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

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## Abstract

We study corporate investment responses to changes in environmental regulations using a manually collected dataset on project investments in China. We categorize projects based on their societal benefits and show that local firms increase their environmental investment after their city is targeted for heightened environmental regulation, particularly through "beneficent investments" that directly spill benefits over to society at large. The effect is more pronounced in long-term projects, non-green sectors, and non-state-owned firms. Targeted cities experience intensified media coverage of environmental issues and greater career advancement opportunities for politicians tied to achieving environmental goals. Firms investing more in green projects receive additional financial incentives. By promoting local corporate environmental investment, targeted cities curb emissions, improve employment, grow green sectors, and attract high-quality firms. Local firms with greater environmental investments generate more green revenue and patents, enhance performance, and enjoy larger value gains. Our findings highlight how regulatory mechanisms can induce environmental investments that boost both corporate value and societal welfare.

Keywords: Project investment, Environmental regulation, Climate finance, Sustainability, Environmental investment
JEL Classifications: G31, G38, O13, Q5

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**Abstract**

We study corporate investment responses to changes in environmental regulations using a manually collected dataset on project investments in China. We categorize projects based on their societal benefits and show that local firms increase their environmental investment after their city is targeted for heightened environmental regulation, particularly through "beneficent investments" that directly spill benefits over to society at large. The effect is more pronounced in long-term projects, non-green sectors, and non-state-owned firms. Targeted cities experience intensified media coverage of environmental issues and greater career advancement opportunities for politicians tied to achieving environmental goals. Firms investing more in green projects receive additional financial incentives. By promoting local corporate environmental investment, targeted cities curb emissions, improve employment, grow green sectors, and attract high-quality firms. Local firms with greater environmental investments generate more green revenue and patents, enhance performance, and enjoy larger value gains. Our findings highlight how regulatory mechanisms can induce environmental investments that boost both corporate value and societal welfare.

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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

The recent two decades have witnessed a significant surge in investor demand for environmentally responsible investments and widespread public attention on environmental and social (E&S) issues. Nevertheless, environmental projects differ from traditional corporate investments, as the former resembles public goods in which firms bear the costs while society and other economic actors share the benefits, thereby giving rise to the free-rider problem (Flammer, Giroux, and Heal 2023). 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; Starks 2023). While researchers have proposed various external mechanisms, particularly highlighting the role of regulators in curbing emissions, much remains unknown about the impact of environmental regulations on firm investment decisions and the real effects of private investment in such public goods.[1]

[1] There have been intensive debates and mixed evidence on the effect of environmental regulations on motivating firms' environmental engagement. On one hand, localized climate policies induce regulatory arbitrage by firms, increasing total firm emissions and undermining the effectiveness of the policy (e.g., Ben-David, Kleimeier and Viehs 2021; Bartram, Hou and Kim 2022). Environmental regulations are costly to firm performance (Karpoff, Lott, and Wehrly 2005) and force production shift by polluting firms, which may lead to aggregate economic loss (De Simone Naaraayanan and Sachdeva 2024). The design and implementation of environmental regulation are also not without challenges (Duflo et al. 2018). 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, Martinsson and Thomann 2022; Najjar and Cherniwchan 2021; Chhaochharia, Sen and Xu 2022).

In this paper, we study within-firm investment response to environmental regulation. Our goal is to understand whether and 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 potentially be both value- and *values*-enhancing.

We manually compile a large sample of environmental projects conducted by Chinese companies during the period of 2001-2014. We hand-collect data on project descriptions from firms' annual reports and perform textual analyses to identify whether a project is related to environmental protection. To capture the "public goods" nature of such projects, we further assess the externalities of an environmental initiative. Specifically, we distinguish between projects that primarily serve a firm's shareholders with relatively limited direct societal impact, and those "beneficent" ones that generate substantial spillover effects for stakeholders, especially the local community. The latter accentuates the potential free-rider problem to a greater extent.

To estimate corporate engagement in environmental investment, we employ a difference-in-differences strategy and exploit a major 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 11$^{th}$ Five-Year Plan for Environmental Protection. A critical element of the plan is to formally introduce 113 cities as "major cities for environmental protection" (MCEPs). These cities are distributed across 31 provinces, accounting 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.

We find that local firms ramp up their investments in environmental projects once their city attains its MCEP status, thereby being targeted for more stringent environmental regulations. The effect is mainly driven by beneficent investments – environmental projects that not only benefit the firm but also directly contribute positive externalities to stakeholders and the local community, thereby facing more severe free-rider problems. This evidence supports the regulatory role in mitigating the free-rider problem in sustainable investment. By contrast, investments in environmental projects that primarily serve the firms themselves do not respond to intensified environmental regulation. This perhaps is not surprising, as profit-maximizing firms may not rely on regulations to incentivize their investment in projects that directly benefit their shareholders. In addition, the increased environmental spending predominantly targets longer-term projects (i.e., those with a duration exceeding three years). Firms in conventional, non-green sectors, as well as non-state-owned firms, exhibit a more pronounced response to heightened environmental regulations than their respective counterparts.

