first replicate the TWFE estimates of the effects of MCEP establishments on local firms' environmental spending. Columns 1-3 of Panel E report the results without the inclusion of time-varying covariates. In columns 4-6, we report the stacked regression estimates. The stacked regression approach not only produces efficient estimators but more importantly, helps circumvent the problems introduced by staggered treatment effect heterogeneity. From Panel E, we continue to observe a significant increase in local firms' investment in environmental projects, particularly the beneficent ones, following the MCEP establishment.

Baker et al. (2022) recommend applying at least one of the three alternative estimators – stacked regression estimators and those developed by Callaway and Sant'Anna (2021) and Sun and Abraham (2021) – so as to circumvent the biases associated with TWFE DiD estimates. For binary and staggered treatments, de Chaisemartin and D'Haultfoeuille (2022) further highlight that the estimators proposed by Borusyak et al.'s (2022) may be more efficient than those of Callaway and Sant'Anna (2021) and Sun and Abraham (2021), while all three estimators allow for dynamic effects. For this reason, we calculate Borusyak et al. (2022) estimators and perform a dynamic

[5] The conventional approach to ensure causal inference in difference-in-differences method is to test for preexisting differences in trends, validating that the treated group does not already behave differently than the untreated group prior to the policy adoption. A recent literature has unveiled limitations and caveats associated with this approach. For detailed discussions, see Roth (2022) and de Cahisemartin and D'Haultfoeuille (2022).

[6] See Baker et al. (2022), page 394 and footnote 3.

analysis to examine whether firms already behave differently in their environmental spending prior to the MCEP assignments. Specifically, we include in the estimation, respectively, the indicator variables for years $t-5$, $t-4$, …, t, $t+1$, …, and $t+7$, where t is the year when the firm's headquarter city becomes an MCEP.

Panel F of Table 3 provides evidence that corporate environmental investment did not exhibit different trends already before the MCEP assignment, suggesting that the timing of the event fully supports the causal interpretation of the empirical evidence.

5. Mechanisms

The results so far indicate that firms spend more on environmental projects when their cities face intensified environmental regulations. To provide some insights on how these events led firms to engage in more environmental investments, especially the beneficent ones, in this section, we explore several potential mechanisms.

5.1 Media Attention

We consider media coverage of environmental issues in local cities. To do so, we collect all 10,630,185 news articles published during the sample period in 485 newspapers included in the CNRI's China Core Newspaper database. The 485 news outlets account for a great majority of media coverage in China, including both national and local newspapers.

We construct a list of environment-related key words in Mandarin by manually reading a random sample of 1,200 news articles. Since there is more than one way to refer to environmental issues, our list of words includes a large array of terms. Internet Appendix IA.2 provides the list of words and phrases used to identify media coverage of local environmental issues. Note that the list to identify a firm's environmental projects (Internet Appendix IA.1) differs from the one for environmental news reports, though there is a large overlap between the two. This is because the former comes from firm disclosures on individual projects, which tend to be technical and specific, whereas the latter contains terms used by mass news media, which refer to more general issues and concepts.

For each city and year, we count the number of news articles mentioning the name of the city in association with environmental issues. Since biases in news coverage can arise from media types (You et al., 2017), we distinguish between state-affiliated and market-oriented news outlets, as well as between national and regional newspapers. We control a host of regional factors that can affect the extent of news coverage, readership, and distribution of media outlets. Such factors include the city's local population, the number of local colleges, and local economic conditions such as its GDP growth, fixed asset investment scale, service sector output, and fiscal surplus. Lastly, we control for city and year fixed effects.

The estimates in Table 4 show that the intensity of media coverage for a city's environmental issues increases after it becomes a MCEP, and thereby subject to more stringent environmental regulations. The rise in media coverage occurs across all types of news outlets, including state-affiliated (column 2) and market-oriented (column 3) newspapers, and national newspapers (column 4) and local newspapers (column 5).

There is a heterogeneity in the economic magnitude of coverage intensity. The chi-square (χ^2) statistic testing the difference in coefficients for *Post* between columns 2 and 3 is 5.21 (p = 0.023), and between columns 4 and 5 is 34.46 (p = 0.000). These results suggest that after MCEP establishment, the increased intensity for state-affiliated media coverage on a city's environmental issues is significantly larger than that for market-based media, and the increase in coverage intensity by local news media is significantly larger than that by national media.

Arguably, the increased media coverage intensity generates greater public scrutiny and applies more pressure to local politicians and firms.[7]

5.2 Politician's Career

Existing literature has documented ample evidence that the actions of Chinese local leaders, who supervise the design and implementation of various policies and deploy resources across local firms, are guided by career concerns (e.g., Li and Zhou 2005). As environmental protection is now part of the performance evaluation of local politicians after the MCEP assignments, politicians are better incentivized to improve the local environment.

We manually collect biographies of city mayors and party chiefs from Local Official Directories.[8] In case where the official bio of a local politician is vague about the detailed career path, we perform extensive internet searches to track his/her career movement.

Table 5 investigates the effect of MCEP on the likelihood of future promotion. We start by interacting the post MCEP dummy with measures of local environmental pollution: the air quality, calculated as the natural logarithm of the level of PM2.5 pollutant in the air (*PM*2.5), industrial sulfur dioxide emissions (*SO*2), industrial effluent emissions (*Effluent*), and carbon emissions (*Carbon*). In selecting the indicators for environmental quality, we focus on those that are less likely influenced by the specific locations of the cities so that these proxies are meaningfully comparable across geographic regions and over time.[9] We also aim to capture a broader range of

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[7] Rather than a rise in media and public scrutiny leading to more corporate environmental investment, it is possible that the increase in coverage intensity after MCEP is driven by news media's reaction to the increase in a local city's corporate environmental spending, To consider the possibility of reverse causality, we examine the effect of corporate environmental investment on future news coverage by regressing environmental news coverage in year $t+1$ on the post dummy as well as, respectively, *Post* × *EI*(*Total*), *Post* × *EI*(*Firm-Specific*), and *Post* × *EI*(*Non-Firm-Specific*). We do not find evidence that an increase in corporate environmental investment, brought about by the MCEP establishment, leads to subsequently more news coverage on a city's environmental issues.

[8] See (in Chinese), https://ldzl.people.com.cn/dfzlk/front/firstPage.htm.

[9] For instance, dust, a common indicator for pollution, may not be a suitable metric as northern parts of China are colder with a climate prone to dusty days. In contrast, many of the southern regions in China are warmer, closer to the ocean, and tend to experience less severe dust exposure.

pollutions, instead of targeting only one dimension of pollution such as air quality. Finally, we follow the literature and scale the last three pollution emission variables by GDP per capita, as they are closely related to industrial production and local economic development.

The coefficient estimates in columns 1-3 suggest that after the MCEP assignment, city mayors or party chiefs are more likely to be promoted in the next three years if the quality of their cities' environment improves. The estimates in column 2 imply that after the MCEP assignment, a one-standard-deviation decrease in SO_2 emissions is associated with a 9.244% (= 3.349 × -0.022 / 0.797) higher propensity of being promoted in the following three years.[10]

To further link local officials' performance on environmental protection to their career advancement, for each city and year, we calculate the fraction of pre-set environmental targets by the government that are achieved. To do so, we manually collect annual reports on the work of the government for all the cities during the sample period from China Statistical Yearbooks and government websites and through internet searches. Our sample contains 2,648 reports on the work of the government issued by 282 cities during the sample period.

For each report, we extract and count the types of environment-related indicators mentioned in the report. To ensure comparability across cities, we focus on the four most frequently used indicators – energy conservation and emission reduction, forest coverage rate, air quality excellent rate, and environmental protection investment. Each report usually specifies the current levels of these environmental indicators, as well as the targeted levels of these indicators that the local government aims to achieve in the following year. We then read the reports and track

[10] Unlike the senior officials of the central government, turnovers of city-level officials are much more frequent. While their term in theory lasts for five years, it is common that many transition to different posts even in the early period of their first term.

whether a pre-set environmental target has subsequently been accomplished.[11] For each city and year, we calculate the fraction of pre-set targets attained.

Column 5 of Table 5 shows a positive coefficient associated with the interaction between the post MCEP dummy and *% of Targets Achieved*. This suggests that after the MCEP assignment, city mayors and party chiefs are more likely to be promoted in the next three years if they have fulfilled a larger percentage of pre-set environmental targets. A one-standard-deviation increase in the percentage of environmental targets accomplished is related to 11.535% (= 0.306 × 0.193/0.512) higher propensity that the city official is promoted in the next three years.

Taken together, the results from Tables 4 and 5 suggest that local politicians face not only increased public monitoring, but also intensified political pressure. Both the media and political career incentives are at play in boosting their effort to improve local environment.

5.3 Firm-Level Incentives

The helping-hand theory of government suggests that government can directly spur investment by providing subsidies, tax credits, and bank loans. We first validate that the establishment of MCEP leads to a change in city policy. Table 6 Panel A indicates that after becoming an MCEP, a city gives out more environmental subsidies to firms, reduces corporate taxes, and increases bank loans.

Next, we consider whether these incentives materialize for firms engaging in environmental investments. Columns 1-3 of Table 6 Panel B explore the effect of environmental investments on firms' tax obligations, calculated as the amount of taxes paid scaled by the firm's total profits. We remove observations with negative profit or with a tax rate exceeding 100%.

[11] To illustrate, a city's 2008 report on the work of the government states that the government aims to increase forest coverage rate from 68% to 72.9% by 2009. This environmental target is considered to be achieved if the city's 2009 report shows that the forest coverage rate reaches 73%. Conversely, we consider the city not accomplishing such a target if its 2009 report shows a forest coverage rate of 69%.

Following the MCEP assignment, taxes decrease for firms that spend more on environmental projects. Column 1 suggests that a one-standard-deviation increase in *EI*(*Total*) is associated with a 12.051 (= -0.030 × 4.017 × 100) percentage points decrease in taxes after the MCEP. This is equivalent to a 22.40% (= 0.121/0.540) decrease for the average firm.

Columns 4-6 investigate the effect of environmental investments on government subsidies. From the CSMAR database, we obtain information on the total amount of environmental subsidies received by a sample firm from the city government each year and scale it by the firm's operating income. Similarly, we observe that environmental subsidies increase for firms with larger investments in environmental projects across all project types after their city is designated as an MCEP. Column 4 suggests that a one-standard-deviation increase in *EI*(*Total*) is associated with a 20.617 (= 0.054 × 3.818 × 100) increase in environmental subsidies relative to a firm's operating income after the MCEP.

Another common practice for government to support local businesses is to provide them with easier access to external finance, often by funneling cheap credit through the banking system. Columns 7-9 of Table 6 examine whether boosting investments in environmental projects results in more bank loans, calculated as the sum of short-term and long-term bank loans scaled by total assets. Following the MCEP assignment, firms in their MCEP city obtain more bank loans when they engage in more environmental project investments. Overall, it appears that firms harvest (short-term) benefits from their environmental investments: they enjoy lower taxes, garnish more environmental subsidies, and expand their credit capacity.

Interestingly, Panels A and B of Table 6 suggests that post MCEP designation, firms pay less taxes, obtain more environmental subsidies and access external bank loans as long as they spend more on environmental projects, regardless of whether the projects benefit shareholders or also directly generate social externalities. Given that the MCEP establishment alters a firm's investments into non-firm-specific, stakeholder-oriented projects, but not shareholder-oriented ones (Table 2), there is suggestive evidence that these financial incentives allow firms to shift their investment focus to those that generate more positive externalities.

5.4 SOEs versus non-SOEs

Compared to private firms, whose objective is to maximize profit and market value for shareholders (Friedman 1970), state-owned enterprises (SOEs) often shoulder social welfare obligations. Common in China and many emerging economies, SOEs may help emerging markets deal with market failures and externalities. Accordingly, Hsu, Liang, and Matos (2021) find that state-owned enterprises are more responsive to environmental issues. For this reason, in all of our regressions, we directly control state ownership. Table 2 reveals that on average, SOEs do not spend more than non-SOEs on environmental projects. The lack of significance associated with the state-ownership variable, however, produces only evidence on the average effect. In this subsection, we compare how investment behaviors differ between SOEs and non-SOEs over time.

Panel A of Figure 2 plots environmental spendings by the SOE sector (the orange bars) and by the non-SOE sector (the blue bars) over the sample period. We scale environmental project investments by total sales then multiply by 100. There is suggestive evidence that SOEs lead non-SOEs in the scale of environmental investment in the early part of the sample period, but non-SOEs catch up especially after year 2007, and eventually exceed SOEs in spending on environmental projects.

Panel B of Figure 2 plots the number of firms engaging in environmental projects. While the number of SOEs with environmental investments appears to be stable prior to 2007, it increased after 2007, when the MCEP assignments began. Nevertheless, the increase in SOEs with environmental project investments is mild. This may not be surprising since SOE's investment schedules are often subject to more stringent scrutiny and regulatory approval. By contrast, the non-SOE sector witnessed a fast rise in the number of firms involved in environmental investment, especially during the treatment period.

Figure 2 points out a potential lead-lag relationship between the SOE and non-SOE sectors. SOEs start projects with high social externalities and often higher costs; non-SOEs catch up and perhaps with proper regulatory incentives, eventually overtake SOEs in engaging in green investments.

Panel C of Table 6 explores the investment dynamics between the two sectors in a regression framework. The outcome variables are a non-SOE's total environmental spending, investment in non-firm-specific and firm-specific green projects in year t. The independent variables in columns 1-3 are, respectively, the amount of total, non-firm-specific, and firm-specific environmental investments (scaled by sales) by the SOE sector, measured at year $t-1$. In columns 4-6 we replace the independent variables with the number of SOEs engaging in the three types of green projects at year $t-1$. There is preliminary evidence that non-SOEs follow SOEs in environmental investments.

6. Welfare Consequences

So far, we provide evidence that firms spend more on environmental projects after their city is subject to more stringent environmental regulations, and that the effect of the regulatory event boosts mainly investments into stakeholder-oriented projects. However, this does not necessarily imply that such investments translate into aggregate welfare improvement. Existing literature documents agency problems associated with corporate philanthropy (e.g., Masulis and Reza 2015) and highlight its role in securing political favors and seeking influence on politicians (e.g., Bertrand et al. 2020). City officials, motivated by their career concerns, may also collude with local firms, promoting environmental projects for window-dressing rather than selecting those that potentially produce long-term social benefits.

6.1 Does the City Benefit?

In this section, we assess whether the city has benefited from environmental investments by its local firms amid the increased regulatory demand to meet higher environmental targets. For this set of analyses, the sample is constructed at the city-year level. Specifically, *EI*(*Total*), *EI*(*Non-Firm-Specific*), and *EI*(*Firm-Specific*) are calculated as, respectively, the sum of spending on total, non-firm-specific, and firm-specific environmental projects by all firms in a city, scaled by the total sales of all local listed firms.

We estimate the following regression model:

$$y_{i,t} = \beta_1 Post_{i,t} \times EI_{i,t} + \beta_2 Post_{i,t} + \beta_3 EI_{i,t} + \boldsymbol{\gamma X_{i,t}} + \alpha_i + \delta_{p,t} + \epsilon_{i,t},$$

where $y_{i,t}$ captures city i's environmental and economic performance in year t as described below. $EI_{i,t}$ are city-level *EI*(*Total*), *EI*(*Non-Firm-Specific*), and *EI*(*Firm-Specific*), respectively. $\boldsymbol{X_{i,c,t}}$ includes controls for time-varying city characteristics, such as its GDP growth, fixed assets investment, the size of the service sector, fiscal surplus, land, population, and the number of colleges. Lastly, we control for city fixed effects (α_i) and province × year fixed effects ($\delta_{p,t}$). Standard errors are clustered by city.

6.1.1 Environmental Consequences

We start by exploring whether the MCEP assignment and corporate environmental investment have helped improve a city's environment. We measure a city's environmental quality by its excellent air quality ratios and annual levels of hazardous industrial emissions.

Table 7 Panel A investigates the effect of corporate environmental spending on a city's pollution level. We consider several common environmental indicators. The dependent variable is the level of PM2.5 in a year in columns 1-3, SO2 emissions in columns 4-6, water pollution in columns 7-9, and carbon emissions in columns 10-12. As one would expect, the coefficient associated with the post-MCEP dummy is negative, and is highly significant for columns 7-12, suggesting that the MCEP assignment leads to a significant reduction in a city's water pollution and carbon emissions. In addition, there is evidence that local firms' environmental investments are significantly related to a decline in air pollution, industrial SO2, effluent and carbon emissions.

Overall, the results suggest that local firms' environmental investments contribute to the reduction of industrial pollution in a city.

6.1.2 Economic Impact

Improved environmental quality may make the location of the city more appealing to entrepreneurs. We test the effect of local corporate environmental spending on firm entry using the Annual Tax Survey (ATS) database, an annual survey administered by the Ministry of Finance and the State Administration of Taxation of China. As discussed in Giannetti et al. (2021), the ATS database provides comprehensive coverage of public and private firms, which is representative of the distributions of firms in the Chinese economy across all regions and industries. Following Giannetti et al. (2021), we define the entry of high-quality firms as the proportion of newly registered, high-quality firms among all firms in a city and a given year. We classify a firm to be high quality if its total factor productivity falls into the top quartile of the sample during the year.

Table 7 Panel B reveals that after a city becomes an MCEP, the proportion of high-quality new firms increases only when local firms invest more in environmental projects for which the benefits spill over to society at large (column 2). A one-standard-deviation increase in *EI*(*Non-*

Firm-Specific) is associated with a 0.902 (= 0.031 × 0.291 × 100) percentage points increase in the fraction of new high-quality firms following the MCEP assignment.

A direct outcome from more entries of high-quality new firms is the improvement in local labor market, as highly productive young firms disproportionately create new jobs (Haltiwanger et al. 2017). Columns 4-6 of Panel B suggest that following the MCEP assignment, a city's unemployment declines when its local firms invest more in stakeholder-oriented environmental projects.

Overall, the results in Panels A and B of Table 7 shed light on the social and economic benefits brought about by local firms' engagement in beneficent environmental projects. Not only the city enjoys reductions in hazardous industrial emissions, but also arguably due to the improved environment, it can attract more high-quality new firms and reduce local unemployment.

6.1.3 Polluting Firms

We also explore how corporate environmental investments and environmental regulations affect local firm compositions. We first consider to what extent a city relies on heavily polluting firms as its fiscal revenue sources once it faces intensified environmental regulations and when its local firms begin to increase environmental investment. A heavily polluting firm is defined as one operating in a heavily polluting industry as identified by the Ministry of Ecology and Environment.[12] Specifically, we calculate, for each city-year, the fraction of sales of heavily polluting firms relative to all industrial firms and the fraction of taxes paid by heavily polluting firms relative to all industrial firms. We obtain information on industrial firms from the Chinese

[12] The heavily polluting industries include thermal power, steel, cement, electrolytic aluminum, coal, metallurgy, chemicals, petrochemicals, building materials, papermaking, brewing, pharmaceuticals, fermentation, textiles, and tanning and mining. See "Notice on Environmental Protection Verification of Companies Applying for Initial Listing and Listed Companies Applying for Refinancing". Formerly the Ministry of Environmental Protection of China, and prior to 2008 known as the State Environmental Protection Administration, the Ministry of Ecology and Environment is a department of the State Council of China.

Industrial Enterprises and merge with our sample firms. Since the former spans from 1998 to 2013, for this set of analysis, our sample period is from 2001 to 2013.

Columns 1-6 of Table 7 Panel C reveal that the coefficient for the interaction term *Post* × *EI*(*Non-Firm-Specific*) is negative and statistically significant. This suggests that after the MCEP establishment and local firms spending more on stakeholder-oriented environmental projects, heavily polluting firms occupy a lower proportion of sales (columns 1-3) and contribute less to a city's tax revenues (columns 4-6). A one-standard-deviation increase in *EI*(*Non-Firm-Specific*) is associated with a 11.136 (= 0.679 × -0.164 × 100) percentage points decrease in the proportion of sales (column 2) and a 13.241 (= 0.679 × -0.195 × 100) percentage points decrease in the proportion of tax contributions (column 5). These effects are sizable relative to the average fractions of sales and taxes of heavily polluting firms (18.498% and 21.495%, respectively).

Lastly, we consider how heavily polluting firms reduce their exposure amid more stringent environmental regulations. We postulate that these firms, most of which operate in traditional industries, begin to expand into non-polluting industries after their cities strengthen the effort to improve local environment. From the Chinese Research Data Service Platform (i.e., CNRDS), we extract mergers and acquisitions (M&A) deals conducted by heavily polluting firms during our sample period and identify whether the acquisition target also belongs to such an industry. We then scale the number of M&A targets in non-heavily polluting industries by the number of polluting firms in a city and in a year.

Columns 7-9 of Table 7 Panel C show that heavily polluting firms acquire more non-polluting targets after their city's MCEP assignment, as the post-MCEP dummy is positively and significantly linked to the non-polluting targets acquired by these firms in all three regression specifications. Importantly, the interaction terms *Post* × *EI*(*Total*) and *Post* × *EI*(*Non-Firm-*

Specific) are positive and significant, indicating that the effect is more pronounced if there are more corporate spending on environmental projects (column 7), in particular, the beneficent ones (column 8). Overall, the results suggest that heavily polluting firms expand into non-polluting sectors rather than staying in the polluting industries. Arguably, such a transition may further contribute to the improvement in their city's overall environment.

6.2 Does the Firm Benefit?

The results in Table 6 suggest that by spending on environmental projects, firms can lower their tax bills, obtain more government subsidies, and secure more bank loans. One may wonder whether firms' commitment to environmental projects – especially the beneficent ones – diminishes, thus the effect becomes transitory, if such regulatory incentives are short-lived. In this section, we evaluate potential channels to infer whether engaging environmental investments, especially spending on beneficent projects, yields long-term benefits. For this set of analyses, the sample is at the firm-year level.

We estimate the following regression model:

$$y_{i,t} = \beta_1 Post_{i,c,t} \times EI_{i,t} + \beta_2 Post_{i,c,t} + \beta_3 EI_{i,t} + \boldsymbol{\gamma X_{i,t}} + \alpha_i + \tau_t + \epsilon_{i,t},$$

where $y_{i,t}$ captures firm i's performance in year t as described below. $EI_{i,t}$ are a firm's *EI*(*Total*), *EI*(*Non-Firm-Specific*), and *EI*(*Firm-Specific*), respectively. $\boldsymbol{X_{i,t}}$ includes controls for time-varying firm characteristics, such as its size, leverage, ROA, cash, age, state-ownership, board independence, and institutional holdings, as well as the GDP growth of the city where the firm is located. We also control for firm fixed effects (α_i) and year fixed effects (τ_t). Standard errors are clustered by firm.

6.2.1 Firm Performance

Table 8 Panel A explores how corporate environmental investments affect a firm's future performance. In columns 1-3, we consider firm valuations captured by the average Tobin's Q in the next three years. The estimates in columns 1-2 imply that after the designation of MCEP, firms located in an MCEP city spending more on environmental projects, particularly non-firm-specific ones, have higher valuations. A one-standard-deviation increase in *EI*(*Non-Firm-Specific*) is associated with a 31.074 (= 2.506 × 0.124 × 100) percentage points increase in future Tobin's Q (column 2). The effect is sizable relative to the average of Tobin's Q (i.e., 3.544).

Columns 4-9 suggest that post MCEP, firms spending more on environmental projects, especially the beneficent ones, produce more patents (columns 4-6), and a greater proportion of these patents are green patents (columns 7-9). A one-standard-deviation increase in *EI*(*Non-Firm-Specific*) is associated with a 41.168 (= 0.166 × 2.480 × 100) percentage points increase in the natural logarithm of the number of patents (column 5), which is equivalent to a 40.63% (= 0.412/1.014) increase in innovation for the average firm. Similarly, in column 8, a one-standard-deviation increase in *EI*(*Non-Firm-Specific*) is associated with an increase in the ratio of green patents relative to all patents of 9.176 (= 0.037 × 2.480 × 100) percentage points. The results are consistent with prior studies documenting that polluting firms boost R&D investments to expand their capacity to absorb external knowledge and technical know-how (e.g., Brown et al. 2021).