Our analysis controls for a host of firm-specific time-varying characteristics and firm fixed effects, which help to track the same firm's investment strategy over time. In particular, the ability to saturate the empirical models with industry × year fixed effects and province × year fixed effects allows us to control non-parametrically for industry- and province-specific shocks. We also construct matched samples using various matching techniques and explore a subsample of projects for which we can obtain information about their locations. These tests help to narrow the comparison of environmental investments among firms with similar characteristics but differing

in their exposure to local regulatory shocks at different times. Our placebo tests help mitigate the concern that the results are driven by other regulatory events or changes in a firm's overall investment policies. Lastly, our empirical strategy relies on the assumption that local firms did not already exhibit changes in their total environmental investment and in beneficent projects prior to the MCEP assignment. A dynamic difference-in-differences analysis confirms that this identifying assumption is satisfied.

Next, we explore potential mechanisms that help facilitate firms' engagement in environmental protection. We first collect news articles published by 485 major newspapers during the sample period and conduct textual analysis on media coverage of environmental issues in local cities. We find a significant surge in coverage intensity across all types of news media after the city's MCEP assignment, suggesting rising public attention and media scrutiny of its environmental issues. Second, we investigate the career path of local bureaucrats. Politicians in targeted cities are more likely to be promoted if they achieve a larger proportion of pre-set environmental targets or reduce pollution. Lastly, targeted cities deploy more environmental subsidies, cut taxes, and provide more credits. These policy changes provide financial incentives for local firms. Accordingly, firms that spend more on green investments pay less taxes, garner larger subsidies, and secure more bank loans. Overall, these findings suggest that both regulation-based and market-based incentive mechanisms are at play in motivating firms' engagement in environmental investments.

In the last step of our analysis, we assess the real consequences brought about by changes in regulation stringency and corporate environmental investment. MCEP cities that experience larger corporate environmental project investments cut down on pollution, improve local employment, reduce excess hospital needs, and attract high-quality new firms to a greater extent.

There is also a meaningful change in the composition of local firms in targeted cities, with an increase in both the number and growth of firms in green sectors and a decline in firms in non-green sectors. As local corporate spending on environmental projects increases, heavily polluting firms contribute a smaller fraction of tax revenue to the MCEP cities' fiscal sources. These cities also rely less upon the revenue 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 polluting industries.

Post MCEP, local firms that allocate more resources to environmental projects expand their green revenue share, produce more green patents, improve labor investment efficiency, and experience higher labor productivity. They have larger value gains and reduced regulatory risk. These findings suggest that effective environmental regulations should foster both short-term incentives and long-term benefits to encourage corporate commitment to environmental initiatives and sustainability.

Our paper adds to the growing literature exploring the determinants of corporate environmental policies. Existing studies establish that institutional investors are essential in shaping corporate environment policies (e.g., Chen, Dong and Lin 2020; Dyck et al. 2019; Akey and Appel, 2020; Krueger, Sautner and Starks 2020). Others document the crucial roles played by stakeholders such as news media, customers, and employees (e.g., Dai, Liang and Ng 2021; Gantchev, Giannetti and Li 2022). The real outcome and sustainability of corporate E&S engagement, however, have been subject to intensive debate. In particular, there is robust evidence of 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 the misuse of corporate resources. Bertrand et al. (2020) highlight its role in securing political favors

and seeking influence on politicians. Duchin, Gao and Xu (2024) show that firms use the asset divestiture market for greenwashing.

Using a novel dataset on project investment, we focus on the role of regulation in facilitating corporate environmental investment and assess both its short-term and long-term real consequences. In this respect, our paper is closely related to recent work exploring the effectiveness and consequences of environmental regulations (e.g., Gibson 2019; Choi et al. 2022; De Simone, Naaraayanan and Sachdeva 2024). On one hand, environmental regulation is costly to firms' profit and cash flows (Karpoff, Lott and Wehrly 2005) and detrimental to product variety and business formation (De Simone, Naaraayanan and Sachdeva2024). As such, localized climate policies induce regulatory arbitrage by firms, increasing total firm emissions and undermining the effectiveness of the policy (e.g., Gibson 2019; Bartram, Hou and Kim 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, Martinsson and Thomann 2022; Najjar and Cherniwchan 2021; Chhaochharia, Sen and Xu 2022; Ramadorai and Zeni 2024).