These results corroborate with the higher Tobin's Q we observe in columns 1-2. Arguably, even if non-firm-specific environmental projects may be unable to directly expand sales or cut production cost, the knowledge and technology developed during the course of project investment and implementation allow firms to file more patents, especially green patents, which in turn translate into higher firm value.

Overall, the findings in Table 8 Panel A highlight a mechanism through which environmental project investments can affect firm performance, independent of the persistence of (or lack thereof) government-based incentives.

6.2.2 Labor Productivity

The effect of environmental investments on firm value may not be limited to patent creations. A high-quality environment, brought by corporate investments on environmental protections, can render local firms a more productive and efficient labor force. To explore this possibility, we first consider firm's employment growth rate. Table 8 Panel B shows that after the establishment of MCEPs, firms investing more in environmental projects decrease their hiring rates (columns 1-2). To evaluate whether retaining fewer employees is detrimental to labor performance, we estimate the Pinnuck-Lillis (2007) measure of labor investment efficiency, calculated as the absolute deviation of actual net hiring from its expected level. From columns 4-6, we observe that labor investment inefficiency declines for these firms spending more on non-firm-specific environment projects after the MCEP. A one-standard-deviation increase in *EI*(*Non-Firm-Specific*) is associated with a 9.055 (= -0.038 × 2.383 × 100) percentage points decrease in the labor investment inefficiency (column 5). The effect is sizable relative to the average fractions of labor investment efficiency (i.e., 22.525%)

Lastly, we directly explore the effect of corporate environmental spending on a Tate and Yang's (2005) measure of labor productivity. We find that after the implantation of the MCEP, labor output significantly increases for firms investing more environmental projects. The effect prevails across all project types (columns 7-9). A one-standard-deviation increase in *EI*(*Non-Firm-Specific*) is associated to a 10.433 (= 0.042 × 2.484 × 100) percentage points increase in labor productivity (column 8). The effect accounts for 0.773% of average labor productivity of sample firms.

Taken together with the findings in employment growth, the results suggest that firms in MCEP cities with larger environmental investments are able to save more on labor cost, improve the efficiency of their labor investment, and boost labor productivity.

7. Conclusion

In this paper, we construct a manually collected dataset of project investments by Chinese listed companies. We conduct textual analysis and identify those that are related to environmental protection. We then further distinguish between environmental projects that benefit shareholders and "beneficent" ones, i.e., those that also generate direct societal benefits to a larger extent.

Exploiting the staggered designation of the major cities for environmental protection (MCEP) scheme in China, we show that firms increase their environmental investments after their city experiences heightened pollution prevention and control by the government. The effect is mostly driven by "beneficent investments". When exploring potential mechanisms, we find that following the MCEP assignment, media coverage on environmental protection issues intensifies. City mayors and party chiefs are more likely to be promoted if their cities achieve pre-set environmental targets or reduce pollution. There are also financial incentives for firms. Firms spending more on green investment pay less taxes, garner more subsidies, and secure more bank loans.

Importantly, we show that with larger corporate environmental investments, cities experiencing more stringent environmental regulations reduce pollution and improve employment to a greater extent. They also attract more productive firms. There is a change in local firm composition, as the city relies less on tax revenue from heavily polluting firms. The heavily polluting firms speed up expansion into non-polluting sectors. Firms investing in more environmental projects – especially the beneficent ones – experience larger value gains, more green patent outputs, and higher labor productivity than other firms in the same MCEP city. Our findings highlight the role of regulatory mechanisms in enabling ESG investment to be both value- and welfare-enhancing.

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Appendix A: Variable Definition

Variable	Definition and Data Source
# of Patents	The natural logarithm of one plus the number of invention patents. Source: CNRDS.
% of Targets Achieved	The fraction of pre-set city-level environmental targets that are accomplished. Sources: China Statistical Yearbooks and local governments' websites.
% of Green Patents	The fraction of total patents as green invention patents. Source: CNRDS.
Age	The natural logarithm of one plus of the difference between the current year and the founding year of the firm. Source: CSMAR database.
Bank Loans	The sum of long- and short-term bank loans scaled by total assets. Sources: CSMAR database.
Board Independence	The number of independent directors divided by the number of board directors. Source: CSMAR database.
Carbon	The level of carbon emission scaled by a city's GDP per capita. Source: CCED database.
Cash	Cash and cash equivalents divided by total assets. Source: CSMAR database.
Dummy for EI(Total)	A dummy variable set to one if the firm invests in any environmental protection project in a year, and zero otherwise. Sources: CSMAR database and manual collection.
Dummy for EI(Non-Firm-Specific)	A dummy variable set to one if the firm invests in environmental protection projects that directly benefit stakeholders rather than shareholders in a year, and zero otherwise. Sources: CSMAR database and manual collection.
Dummy for EI(Firm-Specific)	A dummy variable set to one if the firm invests in environmental protection projects that directly benefit shareholders in a year, and zero otherwise. Sources: CSMAR database and manual collection.
Effluent	Th level of effluent emission scaled by a city's GDP per capita. Source: CSMAR database.
EI(Total)	At firm-year level, this variable is calculated as the amount of corporate investment in new environmental protection projects, scaled by sales, and multiplied by 100. At city-year level, this variable is the total amount of investments in environmental protection projects by all firms in a city, scaled by the total amount of their sales, multiplied by 100. Sources: CSMAR database and manual collection.
EI(Non-Firm-Specific)	At firm-year level, this variable is calculated as the amount of corporate investment in new environmental protection projects that directly benefit stakeholders rather than shareholders, scaled by sales, and multiplied by 100. At city-year level, this variable is the total amount of spending on stakeholder-oriented environmental projects by all firms in a city, scaled by the total amount of their sales, multiplied by 100. Sources: CSMAR database and manual collection.
EI(Firm-Specific)	At firm-year level, this variable is calculated as the amount of corporate

	investment in new environmental protection projects that directly benefit shareholders, scaled by sales, and multiplied by 100. At city-year level, this variable is the total amount of spending on shareholder-oriented environmental projects by all firms in a city, scaled by the total amount of their sales, multiplied by 100. Sources: CSMAR database and manual collection.
Employment Growth	The difference between a firm's number of employees in year t and year $t-1$ divided by its number of employees in year $t-1$. Source: CSMAR database.
Environmental News	We download all news articles published during the sample period from 485 major newspapers in the China Core Newspaper Database. For each city and year in our sample, we count the number of news articles that mention environmental protection issues. Source: CNKI database and manual collection.
Entry of High-quality New Firms	The number of high-quality new firms in a city and year, divided by the total number of firms in that city and year. A new firm is considered high-quality if it is newly registered and its TFP is the top quartile of the sample in a year. Source: ATS database.
Fixed Asset Investment (Service Sector, Fiscal Surplus, Population, Colleges)	These city-year level variables are calculated, respectively, as fixed assets investments scaled by the city's GDP, service sector output scaled by the city's GDP, the difference between fiscal income and fiscal expenses scaled by the city's GDP, as well as the natural logarithms of local population, and number of universities. Source: China Entrepreneur Investment Club.
GDP Growth	The year-on-year change in a city's GDP. Source: CSMAR database.
Institutional Holdings	The fraction of tradable shares held by institutional investors. Source: CSMAR database.
Labor Investment Efficiency	Pinnuck and Lillis's (2007) measure of labor investment efficiency. Calculated as the absolute deviation of actual net hiring from its expected level. Source: CSMAR database.
Labor Productivity	The natural logarithm of a firm's sales divided by the number of employees. Source: CSMAR database.
Leverage	Total liabilities divided by total assets. Source: CSMAR database.
Market to Book	Market value of assets divided by the replacement value of assets. Source: CSMAR database.
Marketization	The natural logarithm of Wang et al.'s (2018) provincial marketization index. Source: Wang et al. (2018).
Non-Polluting Targets Acquired by Polluting Firms	The number of M&A targets operating in non-heavily polluting industries acquired by heavily polluting firms, scaled by the number of heavily polluting industrial firms in a city-year. Sources: CSMAR, Chinese Industrial Enterprises, and CNRDS.
PM2.5	The natural logarithm of the level of PM2.5 pollutant in the air. Source: CSMAR database.
Polluting Firms' Proposition of Sales	The proportion of sales of heavily polluting firms relative to all industrial firms in a city-year. Sources: CSMAR and Chinese Industrial Enterprises databases.

Polluting Firms' Proposition of Taxes	The proportion of taxes of heavily polluting firms relative to all industrial firms in a city-year. Sources: CSMAR and Chinese Industrial Enterprises databases.
Post	At firm-year level, this variable is a dummy variable set to one if the firm is headquartered in a city in the years after the city becomes an MCEP city and zero otherwise. At city-year level, this variable is a dummy variable set to one in the years after the city becomes an MCEP city and zero otherwise. Source: Manual collection.
Promotion	A dummy variable set to one if a city's mayor or party chief is promoted in the next three years, and zero otherwise. Source: Manual collection.
ROA	Net profit divided by total assets. Source: CSMAR database.
Size	The natural logarithm of total assets. Source: CSMAR database.
SO2	The amount of industrial sulfur dioxide (SO2) emissions scaled by a city's GDP per capita. Source: CSMAR database.
State	A dummy variable set to one if a firm is government controlled or owned, and zero otherwise. Source: CSMAR database.
Subsidies	The amount of government environmental subsidies a firm receives in a year, scaled by its operating income. Source: CSMAR database.
Taxes	The amount of taxes paid scaled by total profit. Source: CSMAR database.
Tobin's Q	The average of a firm's market value of assets divided by the book value of assets over the next three years. Source: CSMAR database.
Unemployment	The natural logarithm of the number of the unemployed in a city. Source: CNRDS.

Appendix B: Timing of the Events

The table below describes the distribution of MCEP cities in each province. Column 1 reports the total number of municipal cities for each province. Columns 2 and 4 report the numbers of MCEP cities, respectively, in 2007 and in 2010. Columns 3 and 5 report the fraction of cities in a province being designated as MCEP cities.

Province	# of Cities	MCEP in 2007		MCEP in 2010	
		# of MCPE	% of MCPE	# of MCPE	% of MCPE
	(1)	(2)	(3)	(4)	(5)
Guangdong	21	8	38.10%	6	28.57%
Sichuan	21	5	23.81%	8	38.10%
Shandong	17	10	58.82%	9	52.94%
Henan	17	6	35.29%	7	41.18%
Anhui	16	3	17.65%	3	17.65%
Yunnan	16	2	12.50%	3	18.75%
Xinjiang	15	2	13.33%	2	13.33%
Gansu	14	2	14.29%	2	14.29%
Guangxi	14	4	28.57%	4	28.57%
Hunan	14	6	42.86%	6	42.86%
Liaoning	14	6	42.86%	6	42.86%
Heilongjiang	13	4	30.77%	3	23.08%
Hubei	13	3	23.08%	3	23.08%
Jiangsu	13	8	61.54%	9	69.23%
Inner Mongolia	12	3	25.00%	3	25.00%
Hebei	11	5	45.45%	5	45.45%
Jiangxi	11	2	18.18%	2	18.18%
Shanxi	11	5	45.45%	5	45.45%
Zhejiang	11	7	63.64%	5	45.45%
Shaanxi	10	5	50.00%	6	60.00%
Fujian	9	3	33.33%	3	33.33%
Guizhou	9	2	22.22%	2	22.22%
Jilin	9	2	22.22%	2	22.22%
Qinghai	8	1	12.50%	1	12.50%
Tibet	7	1	14.29%	1	14.29%
Ningxia	5	2	40.00%	2	40.00%
Hainan	2	2	100.00%	1	50.00%
Beijing	1	1	100.00%	1	100.00%
Shanghai	1	1	100.00%	1	100.00%
Tianjin	1	1	100.00%	1	100.00%
Chongqing	1	1	100.00%	1	100.00%
Total	337	113	33.53%	113	33.53%

Appendix C: Industry Distribution of Environmental Projects

The table below describes the distribution of firm-specific and non-firm-specific environmental projects, as well as the number of firms engaging in these projects in each industry. The last column reports the number of firms investing both types of environmental projects in each industry.