While most prior studies argue for the economic loss resulting from environmental regulations, specifically emissions capping regulation, we highlight the social and economic benefits if regulation and mechanisms at play can incentivize private capital investment into public goods. Our findings imply that environmental regulation is desirable for promoting projects where profit-driven firms may ex ante lack the incentive to engage or invest, particularly those inherently associated with a significant free-rider problem. Instead of focusing on stock market reactions and plant-level pollution and production, we are the first to compile a sample of environmental projects and distinguish between projects with different scopes of externalities. Unlike existing studies that mostly rely on firms' ESG disclosure or ESG ratings, the disclosure of major project investments

by public firms in China is mandatory. This disclosure not only contains granular information that is directly comparable across firms but also applies to all project types – instead of being prepared specifically for ESG reporting – which helps mitigate potential selection bias.[2] Our empirical strategy exploits city-level MCEP assignments as a source of variation in local regulatory stringency to study whether and how regulation alters corporate investments in environmental protection. Our findings suggest that both regulation-based and market-based incentives are at play in motivating corporate environmental investments and that the design of an effective regulatory mechanism can facilitate sustainable climate engagement by profit-maximizing corporations.

Our paper is also related to nascent literature in finance highlighting the importance of regulatory environmental risks. Regulatory climate risks increase tail risks in stock prices (Ilhan, Sautner and Vilkov 2021), price the cross-section of portfolio returns of polluting firms (Hsu, Li and Tsou 2023), and are rated highly by institutional investors for the financial materiality of their portfolio firms (Krueger, Sautner and Starks 2020). Firms located in states with stricter environmental regulations suffer lower credit ratings and higher bond yield spreads for poor environmental performance (Seltzer, Starks and Zhu 2022). We contribute to this strand of literature by centering on a regulatory event that allows for better identification and exploring within-firm reactions through shifts in project investment strategies. We show that environmental investment, especially project investments that generate large externalities to society, can help mitigate the impact of regulatory climate risk on stock returns and boost financing capacity.

[2] While many countries have recently adopted mandatory ESG disclosure, there is a lack of standardization in reporting. ESG disclosures often fall into repetitive boilerplate language, failing to provide the necessary specificity for individual reporting firms. The challenges related to enforcement and assurance further complicate the measurement and comparability of ESG performance (see Christensen, Hail and Leuz 2021 for a review). Additionally, researchers have raised concerns regarding the credibility and transparency of ESG ratings. These concerns stem from significant discrepancies and ongoing data revisions, prompting caution when using ESG ratings as a measure of firms' ESG performance (e.g., Berg, Fabisik and Sautner 2021 and Berg, Kölbel and Rigobon 2022).

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 treatment effect of 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. An illustrative example of the Appendix of On-going Project and 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 severely threatens 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 the government's intermediate- and long-term economic and social goals. They have profoundly influenced China's national economy and social life.

Nevertheless, China failed to reach the environmental protection targets specified in the 9$^{th}$ FYP (1996-2000) and 10$^{th}$ 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 the 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 the 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, Li and Lu 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).[3] Located across 31 provinces and covering 60% of the urban 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 10th 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 11th 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 12th Five-Year Plan for Environmental Protection expanded the list of 113 MCEPs to all 337 prefectures and municipalities in mainland China.

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

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. Appendix C confirms that the selection of MCEPs is not significantly influenced by the city's pre-existing pollutant levels, such as carbon and SO2, or the proportion of heavily polluting firms and how the city's fiscal resource relies on their contribution. More importantly, MCEP designation is not determined by the city's ex-ante corporate environmental investment.

## 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. For each firm in each year, we obtain its annual report from which we manually extract the Appendix of On-going Projects. The Appendix reports new projects in which the firm has initiated during the fiscal year, as well as incremental investments made in existing unfinished projects. In general, it includes the name and the nature of the projects, the amount invested, and potentially other relevant information such as expected completion dates or milestones.[4] As an illustrative example, we provide a snapshot of Konka Group's Appendix of On-going Projects, extracted from its annual report, in the Internet Appendix IA.1.

[4] As part of the annual report for a listed company, the Appendix of On-going Projects adheres to the same mandated disclosure standards and audit requirements. Nevertheless, the level of detail in project descriptions varies.

Our project sample includes 196,700 projects during the sample period. We then remove 804 firm-year observations that are financial firms and 2,178 firm-year observations with missing information on the variables used in our empirical analyses that cannot be supplemented with other data sources. The final sample consists of 2,547 firms (21,872 firm-year observations) that invested 144,042 projects.

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, Martineau and Sheng 2022; Sheng, Xu, and Zheng 20232023). In this paper, the dictionary-based method is proper because our focus is environment-related keywords.