Industries	Non-Firm-Specific		Firm-Specific		Both
	Projects	Firms	Projects	Firms	Firms
Agriculture, forestry, animal husbandry and fishery	250	32	79	25	19
Mining	647	51	455	51	43
Agricultural and sideline food processing	274	34	146	29	27
Food manufacturing	109	16	66	10	8
Wine, beverage and refined tea manufacturing	159	25	118	19	16
Textile	216	40	93	29	25
Textile, clothing, apparel	55	14	25	5	4
Leather, fur, feathers and their products and footwear	13	1	6	4	1
Wood processing and wood, bamboo, rattan, palm and grass products	13	4	8	3	2
Furniture manufacturing	0	0	7	4	0
Paper and paper products	383	27	197	20	19
Printing and recorded media reproduction	13	3	9	3	2
Petroleum processing, coking and nuclear fuel processing	283	20	191	17	16
Chemical raw materials and chemical products manufacturing	1,445	134	1,165	131	106
Pharmaceutical products	746	99	600	101	69
Chemical fiber manufacturing	188	19	104	15	12
Rubber and plastic products	97	28	85	24	13
Non-metallic mineral products	553	51	538	58	43
Ferrous metal smelting and rolling processing	1,345	35	1,284	36	34
Non-ferrous metal smelting and rolling processing	525	36	277	35	29
Metal products	82	15	70	18	7
General equipment	458	55	130	37	26
Special equipment	171	39	106	28	13
Automotive	143	31	140	23	15
Railroad, marine, aerospace and other transportation equipment	26	9	35	11	5
Electrical machinery and equipment	317	73	238	52	29
Computer, communications and other electronic equipment	288	74	296	60	39
Instrumentation manufacturing	12	4	8	5	1
Other manufacturing	14	3	13	6	3
Production and supply of electricity, heat, gas and water	1,432	66	785	60	59
Construction	223	37	103	23	18
Wholesale and retail	180	38	111	36	15
Transportation, warehousing and postal	89	25	103	20	9
Accommodation and catering	17	4	9	3	2
Information technology, software, and information technology service	34	12	22	10	7

Real estate	95	19	41	14	8
Leasing and business services	59	10	24	10	6
Scientific research and technical service	12	3	10	1	0
Water conservancy, environment, and public facilities management	44	5	3	1	1
Education	1	1	4	1	1
Culture, sports, and entertainment	3	2	5	2	0
Other	23	6	10	5	4
Total	11,037	1,200	7,719	1,045	756

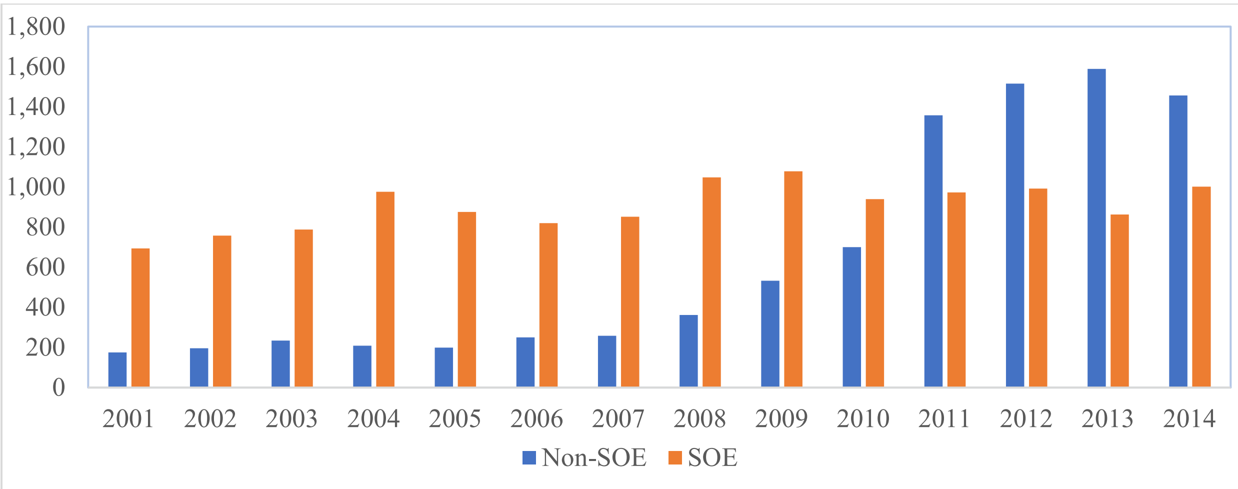
Figure 1: The Distribution of MCEPs

This figure shows the distribution of major cities for environmental protection across mainland China.

Figure 2 Environmental Investments by SOEs and Non-SOEs

Panel A: The Amount of Environmental Investment

This figure compares the amount of environmental investment by the SOE sector and the non-SOE sector over the sample period. *y*-axis is environmental investment in a sector scaled by sales in that sector, multiplied by 100.



Panel B: Number of Firms Engaging in Environmental Investment

This figure plots the numbers of SOEs and non-SOEs that spend on environmental projects over the sample period. *y*-axis is the number of firms spending on environmental projects.

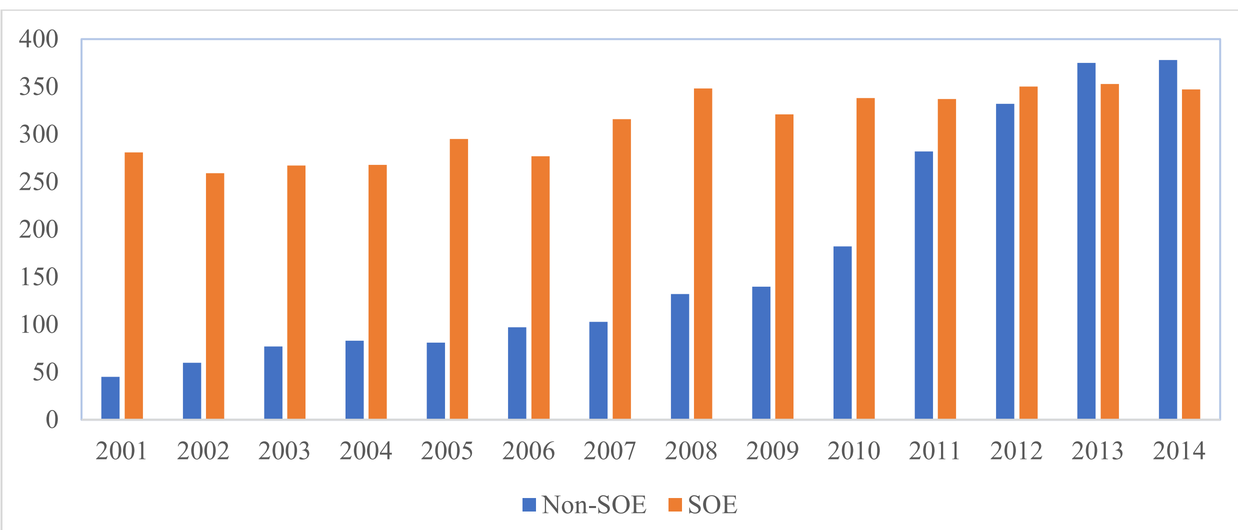


Table 1: Descriptive Statistics

Panel A summarizes the main characteristics of the sample firms. Panel B compares firm environmental investments before and after their cities become the MCEPs. The sample period is 2001-2014. The sample is at firm-year observations. Variable definitions are in Appendix A.

Panel A: Firm-Year Level Characteristics

Variable	N	Mean	Median	SD
EI (million RMB)				
Total	21,394	29.242	0.000	124.864
Non-Firm-Specific	21,394	14.535	0.000	69.765
Firm-Specific	21,394	9.732	0.000	47.773
EI(Total)	21,394	1.014	0.000	3.782
EI(Non-Firm-Specific)	21,394	0.551	0.000	2.480
EI(Firm-Specific)	21,394	0.320	0.000	1.414
Post	21,394	0.583	0.000	0.493
Assets (billion RMB)	21,394	6.761	2.103	18.393
Leverage	21,394	0.479	0.483	0.217
ROA	21,394	0.055	0.054	0.071
Cash	21,394	0.162	0.126	0.129
Market to Book	21,394	0.560	0.543	0.246
Age (years)	21,394	9.332	9.000	5.316
State	21,394	0.496	0.000	0.500
Board Independence	21,394	0.342	0.333	0.089
Institutional Holdings	21,394	0.387	0.397	0.222
Taxes	12,232	0.540	0.528	0.235
Subsidies	19,389	0.042	0.000	0.166
Bank Loans	21,118	0.216	0.199	0.170
# of Patents	21,394	1.014	0.000	1.420
% of Green Patents	21,394	0.160	0.000	0.322
Employment Growth	21,239	0128	0.019	0.550
Labor Investment Inefficiency	13,192	0.225	0.117	0.387
Labor Productivity	21,333	13.488	13.401	1.094

Panel B: Univariate Comparison

	Before MCEP	After MCEP	Difference
EI(Total) (million RMB)	16.148	37.591	-21.443***
EI(Non-Firm-Specific) (million RMB)	8.413	18.335	-9.922***
EI(Firm-Specific) (million RMB)	5.611	12.106	-6.495***
EI(Total)	0.867	1.070	-0.203**
EI(Non-Firm-Specific)	0.468	0.585	-0.117*
EI(Firm-Specific)	0.280	0.329	-0.049*

Table 2: MCEP Assignment and Corporate Environmental Investment

This table compares corporate investment in environmental protection projects before and after the city where the firm is headquartered is subject to heightened environmental regulations. The sample period is 2001-2014. The unit of observation is a firm-year. The dependent variable is *EI*(*Total*) in columns 1-3, *EI*(*Non-Firm-Specific*) in columns 4-6, and *EI*(*Firm-Specific*) in columns 7-9. *Post* is an indicator variable for firms operating in a city in years that the city was designated as a "Major City for Environmental Protection" (MCEP). Variable definitions are in Appendix A. All models include a constant and fixed effects as described in the table, but the coefficients are not tabulated. *T*-statistics based on robust standard errors clustered at the city and year level are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable	EI(Total)			EI(Non-Firm-Specific)			EI(Firm-Specific)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post	0.363***	0.402***	0.389***	0.181**	0.235**	0.183*	0.061	0.056	0.094
	(2.73)	(2.84)	(2.63)	(2.15)	(2.55)	(1.93)	(1.15)	(1.01)	(1.61)
Size	0.486***	0.550***	0.554***	0.282***	0.304***	0.315***	0.107***	0.134***	0.129***
	(7.69)	(8.29)	(8.15)	(7.43)	(7.67)	(7.76)	(4.51)	(5.21)	(4.94)
Leverage	-0.575**	-0.671***	-0.595**	-0.169	-0.289*	-0.257	-0.179**	-0.211**	-0.180*
	(-2.35)	(-2.73)	(-2.34)	(-1.12)	(-1.86)	(-1.61)	(-2.02)	(-2.38)	(-1.95)
ROA	-1.212***	-1.025**	-1.205**	-0.484*	-0.382	-0.514*	-0.293*	-0.285*	-0.294*
	(-2.64)	(-2.21)	(-2.51)	(-1.72)	(-1.35)	(-1.77)	(-1.77)	(-1.68)	(-1.67)
Cash	-0.635**	-0.744***	-0.754***	-0.671***	-0.743***	-0.749***	0.004	-0.041	-0.042
	(-2.36)	(-2.65)	(-2.65)	(-3.93)	(-4.26)	(-4.21)	(0.04)	(-0.39)	(-0.39)
Market to Book	-0.655***	-0.777***	-0.764***	-0.302**	-0.383***	-0.363***	-0.135*	-0.176**	-0.191**
	(-3.34)	(-3.80)	(-3.62)	(-2.51)	(-2.96)	(-2.73)	(-1.73)	(-2.15)	(-2.32)
Age	-0.919***	-0.912***	-1.142***	-0.721***	-0.609***	-0.656***	-0.118	-0.147	-0.174
	(-3.28)	(-3.02)	(-3.40)	(-4.00)	(-3.16)	(-3.08)	(-1.14)	(-1.30)	(-1.47)
State	-0.001	-0.146	-0.191	-0.022	-0.142	-0.169*	-0.008	-0.035	-0.026
	(-0.01)	(-1.19)	(-1.52)	(-0.26)	(-1.63)	(-1.89)	(-0.21)	(-0.85)	(-0.60)
Board Independence	0.304	-0.133	-0.112	0.172	-0.098	-0.012	0.027	-0.054	-0.035
	(0.56)	(-0.24)	(-0.20)	(0.47)	(-0.26)	(-0.03)	(0.14)	(-0.29)	(-0.18)
Institutional Holdings	-0.220	-0.224	-0.209	-0.049	-0.092	-0.110	-0.160**	-0.145**	-0.140**
	(-1.37)	(-1.36)	(-1.25)	(-0.49)	(-0.90)	(-1.06)	(-2.43)	(-2.10)	(-2.02)
GDP Growth	-0.025	-0.020	1.005	-0.198	-0.321	0.200	0.213	0.294	0.469
	(-0.04)	(-0.03)	(1.13)	(-0.48)	(-0.77)	(0.33)	(0.79)	(1.06)	(1.35)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Year FE	Yes	No	No	Yes	No	No	Yes	No	No
Industry × Year FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Province× Year FE	No	No	Yes	No	No	Yes	No	No	Yes
Observations	21,394	21,394	21,394	21,394	21,394	21,394	21,394	21,394	21,394
Adjusted R^2	0.359	0.366	0.367	0.378	0.386	0.388	0.299	0.301	0.305