In general, extracting environment-related information from text sources can be challenging. As highlighted in Sautner et al. (2023), 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.[5]

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

[5] Alternative textual analysis approaches such as machine learning models often require extensive training on large, well-labeled datasets that are similar in nature to the content being analyzed. Without such training, these models can struggle to correctly interpret the context and subtleties of specialized texts. As a result, researchers have cautioned the sole dependence on machine learning in situations involving highly specialized or nuanced content, such as legal documents, medical records, or complex literary works. See Riley (2019) for related discussions.

consisting of 467 unique environment-related words and phrases. Internet Appendix IA.2 tabulates the list of these words and phrases.

Next, we build an initial sample of environmental projects out of the 144,042 projects, classifying a project as environmental 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 judgment biases.[6] Any classification noise, as long as it is not systematic, will work against finding the results.

To address these challenges, we randomize by deploying two new teams of RAs. The first team of 5 RAs audits the projects already included in the above initial sample. The goal is to reduce Type I errors 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.

The second team of 26 RAs audits the remaining projects from the 144,042 sample that are excluded from the above initial sample. The goal is to reduce Type II errors 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.

Finally, we employ the third team of 5 RAs to audit again the sample of 144,042 projects to cross-verify project classifications by the above two teams. This team also collects data on the location and duration of each project. While we can estimate the duration for most projects, we are

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

only able to identify locations for 17.82% of sample projects. For the remaining 82.18% of projects, we assign their locations to the headquarters locations of the investing firms.[7]

The final sample consists of 17,255 environmental projects from 1,461 firms. This accounts for 11.98% of total projects invested during the sample period. Other data sources are described as we introduce them in the analysis.

### *3.2 The Extent of Externalities in Environmental Projects*

A significant distinction between environmental projects and traditional corporate investments is that the former creates externalities that can have a direct impact on society. To reflect the "public goods" aspect of environmental investment, we assess the degree of externalities produced by a project. For instance, a firm may undertake environmental projects that mostly benefit its shareholders, without delivering substantial and direct economic and social values to the larger community. Examples would include the installation of a new water-saving system or solar panel roofing in production plants, the investment in energy-saving thermal insulation bricks for the exterior walls of factories, the launch of an energy-saving fluorescent lamp production line, or the installation of high-efficiency boilers and furnaces. These projects add value to the firm's shareholders by cutting costs or generating sales, but the broader society has limited direct access to the environmental benefits they yield. We label those that are primarily oriented towards shareholders and have a relatively narrow range of societal externalities as *firm-specific* environmental projects.

An environmental project may also be a "beneficent" one, bringing in a prominent spillover to stakeholders or local communities. Examples include investments in sewage treatment stations,

[7] It is very common that the same firm in the same year may have projects that are easy to identify their locations and those without location information. In a robustness check, we repeat our baseline test using the subsample of firms with which we can secure the locations of their projects. Our findings are robust.

anti-corrosion water and floor works, and exhaust gas treatment systems, which produce direct environmental benefits for the local communities. We label those with relatively large societal externalities as *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 larger *direct* societal consequences.

To classify whether an environmental project is beneficent, we employ another team of 14 RAs. For each of the 17,255 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 costs or expanding sales) or also spills over to the society at large. 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.

Among the 17,255 environmental projects, 10,143 are beneficent projects funded by 1,147 firms, 7,112 are shareholder-oriented projects initiated by 1,018 firms, and 704 firms have invested in both types of environmental projects.

Appendix D presents the industry distributions of firm-specific and non-firm-specific environmental projects as well as the number of sample 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. Although environmental projects

are distributed across a variety of industries, manufacturing, energy, and materials sectors attract disproportionally more environmental investments in terms of both non-firm-specific and firm-specific projects.

### *3.3 Variable Definitions*

We measure each sample firm's environmental investments as follows. First, we define *EI*(*Total*) as the total corporate investment in environmental protection projects, normalized by sales and then multiplied by 100. In a nutshell, we aim to capture the extent to which a firm is willing to allocate its revenue towards environmental investments.[8] 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 29.627 million RMB on environmental projects per year, accounting for 1.028% of its revenue. This is equivalent to 7.619% of its capital expenditure (Capex) and 17.028% of its on-going project investments (untabulated). An average sample firm spends 14.871 million RMB – or 0.542% of its revenue – on beneficent projects, accounting for 4.201% of its Capex and 7.876% of its on-

[8] In subsection 4.2.2, we show our baseline findings are robust when we normalize a firm's environmental investment by its capital expenditure, total assets, or cash flows from operations.

going project investments. It spends 9.73 million RMB – or 0.347% of its revenue – on projects that directly boost values for its shareholders, accounting for 3.053% of its Capex and 5.795% of its on-going project investments.[9]

An average sample firm has 6.238 billion RMB assets, and a leverage ratio of 46.9%. Institutional investors hold 49.6% of firm shares. These are similar to those documented in the prior literature on Chinese listed companies (e.g., Giannetti, Liao and Yu 2015).

Panel B of Table 1 outlines the key features of the environmental projects. On average, an environmental project has a size of 80.11 million RMB, necessitates an investment of 52.4 million RMB per year, and lasts for 1.66 years. Not surprisingly, non-firm-specific projects tend to be bigger (82.17 million) compared to firm-specific ones (76.02 million), and they also incur higher annual expenditures. While non-firm-specific projects, on average, take longer to complete than firm-specific ones, the difference is not economically significant.

In Panel C of Table 1, we compare corporate environmental investments before and after the establishment of MCEPs. On average, a sample firm spends 19.08 million RMB on environmental projects before the MCEP designation. Post MCEP, an average firm spends 37.317 million RMB. Among these that have made environmental investments at least once during the sample period, an average firm spends 58.561million RMB on environmental projects prior to MCEP, but 123.761 million RMB post MCEP.

## 4. MCEP Assignment and Corporate Environmental Investment

### *4.1 Corporate Reactions to Intensified Environmental Regulations*

[9] Among those firms that have made environmental investments at least once during our sample period (untabulated), environmental spending accounts for 3.297% of their revenue, 23.866% of their Capex, and 48.691% of their on-going projects per year. Beneficent environmental projects account for 1.739% of their revenue, 13.159% of their Capex, and 22.522% of their on-going projects per year. Firm-specific ones, on the other hand, account for 1.114% of their revenue, 9.563% of Capex, and 16.571% of on-going projects per year.

To explore the treatment effect on corporate environmental investment, we perform our empirical analysis in a difference-in-differences setting, estimating the following regression model:

$$y_{i,c,t} = \beta_0 + \beta_1 Post_{i,c,t} + \boldsymbol{\gamma X_{i,c,t}} + \alpha_i + \tau_t + \theta_{b,t} + \delta_{p,t} + \epsilon_{i,t},$$

where $y_{i,c,t}$ is a measure of environmental project investment by firm $i$ based in city $c$ during year $t$. Specifically, the dependent variables are *EI*(*Total*), *EI*(*Non-Firm-Specific*), and *EI*(*Firm-Specific*), respectively. $Post_{i,c,t}$ is a dummy variable set to one if firm $i$ is headquartered in city $c$ in the years after the city attains its MCEP status, and zero otherwise. Vector $\boldsymbol{X_{i,c,t}}$ includes controls for time-varying firm characteristics, such as firm size (*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 (*Cash*), defined as cash and cash equivalent scaled by total assets; growth opportunities as captured by market to book value of assets (*Market to Book*); firm age (*Age*); and a dummy for state ownership (*State*). We consider the firm's governance characteristics, such as the fraction of board members being independent directors (*Board Independence*) and institutional ownership (*Institutional Holdings*), which are known to drive firm environmental engagement (Krueger, Sautner and Starks, 2020). $\boldsymbol{X_{i,c,t}}$ also includes a control for local economic development, captured by the city's yearly GDP growth (*GDP Growth*).

Lastly, we control for a host of fixed effects, including firm fixed effects ($\alpha_i$), year fixed effects ($\tau_t$), and in some specifications, industry × year fixed effects ($\theta_{b,t}$) and 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.

*4.1.1 Which Types of Projects Attract Corporate Investment?*

In Panel A of Table 2, we examine how sample firms alter their environmental investment policies when facing intensified local environmental regulations. Following the MCEP assignment, firms in a treated city allocate more capital to environmental projects (columns 1-4). The coefficient estimates in column 4 suggest that post MCEP, local firms, on average, increase their investment in environmental projects by 13.061 million RMB.

There is a heterogeneity in their selection of environmental projects: Firms react to heightened environmental regulations by ramping up investment in "beneficent" projects that benefit society to a larger extent (columns 5-9). The economic magnitude is also sizable. Column 8 implies that post MCEP, a local firm spends 7.299 million RMB more for these beneficent ones. On the other hand, heightened environmental regulation does not significantly change the firm's investments in firm-specific projects (columns 9-12). This is not surprising, as profit-maximizing firms might not require regulations as a catalyst for investing in projects that ultimately yield benefits for their shareholders.