Table 3: Robustness

The sample period is 2001-2014. The unit of observation is a firm-year. The dependent variable is indicated on top of each column. In Panel A, the matched sample is created using the propensity score matching (PSM) approach in columns 1-3, the coarsened exact matching (CEM) approach in columns 4-6, and entropy balanced matching approach in columns 7-9. In Panel B, we exclude firm-year observations whose business locations and the location of registration are inconsistent in columns 1-3. We exclude from the sample firm-year observations that occur in the event years in columns 4-6. We report the regression results using fixed event windows (three years before and after the MCEP assignments) in columns 7-9. In Panel C, we estimate the likelihood that a firm invests in environmental project. Panel D reports the results from a placebo test (columns 1-3), in which we create a pseudo-post variable by assigning three years before the actual year of designation as the artificial enactment year for the MCEP. In column 4-6, we redefine the pseudo-post variable to be one for years of and after 2009 – the passage of the Copenhagen Accord – and zero otherwise. All models include a set of control variables (*Size*, *Leverage*, *ROA*, *Cash*, *Market to Book*, *Age*, *State*, *Board Independence*, *Institutional Holdings*, and *GDP Growth*), a constant, and fixed effects as described in the table, but the coefficients are not tabulated. In Panel E, we replicate the regressions in Table 2 without including time-varying control variables in columns 1-3 and estimate a stacked regression without control variables in columns 4-6. In Panel F, we report the Borusyak et al.'s (2022) estimators for dynamic effect, with indicator variables for years $t-5$, $t-4$, …, t, up to year $t+7$, where t is the year of MCEP designation. Detailed definition of variables is provided by Appendix A. *T*-statistics based on robust standard errors clustered at the city and year level are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Panel A: Matched Samples

Matching Method:	PSM matching			CEM matching			Entropy Balance matching		
Dependent Variable:	EI(Total)	EI(Non-Firm-Specific)	EI(Firm-Specific)	EI(Total)	EI(Non-Firm-Specific)	EI(Firm-Specific)	EI(Total)	EI(Non-Firm-Specific)	EI(Firm-Specific)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post	0.677***	0.456***	0.090	0.428*	0.252*	0.080	0.352***	0.199**	0.043
	(3.97)	(4.04)	(1.29)	(1.91)	(1.86)	(0.82)	(2.65)	(2.46)	(0.80)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,554	7,554	7,554	5,610	5,610	5,610	21,394	21,394	21,394
Adjusted R^2	0.357	0.330	0.284	0.305	0.321	0.281	0.330	0.347	0.301

Table 3 continued.

Panel B: Alternative Sample Restrictions

Sample:	Excluding observations with inconsistent business and registration locations			Excluding observations in the event year			Fixed event windows		
Dependent Variable:	EI(Total)	EI(Non-Firm-Specific)	EI(Firm-Specific)	EI(Total)	EI(Non-Firm-Specific)	EI(Firm-Specific)	EI(Total)	EI(Non-Firm-Specific)	EI(Firm-Specific)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post	0.407***	0.267***	0.043	0.392***	0.212**	0.060	0.418**	0.254**	0.032
	(2.72)	(2.79)	(0.73)	(2.88)	(2.45)	(1.10)	(2.57)	(2.45)	(0.48)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,796	18,796	18,796	20,306	20,306	20,306	13,684	13,684	13,684
Adjusted R^2	0.368	0.382	0.305	0.357	0.378	0.298	0.385	0.399	0.322

Panel C: Are Firms More Likely to Engage in Environmental Investment after MCEP?

Dependent Variable:	Dummy for EI(Total)			Dummy for EI(Non-Firm-Specific)			Dummy for EI(Firm-Specific)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post	0.041***	0.044***	0.046***	0.024*	0.029**	0.030**	-0.010	-0.007	-0.005
	(3.67)	(3.86)	(3.86)	(1.94)	(2.30)	(2.33)	(-0.93)	(-0.63)	(-0.37)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	No	No	Yes	No	No	Yes	No	No
Industry × Year FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Province× Year FE	No	No	Yes	No	No	Yes	No	No	Yes
Observations	15,101	15,101	15,101	15,101	15,101	15,101	15,101	15,101	15,101
Adjusted R^2	0.577	0.597	0.597	0.699	0.708	0.710	0.739	0.746	0.745

Table 3 continued.

Panel D: Placebo Tests

Dependent Variable:	EI(Total)	EI(Non-Firm-Specific)	EI(Firm-Specific)	EI(Total)	EI(Non-Firm-Specific)	EI(Firm-Specific)
	(1)	(2)	(3)	(4)	(5)	(6)
Pseudo Post	0.137	0.097	0.038	0.098	0.037	0.032
	(0.71)	(0.73)	(0.48)	(1.25)	(0.75)	(1.01)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	No	No	No
Observations	10,946	10,946	10,946	21,394	21,394	21,394
Adjusted R^2	0.379	0.368	0.326	0.359	0.377	0.299

Panel E: Replication Using TWFE and Stacked Regressions without Covariates

Regressions:	TWFE			Stacked		
Dependent Variable:	EI(Total)	EI(Non-Firm-Specific)	EI(Firm-Specific)	EI(Total)	EI(Non-Firm-Specific)	EI(Firm-Specific)
	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.383***	0.195**	0.063	0.360***	0.196**	0.051
	(2.90)	(2.33)	(1.19)	(2.72)	(2.33)	(0.96)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	21,394	21,394	21,394	24,135	24,135	24,135
Adjusted R^2	0.356	0.375	0.298	0.351	0.371	0.292

Table 3 continued.

Panel F: Borusyak et al.'s (2022) Estimators for Dynamic Effect

Dependent Variable:	EI(Total)	EI(Non-Firm-Specific)	EI(Firm-Specific)
	(1)	(2)	(3)
$t-5$	0.204	0.091	0.150
	(0.44)	(0.30)	(0.76)
$t-4$	0.307	0.124	0.161
	(0.65)	(0.38)	(0.81)
$t-3$	0.380	0.092	0.207
	(0.84)	(0.29)	(1.14)
$t-2$	0.476	0.103	0.292
	(1.03)	(0.31)	(1.58)
$t-1$	0.011	-0.008	0.079
	(0.02)	(-0.02)	(0.42)
t	0.181	0.255*	-0.048
	(0.74)	(1.71)	(-0.47)
$t+1$	0.399*	0.340**	-0.046
	(1.72)	(2.10)	(-0.43)
$t+2$	0.345	0.304*	-0.071
	(1.30)	(1.81)	(-0.66)
$t+3$	0.701***	0.407**	0.111
	(2.95)	(2.53)	(1.31)
$t+4$	0.768***	0.337**	0.221**
	(2.83)	(2.06)	(2.38)
$t+5$	0.558**	0.321**	0.140
	(2.49)	(2.39)	(1.47)
$t+6$	0.300	0.234	-0.010
	(1.20)	(1.56)	(-0.11)
$t+7$	0.067	0.057	-0.017
	(0.25)	(0.33)	(-0.16)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	17,124	17,124	17,124

Table 4: Media Attention

This table reports the results analyzing media coverage of a city's environmental issues. The sample period is 2001-2014. The unit of observation is a city-year. The dependent variable is the natural logarithm of one plus the number of news articles covering a city's environmental issues. In column 1, we consider news reports from all media outlets. In columns 2 through 5, we consider news reports from, respectively, state-owned media, market-based media, national media and local media. All models include a constant and fixed effects as described in the table, but the coefficients are not tabulated. Detailed definition of variables is provided by Appendix A. *T*-statistics based on robust standard errors clustered at the city level are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable:	Environmental News				
	All media outlets	State-affiliated media	Market-based media	National media	Local media
	(1)	(2)	(3)	(4)	(5)
Post	0.543***	0.610***	0.522***	0.483***	0.738***
	(12.69)	(15.42)	(13.07)	(11.70)	(18.95)
GDP Growth	-0.016***	-0.014***	-0.014***	-0.015***	-0.013***
	(-3.74)	(-3.42)	(-3.50)	(-3.68)	(-3.37)
Fixed Asset Investment	0.038	0.044	-0.054	-0.037	-0.051
	(0.46)	(0.57)	(-0.69)	(-0.46)	(-0.66)
Service Sector	0.010***	0.011***	0.008***	0.008***	0.014***
	(3.04)	(3.73)	(2.73)	(2.60)	(4.66)
Fiscal Surplus	1.165***	1.307***	0.821**	0.939***	1.287***
	(3.20)	(3.88)	(2.42)	(2.67)	(3.88)
Population	0.251	0.404***	0.277*	0.216	0.615***
	(1.57)	(2.74)	(1.86)	(1.41)	(4.24)
Colleges	0.107***	0.108***	0.077**	0.084**	0.105***
	(2.85)	(3.09)	(2.20)	(2.31)	(3.05)
City FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	3,839	3,839	3,839	3,839	3,839
Adjusted R^2	0.849	0.814	0.827	0.837	0.766

Table 5: Politician's Career

This table reports the results analyzing the likelihood of local politicians' career promotion. The sample period is 2003-2014. The unit of observation is a city-year. The dependent variable is an indicator variable for whether a city's mayor or party chief is promoted in the following three years. All models include a set of control variables (*GDP Growth*, *Fixed Asset Investment*, *Service Sector*, *Fiscal Surplus*, *Population*, and *Colleges*), a constant, and fixed effects as described in the table, but the coefficients are not tabulated. Detailed definition of variables is provided by Appendix A. *T*-statistics based on robust standard errors clustered at the city level are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable:	Promotion				
	(1)	(2)	(3)	(4)	(5)
Post × PM2.5	-0.052*				
	(-1.71)				
Post × SO2		-0.022***			
		(-3.02)			
Post × Effluent			-0.232***		
			(-3.40)		
Post × Carbon				-1.362***	
				(-7.15)	
Post × % Targets Achieved					0.193**
					(2.05)
PM2.5	0.008				
	(0.58)				
SO2		0.007**			
		(2.17)			
Effluent			0.005		
			(0.21)		
Carbon				-0.160	
				(-1.07)	
% Targets Achieved					0.006
					(0.15)
Post	0.458	0.065***	0.070***	0.194***	-0.124
	(1.38)	(2.65)	(2.82)	(6.32)	(-1.42)
Control Variables	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1,377	3,175	3,181	2,562	1,381
Adjusted R^2	0.381	0.663	0.664	0.677	0.502

Table 6: Firm-Level Incentives

Panel A compares city policies before and after MCEP. The sample period is 2001-2014. The unit of observation is a city-year. *Taxes* is the sum of tax expenses of all firms in a city-year divided by the sum of these firms' operating income in a city-year. *Subsidies* is the sum of environmental subsidies received by all firms divided by the sum of these firms' sales in a city-year, multiplied by 100. *Bank Loan* is the sum of short-term and long-term loans received by all firms divided by the sum of these firms' assets in a city-year. Panel B reports the results analyzing the financial consequences for firms engaging in environmental investments. The sample period is 2001-2014 for columns 1-3 and 7-9; it is 2003-2014 for columns 4-6. The unit of observation is a firm-year. The dependent variable is a firm's effective tax rate in columns 1-3, government's environmental subsidies in columns 4-6, and bank loans in columns 7-9. Panel C reports the results analyzing environmental investments by non-SOEs at year t. The independent variables in columns 1-3 are the total, non-firm-specific, and firm-specific environmental investments by the SOE sector scaled by sales in that sector, multiplied by 100. In columns 4-6 the independent variables are the number of SOEs engaging in environmental project investment, non-firm-specific and firm-specific environmental project investments. All independent variables are measured at year $t-1$. All models include a set of control variables (*Size*, *Leverage*, *ROA*, *Cash*, *Market to Book*, *Age*, *State*, *Board Independence*, *Institutional Holdings*, and *GDP Growth*), a constant, and fixed effects as described in the table, but the coefficients are not tabulated. Detailed definition of variables is provided by Appendix A. *T*-statistics based on robust standard errors clustered at the city and year level are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Panel A: Changes in City Policies

	Before MCEP	After MCEP	Difference
Taxes	0.587	0.533	-0.054***
Subsidies	0.039	0.063	0.024***
Bank Loans	0.247	0.257	0.010*

Table 6 continued.