We obtain these estimates with controls for firm and year fixed effects (columns 1, 5, and 9) as well as interactions of industry and year fixed effects and province and year fixed effects (the rest of columns). 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 Panel A provides evidence that local firms react to a rising intensity of environmental regulations by increasing their investments in environmental projects. The effect is driven mainly by their investment in projects with greater societal impacts. These findings imply that environmental regulation is desirable for promoting projects where profit-driven firms may

ex ante lack the incentive to engage or invest, particularly those inherently associated with a significant free-rider problem. Such policies may not be necessary for projects in which firms are already effective and motivated to invest.

Due to their beneficial nature, non-firm-specific projects typically necessitate greater capital outlays and have extended completion timeframes. Corroborating with the above evidence, we expect that firms adjust their investment strategies by directing resources to long-term projects. We classify a project as long-term if its duration equals or exceeds three years. Conversely, a project is deemed short-term if it lasts less than three years.

In Panel B of Table 2, we observe that local firms allocate more funds to long-term environmental projects after their city's MCEP assignment, particularly those with larger beneficial impacts on society. In contrast, there is no significant change in how firms allocate resources to short-term environmental projects, nor projects that mostly directly benefit the firms themselves. These findings offer preliminary evidence that environmental regulations can facilitate substantial investments without promoting temporary or window-dressing behaviors.

*4.1.2 Who Responds More to Heightened Environmental Regulations?*

The observed increase in environmental project investment – especially in beneficent ones – may come from local firms already operating in green sectors, who stand to directly benefit from resources titled from heightened environmental regulations and competitive edges gained over their counterparts in conventional, non-green sectors. Alternatively, it is possible that resources deployed and policies carried out by these regulations make environmental investments potentially more profitable, thereby crowding in local firms in conventional, non-green sectors and incentivizing them to engage in such investments.

To compare the reactions to the environmental regulation between firms operating in green sectors and non-green sectors, we augment the regression in Panel A of Table 2 by including an interaction term between the post-MCEP dummy and an indicator variable for firms in non-green sectors. Green sectors are defined based on the China Securities Regulatory Commission (CSRC) 2012 industry classification code "N" (water conservancy, environment, and public facilities management). Given the limited number of firms in the green sectors during our sample period, we conduct this set of tests using a matched sample to ensure that our findings are not influenced by differences in sample sizes. Specifically, we apply a propensity score matching (PSM) approach to match firms in the green sectors with those in conventional, non-green sectors. Results are similar if we estimate these tests using the full sample.

Table 3 shows that following heightened environmental regulation, firms in non-green sectors increase their environmental investments to a greater extent compared to matched firms in green sectors (column 1), and they invest significantly more in non-firm-specific projects (column 2). By contrast, both sectors experience a similar boost in firm-specific environmental project investment (column 3). The findings suggest that the regulatory effect likely arises from crowding in firms in the non-green sectors, motivating them to increase investments in environmental projects and expand into the green sectors.

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 in many other developed and developing economies, SOEs may help emerging markets deal with market failures and externalities. Accordingly, Hsu, Liang, and Matos (2023) find that state-owned enterprises are more responsive to environmental issues.

For this reason, we directly control state ownership in all regressions. Panel A of Table 2 reveals that 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 of the average effect. We now explicitly compare the investment dynamics between the SOE and non-SOE sectors, augmenting the baseline regression in Table 2 Panel A by interacting the post-MCEP dummy with a dummy variable set to one if a firm is a non-SOE.

Columns 4-6 of Table 3 reveal that while local firms in treated cities increase environmental spending after MCEP, non-SOE firms ramp up environmental investment to a larger extent (column 4). Column 5 suggest that post MCEP, both SOE and non-SOE sectors boost their investments in non-firm-specific projects.[10] In terms of firm-specific environmental projects, non-SOE firms increase their investment to a larger extent than SOE firms (column 6).

### *4.2 Robustness*

#### *4.2.1 Matched Samples*

The results so far indicate that firms in treated cities increase their spending on environmental projects in response to a staggered change in the intensity of environmental regulations. To mitigate the potential confounding effects driven by unobserved firm-specific, industry-specific, and region-specific dynamics, 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 baseline results in Panel A of Table 2.

[10] The *F*-statistics testing the sum of the coefficient estimates of *Post* × *Non-State* and *Post* are 6.73 (in column 5), significant at the 1% level.

In columns 1-3 of Table 4 Panel A, we apply the propensity score matching (PSM) method to form a matched control group. Specifically, using the same set of control variables in Table 2 Panel A, 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 the 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 the 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 4 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 Alternative Scalars*

Our main outcome variable is firm-year-level project investment, which we normalize by revenue. This approach allows us to gauge the extent to which a firm allocates resources to projects with environmental externalities relative to its overall income.