Panel B: Financial Incentives for Corporate Environmental Investment

Dependent Variable:	Taxes			Subsidies			Bank Loans		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post × EI(Total)	-0.030***			0.054***			0.008***		
	(-3.57)			(9.49)			(2.80)		
Post × EI(Non-Firm-Specific)		-0.028***			0.046***			0.008***	
		(-3.22)			(7.08)			(2.74)	
Post × EI(Firm-Specific)			-0.028***			0.054***			0.007**
			(-2.61)			(6.61)			(2.24)
EI(Total)	0.023***			-0.017***			0.000		
	(3.14)			(-4.24)			(0.00)		
EI(Non-Firm-Specific)		0.020***			-0.016***			-0.000	
		(2.74)			(-3.42)			(-0.05)	
EI(Firm-Specific)			0.029***			-0.015***			-0.003
			(3.29)			(-2.70)			(-1.31)
Post	0.017	0.013	0.012	-0.025***	-0.018**	-0.016**	-0.005	-0.004	-0.004
	(1.59)	(1.27)	(1.12)	(-3.27)	(-2.27)	(-2.07)	(-1.36)	(-1.19)	(-1.00)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,232	12,232	19,389	19,389	19,389	13,376	21,118	21,118	21,118
Adjusted R^2	0.549	0.548	0.294	0.292	0.292	0.444	0.791	0.791	0.791

Table 6 continued.

Panel C: Non-SOEs' Environmental Investment

Dependent Variable:	EI(Total)	EI(Non-Firm-Specific)	EI(Firm-Specific)	EI(Total)	EI(Non-Firm-Specific)	EI(Firm-Specific)
	(1)	(2)	(3)	(4)	(5)	(6)
SOE-EI(Total)	0.007***					
	(2.75)					
SOE-EI(Non-Firm-Specific)		0.004*				
		(1.70)				
SOE-EI(Firm-Specific)			0.007**			
			(2.58)			
# of SOE-EI(Total)				0.045***		
				(3.30)		
# of SOE-EI(Non-Firm-Specific)					0.026***	
					(2.85)	
# of SOE-EI(Firm-Specific)						0.013**
						(1.97)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,226	9,226	9,226	9,226	9,226	9,226
Adjusted R^2	0.397	0.410	0.363	0.398	0.411	0.362

Table 7: Does the City Benefit?

Panel A: Environmental Impact

This table reports the results analyzing the city's environmental consequences from corporate environmental investments. The sample period is 2003-2014. The unit of observation is a city-year. The dependent variable is a city's PM2.5 level in columns 1-3, SO2 emissions in columns 4-6, effluent emissions in columns 7-9 and carbon emissions in columns 10-12. All models include a set of control variables (*GDP Growth*, *Fixed Asset Investment*, *Service Sector*, *Fiscal Surplus*, *Land*, *Population*, and *Colleges*), a constant, and fixed effects as described in the table, but the coefficients are not tabulated. Detailed definition of variables is provided by Appendix A. *T*-statistics based on robust standard errors clustered at the city level are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable:	PM2.5			SO2			Effluent			Carbon		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Post × EI(Total)	-2.153***			-4.447***			-0.160*			-0.035*		
	(-3.80)			(-5.56)			(-1.73)			(-1.82)		
Post × EI(Non-Firm-Specific)		-2.303**			-3.126**			-0.158			-0.044	
		(-2.56)			(-2.33)			(-1.02)			(-1.37)	
Post × EI(Firm-Specific)			-7.316***			-4.984***			-0.159			-0.029
			(-4.47)			(-5.08)			(-1.41)			(-1.23)
EI(Total)	1.694***			0.005			0.002			0.000		
	(3.04)			(0.29)			(1.04)			(0.23)		
EI(Non-Firm-Specific)		0.797			0.030			0.004			0.001	
		(0.89)			(0.72)			(0.86)			(0.59)	
EI(Firm-Specific)			7.302***			0.009			0.004			0.000
			(4.85)			(0.29)			(1.15)			(0.02)
Post	-0.073	-0.165	-0.023	-0.045	-0.109	-0.078	-0.028**	-0.030**	-0.030**	-0.015***	-0.016***	-0.016***
	(-0.16)	(-0.37)	(-0.05)	(-0.37)	(-0.88)	(-0.63)	(-1.97)	(-2.11)	(-2.08)	(-4.39)	(-4.53)	(-4.50)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,307	1,307	1,307	3,250	3,250	3,250	3,256	3,256	3,256	2,608	2,608	2,608
Adjusted R^2	0.707	0.706	0.706	0.790	0.788	0.789	0.768	0.768	0.768	0.892	0.892	0.892

Table 7 continued.

Panel B: Firm Entry and Labor Market

This table reports the results analyzing the city's economic consequences from corporate environmental investments. The sample period is 2004-2014 for columns 1-3 and is 2003-2014 for columns 4-6. The unit of observation is a city-year. The dependent variable is the entry of high-quality new firms in columns 1-3 and unemployment in columns 4-6. All models include a set of control variables (*GDP Growth*, *Fixed Asset Investment*, *Service Sector*, *Fiscal Surplus*, *Population*, and *Colleges*), a constant, and fixed effects as described in the table, but the coefficients are not tabulated. Detailed definition of variables is provided by Appendix A. *T*-statistics based on robust standard errors clustered at the city level are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable:	Entry of High-quality Firms			Unemployment		
	(1)	(2)	(3)	(4)	(5)	(6)
Post × EI(Total)	0.131			-0.393***		
	(1.56)			(-2.62)		
Post × EI(Non-Firm-Specific)		0.291*			-1.103***	
		(1.77)			(-4.37)	
Post × EI(Firm-Specific)			0.001			-0.012
			(0.02)			(-0.06)
EI(Total)	0.000			0.001		
	(0.30)			(0.35)		
EI(Non-Firm-Specific)		0.001			0.001	
		(0.51)			(0.13)	
EI(Firm-Specific)			0.000			0.003
			(0.08)			(0.50)
Post	0.060**	0.061**	0.063**	0.037*	0.039*	0.029
	(2.24)	(2.24)	(2.32)	(1.70)	(1.77)	(1.33)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Province × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,334	2,334	2,334	3,757	3,757	3,757
Adjusted R^2	0.256	0.256	0.256	0.850	0.850	0.849

Table 7 continued.

Panel C: Heavily Polluting Firms

This table reports the results analyzing the city's economic consequences from corporate environmental investments. The sample period is 2001-2013. The unit of observation is a city-year. The dependent variable is the proportion of sales (columns 1-3) and taxes (columns 4-6) of heavily polluting firms relative to all industrial firms in a city; and is non-polluting M&A targets acquired by heavily polluting firms relative to all heavily polluting industrial firms in a city (columns 7-9). All models include a set of control variables (*GDP Growth*, *City FA Investment*, *Service Sector*, *Fiscal Surplus*, *Population*, and *Colleges*), a constant, and fixed effects as described in the table, but the coefficients are not tabulated. Detailed definition of variables is provided by Appendix A. *T*-statistics based on robust standard errors clustered at the city level are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable:	Polluting firms' proportion of sales			Polluting firms' proportion of taxes			Non-polluting targets acquired by polluting firms		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post × EI(Total)	-0.013			0.008			0.023***		
	(-0.28)			(0.12)			(3.81)		
Post × EI(Non-Firm-Specific)		-0.164**			-0.195*			0.077***	
		(-2.03)			(-1.69)			(7.71)	
Post × EI(Firm-Specific)			0.068			0.120			-0.007
			(1.16)			(1.43)			(-0.89)
EI(Total)	-0.000			-0.001			-0.000		
	(-0.08)			(-0.90)			(-0.63)		
EI(Non-Firm-Specific)		0.001			-0.001			-0.000	
		(0.28)			(-0.16)			(-0.14)	
EI(Firm-Specific)			-0.001			-0.004			-0.000
			(-0.37)			(-1.40)			(-0.94)
Post	-0.000	0.001	-0.001	-0.002	0.001	-0.003	0.009***	0.009***	0.009***
	(-0.02)	(0.16)	(-0.20)	(-0.16)	(0.05)	(-0.31)	(9.77)	(9.71)	(10.50)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,553	3,553	3,553	3,553	3,553	3,553	3,553	3,553	3,553
Adjusted R^2	0.893	0.893	0.893	0.814	0.815	0.815	0.461	0.469	0.458

Table 8: Does the Firm Benefit?

Panel A: Firm Performance

This table reports the results analyzing firm performance from engaging in environmental investments. The sample period is 2001-2014. The unit of observation is a firm-year. The dependent variable is a firm's Tobin's Q in columns 1-3, the natural logarithm of one plus the number of patents in columns 4-6, and the fraction of patents as green patents in columns 7-9. Models in columns 1-3 include a set of control variables (*Size*, *Leverage*, *ROA*, *Cash*, *Age*, *State*, *Board Independence*, *Institutional Holdings*, and *GDP Growth*), a constant, and fixed effects as described in the table, but the coefficients are not tabulated. Models 4-9 controls additionally, *Market to Book*. Detailed definition of variables is provided by Appendix A. *T*-statistics based on robust standard errors clustered at the firm level are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable:	Tobin's Q			# of Patents			% of Green Patents		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post × EI(Total)	0.147**			0.170***			0.039***		
	(2.15)			(6.44)			(4.42)		
Post × EI(Non-Firm-Specific)		0.124*			0.166***			0.037***	
		(1.67)			(5.64)			(3.76)	
Post × EI(Firm-Specific)			0.060			0.147***			0.028**
			(0.83)			(4.41)			(2.43)
EI(Total)	-0.041			-0.096***			-0.023***		
	(-0.69)			(-4.71)			(-3.25)		
EI(Non-Firm-Specific)		-0.043			-0.088***			-0.021***	
		(-0.67)			(-3.94)			(-2.64)	
EI(Firm-Specific)			-0.067			-0.067**			-0.022**
			(-1.06)			(-2.57)			(-2.48)
Post	0.035	0.055	0.076	-0.127***	-0.109***	-0.093***	-0.025*	-0.020	-0.016
	(0.36)	(-0.59)	(0.83)	(-3.49)	(-3.05)	(-2.61)	(-1.92)	(-1.59)	(-1.24)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	21,394	21,394	21,394	21,394	21,394	21,394	21,394	21,394	21,394
Adjusted R^2	0.776	0.776	0.776	0.742	0.742	0.742	0.407	0.407	0.406

Table 8 continued

Panel B: Labor Productivity

This table reports the results analyzing labor performance for firms engaging in environmental investments. The sample period is 2001-2014. The unit of observation is a firm-year. The dependent variable is a firm's employment growth in columns 1-3, labor investment inefficiency in columns 4-6, and labor productivity in columns 7-9. All models include a set of control variables (*Size*, *Leverage*, *ROA*, *Cash*, *Market to Book*, *Age*, *State*, *Board Independence*, *Institutional Holdings*, and *GDP Growth*), a constant, and fixed effects as described in the table, but the coefficients are not tabulated. Detailed definition of variables is provided by Appendix A. *T*-statistics based on robust standard errors clustered at the firm level are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable:	Employment Growth			Labor Investment Inefficiency			Labor Productivity		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post × EI(Total)	-0.043**			-0.028*			0.054***		
	(-2.31)			(-1.71)			(3.00)		
Post × EI(Non-Firm-Specific)		-0.039*			-0.038*			0.042**	
		(-1.84)			(-1.96)			(2.18)	
Post × EI(Firm-Specific)			-0.031			-0.008			0.087***
			(-1.47)			(-0.40)			(4.00)
EI(Total)	0.033**			0.015			-0.037**		
	(2.14)			(1.25)			(-2.34)		
EI(Non-Firm-Specific)		0.032*			0.025*			-0.029*	
		(1.83)			(1.88)			(-1.88)	
EI(Firm-Specific)			0.008			-0.010			-0.053***
			(0.50)			(-0.79)			(-2.75)
Post	0.001	-0.004	-0.009	-0.031*	-0.031*	-0.039**	-0.090***	-0.082***	-0.087***
	(0.06)	(-0.17)	(-0.39)	(-1.83)	(-1.85)	(-2.34)	(-3.96)	(-3.66)	(-3.91)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	21,239	21,239	21,239	13,192	13,192	13,192	21,333	21,333	21,333
Adjusted R^2	0.116	0.116	0.116	0.060	0.061	0.060	0.748	0.748	0.748

Internet Appendix for

“Levelling Up Your Green Mojo: The Benefits of Beneficent Investment

This online appendix contains the following:

IA.1: A List of Words/Phrases to Identify Environmental Projects in Annual Reports

IA.2: A List of Words/Phrases to Identify Environment-related News Articles

Appendix IA.1: A List of Words/Phrases to Identify Environmental Projects in Annual Reports

This table lists the 467 Chinese words/phrases that we use to identify a firm's environmental projects.