In Panel B of Table 4, we divide a firm's environmental investment by capital expenditure to gauge the fraction of its capital investment allocated to environmental protection projects (columns 1-3). Since project investments eventually materialize into a firm's assets, we also consider normalizing its environmental investment by total assets (columns 4-6). Lastly, we consider the fraction of operating cash flows directed to environmental project investments

(columns 7-9). The results in Panel B of Table 4 reveal that our findings do not depend on how we scale each firm-year's project investments.

*4.2.3 The Propensity of Engaging in 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 without environmental project investment throughout the sample period. In these tests, the control sample consists of firms that have spent or may spend 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 those that are affected by the MCEP designations.

For this set of analyses, we consider indicator variables 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 once a firm begins investing in any environmental project, in any environmental project that generates relatively larger direct externalities to society, and in any project that mostly benefits the firm's shareholders.

Panel C of Table 4 explores the likelihood of sample firms engaging in environmental investments after the establishment of MCEP. We observe that firms in an MCEP city are more likely to begin investments in environmental projects (columns 1-3). They are more likely to select projects that also yield societal benefits to a larger extent (columns 4-6), whereas they do not change their investment policies in environmental projects that directly benefit their shareholders (columns 7-9). Overall, the results are consistent with the baseline findings in Table 2 Panel A.

*4.2.4 Project Locations and the Timing of MCEP Assignment*

Our empirical strategy employs the staggered changes in local environmental regulation stringency at different times, and we identify the timing of a firm's exposure to such a change in local regulation based on its headquarters' location. 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 treatment group at the time when the city where it has registered becomes an MCEP, whereas the city where it conducts most of its business does not face intensified environmental regulations. To check the robustness of our results, in columns 1-3 of Table 4 Panel D, 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).

It is also possible that a firm operates in multiple cities across China. A project investment may be misclassified into the treatment group if the city where the project occurs differs in the timing of MCEP assignment from that of the headquarters city. As described earlier, many firms do not always disclose location information of all their projects, even if these investments occur in the same year. To mitigate the impact of potential misclassifications at the project level, we aggregate environmental project investments to the firm-year level when conducting the baseline analysis.

In this subsection, we further address this concern with two additional tests. First, we repeat our analysis on a subsample of focused firms – i.e., firms that operate only within one city – so as to minimize the likelihood of mis-specified timing of the MCEP exposure. Columns 1-3 of Table 4 Panel E report the regression estimates for the focused-firm-only sample. Even with a significantly reduced sample size, the results are statistically and economically comparable to those in Table 2 Panel A.

Second, since we are able to identify locations for 17.82% of the sample projects, we re-estimate our baseline regressions using the sample of projects where we can obtain information on their locations. For this set of tests, the unit of analysis is at the project-city-year level. The evidence from columns 4-6 of Table 4 Panel E suggests that the regulation-induced environmental investment we document in Table 2 Panel A prevails in the project-level setting.

Overall, the results in Panels A, D, and E of Table 4 indicate that our findings are not sensitive to the sample restrictions nor to whether we assign all projects to a firm's headquarters city. While each of the approaches we employ is imperfect, the consistent inferences across multiple approaches lend confidence to our baseline finding. Collectively, we continue to observe that firms boost their environmental investments, especially the beneficent ones that benefit society to a larger extent, following the establishment of the MCEP.

*4.2.5 Falsification Tests*

Our empirical design explores the staggered designations of MCEP, which affect differently firms located in treatment cities and those that are not. In this subsection, we perform placebo tests to further tighten our identification.

It is possible that firms alter their environmental strategies over time. For instance, the 2009 Copenhagen Accord – which took place before the MCEP designations – would have sparked widespread public consciousness and prompted global governmental actions to combat climate challenges. As such, the findings that we document may capture firms' direct reactions to the 2009 Copenhagen Accord instead of the regulatory event establishing the MCEPs.

To evaluate this possibility, we redefine our post dummy as a dummy variable set to one if environmental project investments occurred in 2009 or after, and zero otherwise. For this set of tests, we cannot include year fixed effect. From columns 1-3 of Panel F, we observe no significant

loading for the post-Copenhagen Accord dummy, indicating that the change in corporate investments in environmental projects that we document is unlikely driven directly by the 2009 Copenhagen Accord.