三废	生态	引水渠	厌氧发电	生态监测	防风抑尘网
低碳	疏浚	循环水	变电增容	甲醇燃料	零化学成份
余热	省煤	抑尘网	喷洒管道	电价补贴	鼠密度监测
光伏	硫酸	拦水堰	喷淋设施	电所改造	传染媒介控制
冶渣	种植	放射源	噪声治理	电炉技改	低热值煤发电
净化	种草	新热源	噪声监测	电炉改造	卫生防疫监测
净水	空气	新能源	噪声防治	电站改造	合同能源管理
减噪	粉尘	无害化	回收 CO	疫情监测	吸收系统改造
减振	精馏	树种植	回收利用	石墨换热	回收综合利用
减排	绿化	核发电	固废处理	矿粉改造	垃圾焚烧发电
减碳	绿地	水处理	地埋管网	研保项目	天然气化铁炉
制酸	绿色	水改造	地源热泵	硫酸技改	尾矿排放系统
厌氧	能效	水电站	垃圾发电	碧水蓝天	废酸浓缩技改
双绿	脱水	水过滤	垃圾处理	磷酸铁锂	扩能技术改造
变频	脱硝	污染源	垃圾焚烧	磺二技改	技能技术改造
吸声	脱硫	沉沙池	大气监测	秸秆发电	本部景观改造
噪声	脱销	沉淀池	太阳能电	稀酸技改	林浆纸一体化
回收	节水	沉渣池	尾气净化	简易渗渠	氢氧化钾技改
回用	节电	油改气	尾矿治理	管沟工程	氧脱木素改造
垃圾	节约	泥石流	废料处理	粉尘防治	氨氮自动监控
填埋	节能	洒水车	废旧物品	精馏系统	水生生物保护
复垦	花园	浓缩罐	废油处理	经济林木	水电增效扩容
太阳	花坛	消音室	废酸回收	综合利用	水解岗位提质
尾气	蓝天	清扫车	废酸技改	老线技改	池塘土方回填
尾矿	造林	清水池	影响补偿	能源环保	消防水池建造
废气	酸解	渣处理	循环利用	能源节约	焦炉煤气发电
废水	锅炉	渣治理	循环经济	臭气处理	环境地质勘察
废液	防尘	漂浮物	扩能改造	节能技改	生物质能发电
废渣	防治	澄清池	报废更新	蓝色经济	矸石堆场治理
废酸	防洪	炉技术	捞渣行车	蚁虫监测	碱渣压滤装置
循环	防渗	炉改造	排水改造	资源利用	磷酸升级改造
扩能	防火	煤制气	景观湿地	资源节约	磷酸浓缩装置
抑尘	防疫	煤制油	植被观测	退耕还林	空气智能采样
护坡	降噪	煤改气	水利建设	酸浴脱气	联合循环发电
排水	降尘	煤矸石	水力发电	金属回收	能源节约利用
排污	降耗	电解槽	水土流失	锅炉冷渣	节能技术改造
排烟	除尘	疫源地	水泥技改	锅炉处理	苗圃土地平整

排矸	除灰	硫磺池	水源改造	锅炉改造	资源综合利用
收尘	除硝	碳处理	水源热泵	锅炉更新	输煤系统改造
无氟	除腐	碳排放	水管改造	锅炉治理	酒店园林景观
景观	隔声	碳汇林	水质监测	锅炉除尘	酸站系统改造
检疫	隔音	碳过滤	污染治理	防护栏杆	陆生动物保护
森林	风场	碳酸锂	污水处理	防水设施	陆生植物保护
植树	风景	示范林	污泥发电	防渗截渗	风沙荒漠治理
植物	风电	种植等	污泥处理	阳光发电	高分散白炭黑
植草	鼓风	经济林	污泥干化	雨污分流	高新技术循环
植被	GMP	给水管	污泥干燥	霉菌改造	高档分散染料
氨气	LCD	臭氧机	污泥焚烧	风力发电	高炉煤气发电
氨氮	LED	还原炉	河道整治	风炉改造	龙游苗圃滴灌
水利	PVC	酸改造	油库改造	高效电机	动力生产线改造
水文	中段水	锂电池	沼气发电	高炉喷煤	化工热力线改造
水电	低铅耗	防护林	洁净排放	LED 照明	地坑过滤器水池
污染	光伏电	防腐漕	清洁生产	六氟磷酸锂	污染源自动监控
污水	光照电	除尘器	清洗设备	可再生能源	烟化炉收尘系统
治污	再利用	除碳器	湿地保护	塌陷区治理	热钛液过滤技改
沼气	冷凝热	除雾器	灰场治理	天然气利用	猛洞河景区绿化
洗尘	冷却塔	隔离带	烟囱改造	天然气发电	电厂澄清池改造
洗涤	冷却水	隔音板	烟气净化	有机绿化区	矸石山专项治理
洗煤	冷氢化	集油池	烟气治理	水浴灭菌柜	设施改建、加固
浮渣	冷水机	LED 灯	烧碱更新	水系统改造	食品级二氧化碳
消声	净化水	上大压小	热电技改	油气站改造	废酸填平补齐技改
消毒	净水厂	两酸处理	热电联产	浓硝酸贮槽	水质在线自动监控
淘汰	化学水	中水回用	焦化技改	烧结维修站	烟气排放自动监测
清污	可持续	二氧化碳	焦油加氢	热钛液过滤	移民安置环境保护
清洁	吸附剂	产能升级	焦炉技改	牛磺酸技改	苗圃基础设施建设
清理	噪音墙	产能补贴	燃气发电	生化处理池	CDI 系统技术改造
滴灌	地下水	余热利用	燃气锅炉	生物多样性	一系统硫酸干吸改造
灭蚊	垃圾炉	余热发电	环境保护	电镀线改造	化学水活性碳过滤器
灭蝇	增温池	供水工程	环境卫生	疫源地控制	化工热力线改造项目
灭鼠	复合肥	光伏发电	环境友好	盐酸罐土建	污染源自动监控系统
烟尘	太阳嫩	光电发电	环境应急	矿热炉技改	汽车排放环模实验室
烟气	太阳能	再生系统	环境恢复	硫酸厂改造	高分散沉淀法白炭黑
烟道	射雾器	分层取水	环境检测	碳酸二甲酯	外购硫酸中转装置技改
烧结	小水电	化学澄清	环境治理	磷酸沉降槽	热力燃气系统技术改造
热能	干煤棚	升级改造	环境监测	磺化酸吸收	大叶清化桂、山银花种植
环保	干熄焦	卫生防疫	环境管理	酸冷器改造	环境空气质量自动检测系统
环境	废弃物	危废处置	环氧地坪	酸雾净化塔	多晶硅生产线冷氢化技术改造
环评	废蒸汽	危险废物	生产除尘	铅雨冷凝器	

Appendix IA.1 continued.

The table below lists corresponding English translations of the 467 Chinese words/phrases that we use to identify a firm's environmental projects.

Wastewater, waste gas, waste solid	Ecology	Water circulation
Low carbon	Dredging	Depressing dust net
Waste heat	Coal saving	Water weir
Photovoltaic	Sulfuric acid	Radioactive source
Smelt control	Planting	New heat source
Purification	Grass planting	New energy source
Clean water	Air	Innocuity treatment
Noise reduction	Dust particle	Tree planting
Vibration reduction	Distillation	Nuclear power
Emission reduction	Afforestation	Water treatment
Carbon reduction	Ecological green land	Water system transformation
Acid making	Green	Hydropower station
Anaerobic	Energy efficiency	Water filtration
Shuanglu environmental investment project	Dehydration	Polluter
Frequency conversion	Denitrification	Sand settling pond
Noise absorption	Desulfurization	Settling tank
Noise	Out of stock	Ash settling pond
Recycle	Water preservation	Oil conversion to gas
Reutilization	Electricity saving	Debris flow
Rubbish	Saving	Sprinkler
Landfill	Energy saving	Concentrating tank
Reclamation	Garden	Anechoic chamber
Solar	Flowerbed	Sweeper
Waste gas	Blue sky	Clean water pool
Mine tailing	Planting	Residue treatment
Waste gas	Acid hydrolysis	Residue management
Wastewater	Boiler	Floater
Liquid waste	Dust proof	Clarifying basin
Waste residue	Prevention and treatment	Furnace technology
Acid waste	Flood control	Furnace transformation
Recycling	Anti-seepage	Coal-based gas
Capacity expansion	Fire prevention	Coal synthetic oil
Dust inhibition	Disease prevention	Coal to gas
Slope protection	Denoise	Coal gangue
Drainage	Dust reduction	Electrolyzer
Pollution discharge	Consumption reduction	Natural foci
Smoke Emission	Dedust	Sulphur tank

Gangue removal	Ash disposal	Carburizing
Dust recovery	Sulphate removal	Carbon dioxide emission
Fluoride-free	Spoilage removal	Carbon sequestration forest
Landscape	Sound insulation	Carbon filter
Quarantine inspection	Soundproofing	Lithium carbonate
Forest	Wind field	Sample forest zone
Forestation	Scenery	Economic forest
Plant	Wind power	Feedwater pipe
Landscaping	Blower	Ozone generator
Vegetation	GMP	Reduction furnace
Ammonia	LCD	Acid reform
Ammonia nitrogen	LED	Li-battery
Hydraulic engineering	PVC	Shelterbelt
Hydrology	Midcourse wastewater	Anti-corrosion tank
Hydroelectricity	Low lead consuming	Vacuum dust cleaner
Pollution	Photovoltaic power	Decarbonator
Sewage	Light-based electricity	Demister
Pollution control	Reuse	Grassland barrier
Biogas	Heat of condensation	Acoustic board
Dust Scrub	Cooling tower	Oil accumulation
Washing	Cooling water	LED lights
Coal washing	Hydrogenation	Gas-station upgrade
Scum	Water cooler	Waste treatment of phosphoric acid and sulfuric acid
Sound elimination	Purified water	Reclaimed water reusing
Disinfection	Water purify plant	CO2
Phase out	Chemical water	Productivity uplift
Pollution clean-up	Sustainable	Productivity subsidies
Clean	Adsorbent	Waste heat utilization
Clean off	Noise barrier	Waste heat generation
Drip irrigation	Underground water	Water supply engineering
Mosquito control	Garbage furnace	Photovoltaic power generation
Fly control	Thermal pool	Photovoltaic-power electricity
Deratization	Compound fertilizer	Regenerating system
Coking dust	Solar power	Stratified water extraction
Flue gas	Blast atomizer	Chemical clarification
Flue pipe	Small-scale hydropower	Upgrade and transformation
Sintering	Dry coal shed	Sanitation and epidemic prevention
Thermal energy	Coke dry quenching (CDQ)	Hazardous waste disposal
Environmental protection	Waste discharge	Hazardous waste
Environment	Waste steam	Anaerobic power generation
Environmental assessment	Diversion canal	Substation capacity Expansion

Sprinkle pipeline	Electricity price subsidies	Rodent density monitoring
Water spray facility	Power station transformation	Infection vector control
Noise treatment	Electric furnace technical transformation	Low-calorific-value coal power generation
Noise monitoring and testing	Electric furnace transformation	Hygiene and epidemic prevention monitoring
Noise prevention and control	Power station transformation	Energy management contracting
CO recycling	Epidemic surveillance	Absorption system modification
Recovery and utilization	graphite heat exchange	Recycling and comprehensive utilization
Solid waste treatment	Mine-ore transformation	Power generation of garbage incineration
Underground pipe network	Research and assurance project	Natural-gas iron furnace
Ground-coupled heat pump	Sulphuric acid technical reform	Tailings discharge system
Waste-to-energy	Clean water and blue sky	Waste acid concentration technical reformation
Garbage disposal	Lithium iron phosphate	Technical transformation on capacity expansion
Waste incineration	Sulfamethazine technology reform	Skill and technology upgrade
Air monitoring	Straw power generation	Main landscape transformation
Solar-power electricity	Dilute acid technical transformation	Paper-pulp-forestry integration
Vent gas purification	Simple seepage channel	Technical modification of potassium hydroxide
Tailing treatment	Trench project	Oxygen delignification modification
Waste materials treatment	Dust Prevention and Control	Automatic monitoring of ammonia nitrogen
Waste materials	Distillation system	Aquatic life protection
Waste oil disposal and recovery	Economical plants	Hydropower efficiency expansion
Acid waste recycling	Integrated utilization	Hydrolysis post quality improvement
Acid-waste transformation	Old line transformation	Pond backfills
Compensation for environmental damage	Energy and environmental protection	Fire pool construction
Recycling	Energy Saving	Coke oven gas power generation
Circular economy	Oder treatment	Environmental geological field survey
Capacity-expansion transformation	Energy saving technology reform	Biomass energy generation
End-of-life renewal	Blue economy	Waste rock processing
Dredging truck	Ant monitoring	Alkali slag filter and press device
Drainage transformation	Resource utilization	Phosphoric acid upgrade
Landscape wetland	Resource conservation	Phosphoric acid concentration device
Vegetation observing and monitoring	Converting cropland to forest	Intelligent Air Sampling

Water conservancy construction	Acid bath degasification	Combined-cycle power generation
Waterpower generation	Metal recovery	Energy conservation and utilization
Water loss and soil erosion	Boiler cooler	Energy-saving technology transformation
Cement technical transformation	Boiler treatment	Nursery land leveling
Water-source transformation	Boiler transformation	Comprehensive utilization of resources
Water-source heat pump	Boiler update	Coal transmission system transformation
Pipeline transformation	Boiler management	Hotel landscape
Water quality monitoring	Boiler de-dusting	Acid station system transformation
Pollution control	Protective railing	Terrestrial animal protection and conservation
Wastewater treatment	Waterproof facility	Terrestrial plant protection and conservation
Sludge electricity generation	Seepage interruption	Aeolian desert control
Sludge disposal	Solar-power generation	High dispersive silica
Sludge drying	Separation of rain from sewage	High-tech cycle
Sludge drying/ dehydrate sludge	Mould transformation	High-grade disperse dyes
Sludge incineration	Wind-power generation	Blast furnace gas power generation
Rectification of river	Draft furnace modification	Power production line transformation
Oil depot transformation	High-efficiency motor	Chemical heat line transformation
Biogas production	Blast furnace coal blasting	Pit filter pool
Clean emission	LED illumination	Automatic monitoring of pollution sources
Clean production	Lithium hexafluorophosphate	Smoke furnace dust collection system
Cleaning equipment	Renewable energy	Technical modification of hot titanium fluid filtration
Wetland protection	Subsidence area management	Mengdong River Greening
Ash yard governance	Natural gas utilization	Power plant clarifier modification
Chimney modification	Natural gas powering	Special treatment of gangue mountain
Gas purification	Organic green area	Facility alteration and reinforcement
Flue gas control	Water-bath sterilization cabinet	Food grade carbon dioxide
Caustic soda update	Water system modification	Waste acid filling technology reform
CHP technical transformation	Oil-gas station transformation	Online automatic monitoring of water quality
Combined heat and power cogeneration (CHP)	Concentrated nitric acid storage tank	Automatic monitoring of flue gas emissions
Coking technology reform	Sintering maintenance station	Environment protection for immigrant resettlement
Tar hydrogenation	Thermal titanium liquid filtration	Nursery infrastructure construction

Coke oven technical transformation	Taurine technical modification	CDI system technical transformation
Gas-fired power generation	Biochemical pool/ biochemical treatment pool	One system sulfuric acid dry suction modification
Gas boiler	Biodiversity	Chemical water activated carbon filter
Environmental protection	Electroplating line transformation	Chemical heat line transformation project
Environmental sanitation	Natural foci control	pollution sources auto-monitoring system
Environment friendly	Civil construction of salt acid tank	Automotive emission ring model laboratory
Environmental emergency	Technical transformation of mine-heat furnace	high dispersive precipitated silica
Environmental recovery	Sulfuric acid plant transformation	Technical transformation of purchased sulfuric acid transfer device
Environmental detection	DMC	Technical transformation of heat and gas system
Environmental management	Setting tank of phosphoric acid	Large-leaf Qinghua cinnamon and honeysuckle planting
Environmental supervision and examination	Sulfonated acid absorption	Automatic detection system for ambient air quality
Environmental management	Acid cooler modification	Cold hydrogenation technology transformation of polysilicon production line
Epoxy terrace	Acid mist purification tower	
De-dust during production	lead-splash condenser	
Ecologic monitoring	Wind dust suppression net	
Methanol fuel	Zero chemical composition	

Appendix IA.2: A List of Words/Phrases to Identify Environment-related News Articles

This table provides the list of 215 Chinese words/phrases that we use to classify news coverage of local environmental issues.

API	废气	环卫	林地保护	生物质能	循环经济
AQI	废弃物	荒漠化	零排放	湿地保护	循环利用
CO2	废水	灰霾	乱排	收尘	烟尘
COD	废酸	回收	绿化	水土流失	烟囱改造
ODS	废物	减排	绿色建筑	水污染	烟粉尘
PFC	废渣	减碳	绿色能源	水源污染	盐碱地
PM10	焚烧	碱化	绿色评价	水质	厌氧
PM2.5	粉尘	降产能	绿水青山	水资源	冶渣
SO2	浮渣	降尘	煤改气	酸雨	一氧化碳
安全环保	复垦	降耗	能耗	碳排放	抑尘
氨氮	高耗能	降霾	能源	碳市场	有毒气体
保护地球资源	高排放	降碳	排放	碳信息披露	有毒物质
保护耕地	高污染	降噪	排气	碳中和	有害气体
保护环境	高效环保	节电	排水	碳足迹	有害物质
保护资源	隔音	节能	排污	填埋	再回收
变废为宝	固废	节水	排烟	停牌	再利用
澄清池	过度用水	节约用水	破坏耕地	偷排	再生利用
臭氧	黑臭	节约资源	破坏环境	土壤污染	再生系统
除尘	黑水	截渗	破坏林地	脱硫	再生资源
除灰	化学需氧量	截污	破坏农地	脱气	噪声
除雾	环保	净化	青山绿水	脱硝	噪音
大气污染	环境保护	净水	倾倒	危废	沼气
大气治理	环境处罚	净土	清废	温室气体	直排
氮氧化物	环境监测	开荒	清洁	温室效应	植树造林
低耗	环境监督	开垦	清污	污泥	治碱
低能耗	环境检测	颗粒物	清淤	污染	治理环境
低碳	环境破坏	可持续发展	全氟化合物	污水	治沙
低污染	环境违规	可吸入颗粒物	燃煤脱硫	无机氮	治山
低消耗	环境卫生	可再生	三废	无磷化	治水
地下水	环境污染	空气污染	沙化	雾霾	治污
恶臭	环境信息披露	空气质量	生化需氧量	洗尘	资源化利用
二氧化氮	环境应急	垃圾	生态	泄漏	资源回收
二氧化硫	环境友好	滥采滥挖	生物多样性	新能源	资源节约
二氧化碳	环境责任	滥采乱挖	生物能源	修复耕地	资源枯竭
防风固沙	环境治理	浪费电	生物燃料	修复环境	总磷
防渗	环评	浪费资源	生物油	悬浮物	

Appendix IA.2 continued.

This table provides the corresponding English translations of the 215 Chinese words/phrases that we use to classify news coverage of local environmental issues.

API	Waste gas	Environmental sanitation
AQI	Waste	Sandy desertification
CO2	Water waste	Ash haze
COD	Acid waste	Recycling
ODS	Waste	Emission reduction
PFC	Waste residue	Carbon reduction
PM10	Incineration	Alkalization
PM2.5	Dust	Productivity reduction
SO2	Scum	Dust reduction
Safety and environmental protection	Reclamation	Consumption reduction
Ammonia nitrogen	Excessive energy-consumption	Haze reduction
Protect the earth's resources	Excessive emission	Carbon reduction
Farmland protection	Excessive pollution	Noise reduction
Environment protection	Efficient and environmentally friendly	Electricity saving
Resource protection	Sound insulation	Energy saving
Waste transformation	Solid waste	Water saving
Clarifying basin	Water overuse	Water preservation
Ozone	Malodorous and black waste	Resource saving
Dust disposal	Soot water	Cutting off seepage
Ash removal	Chemical oxygen demand	Pollution interception
Defog	Environmental protection	Purification
Air pollution	Protecting environment	Clean water
Air quality management	Environmental punishment	Clean land
Nitrogen oxide	Environmental supervision and examination	Waste land reclamation
Low consumption	Environmental monitoring	Grassland cultivation
Low energy consumption	Environmental detection	Particle
Low carbon	Environmental destruction	Sustainable development
Low pollution	Environmental violation	PM10
Low usage	Environmental sanitation	Renewable
Underground water	Environmental pollution	Air pollution
Stink	Environmental information disclosure	Air quality
NO2	Environmental emergency	Garage
SO2	Environment friendly	Indiscriminate mining
CO2	Environmental responsibility	Careless mining and digging
Wind-prevention and sand-fixation	Environmental governance	Waste of electricity

Anti-seepage	Environmental assessment	Waste of resources
Forestland protection	Biomass energy	Circular economy
Zero emission	Wetland protection	Recycling
Illegal emission	Dust collection	Coking dust
Afforestation	Water loss and soil erosion	Chimney modification
Green architecture	Water pollution	Smoke powder
Clean energy	Water source pollution	Saline land
Green assessment	Water quality	Anaerobic
Verdant hills and green waters	Water resource	Smelt control
Coal to gas	Acid rain	CO
Energy consumption	Carbon Emission	Dust suppression
Energy	Carbon market	Poisonous gas
Emission	Carbon disclosure	Toxic substance
Gas emission	Carbon neutral	Hazardous gas
Drainage	Carbon footprint	Toxicant
Pollution discharge	Landfill	Reuse
Smoke emission	Delist	Renewal
Farmland destruction	Illegal emissions	Regenerative utilization
Environmental damage	Soil contamination	Regenerating system
Forestland destruction	Desulfurization	Renewable resource
Agricultural land destruction	Degasification	Noise
Verdant hills and green waters	Denitrification	Undesired sound
Dump	Hazardous waste	Biogas
Trash clean	Greenhouse gas	Direct drainage
Clean	Greenhouse effect	Reforestation
Feculence clearing	Sludge	Alkali control
Desilting	Pollution	Governing environment
Perfluorochemicals	Sewage	Desertification control
Coal combustion gas desulfurization	Inorganic nitrogen	Mount prevention
Wastewater, waste gas, waste solid	De-phosphatizing	Water control
Land deterioration	Fog-haze	Pollution abatement
BOD	Dust Scrub	Resource utilization
Ecology	Leakage	Resource recycling
Biodiversity	New energy source	Resource saving
Biological energy	Arable land restoration	Resource exhaustion
Biofuel	Environment remediation	Total phosphate
Bio-oil	Suspended substance	