It is also possible that macro-factors other than the 2009 Copenhagen Accord or confounding regulatory events – instead of MCEP designations – drive an overall change in firm investment strategies during the sample period, regardless of whether or not the projects are related to environmental protection. To rule out this possibility, we regress the post-MCEP dummy on the firm's non-environmental project investments. Since the designation of MCEP leads to the change in stringency of local environmental regulation, we should expect that firms respond by adjusting their environmental investment instead of traditional types of investment. The results from column 4 of Table 4 Panel F confirm this intuition: we do not observe a significant and direct response by local firms' non-environmental investment to the increased environmental regulation.[11]

To further mitigate the concern that omitted variables, rather than the MCEP regulatory event itself, drive differential investment in environmental projects, we follow Leary and Roberts (2014) and conduct a placebo test. We randomly select 100 dates within the sample period and assign them as pseudo dates for the MCEP assignment. We then re-estimate the regressions in columns 1, 5, and 9 of Table 2 Panel A by replacing the date of actual assignment with these placebo-assignment dates.[12]

Table 4 Panel G presents the distribution of the coefficient estimate for the post-MCEP dummy for *EI*(*Total*), *EI*(*Non-Firm-Specific*), and *EI*(*Firm-Specific*), respectively, from the tests

[11] The findings that local firms' environmental investment does – whereas non-environmental investment does not – respond to the increased environmental regulation also help rule out the indirect effects of environmental investments. For instance, subsidies or loans deployed to incentivize local firms' environmental investment may allow them to shift internal resources to pursue more profitable non-environmental projects. Our results do not support that the use of subsidies and financing facilitates investments in projects that are unrelated to environmental protection, which otherwise lead to distorted investment incentives.

[12] Using alternative numbers (up to 1,000) of pseudo dates does not alter our findings.

based on the 100 simulated pseudo-assignment dates (columns 2 through 7) and the corresponding *T*-statistics (in the parenthesis) in comparison with the coefficient for the post-MCEP dummy based on the actual assignment date (column 1). Both the mean and median of the coefficient estimates for the post dummy from the simulated pseudo-assignment dates are significantly smaller in magnitude than those estimated using the actual assignment date (column 1). In terms of *EI*(*Total*), the mean and median of placebo estimates for the placebo estimates are -0.003 and 0.001, compared with the actual coefficient, 0.331. In terms of *EI*(*Non-Firm-Specific*), the mean and median of the placebo estimates are -0.000 and -0.003, respectively, compared with the actual coefficient (0.196). Moreover, the table shows that most of the placebo estimates are statistically insignificant, indicating that the timing of MCEP assignment fully supports the causal interpretation of the empirical evidence.

*4.2.6 TWFE and Stacked 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 effects of policies. 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, Larcker and Wang 2022; de Cahisemartin and D'Haultfoeuille 2022).[13]

[13] 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 (2023).

To mitigate the concern for biases in the estimators from TWFE staggered DiD regressions, we follow Baker, Larcker and Wang (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."[14]

We first replicate the TWFE estimates of the effects of MCEP establishments on local firms' environmental spending. Columns 1-3 of Panel H 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 H, we continue to observe a significant increase in local firms' investment in environmental projects, particularly the beneficent ones, following the MCEP establishment.

Baker, Larcker and Wang(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 (2023) further highlight that the estimators proposed by Borusyak, Jaravel and Spiess (2024) 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, Jaravel and Spiess' (2024) estimators and perform a dynamic analysis to examine whether firms already behave differently in their environmental spending prior to the MCEP assignments. Specifically,

[14] SeeBaker, Larcker and Wang (2022) , page 394 and footnote 3.

we include in the estimation, respectively, the indicator variables for years $t-7$, $t-6$, …, $t$, $t+1$, …, and $t+3$, where $t$ is the year when the firm's headquarter city becomes an MCEP.

Panel I of Table 4 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 environmental investments, especially the beneficent projects, in this section, we explore several potential mechanisms.

### *5.1 Media Attention*

Existing literature documents the real effect of media attention and public concerns on environmental issues (Ardia et al. 2023; Engle et al. 2020). 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.3 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.2) 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. We then construct the variable to measure media coverage intensity by taking the natural logarithm of one plus the number of environment-related news articles. Since biases in news coverage can arise from media types (You, Zhang and Zhang2018), 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 (*Population*), the number of colleges (*Colleges*), and local economic conditions such as its GDP growth, fixed asset investment scale (*Fixed Asset Investment*), service sector output (*Service Sector*), and the number of large industrial firms (*# of Large Industrial Firms*).

Local firms may leverage their political connections and the extent to which they can corrupt bureaucrats to influence media coverage of their city's environmental issues. We thus control for local firms' political connections (*Political Connection*) as well as their entertainment and travel expenses (*ETC*), the latter of which is highly correlated with the grease money firms spend to secure political favors and thus captures firms' corruption effort (Giannetti et al. 2021). Local firms may alter their advertisement spending to affect media coverage, as extensive media coverage leads to increased publicity. For this reason, we control local firms' advertisement expenditures (*Advertising Expenses*). Lastly, we include city and year fixed effects.

The estimates in Table 5 show that the intensity of media coverage for a city's environmental issues increases after it becomes an MCEP, 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, national newspapers (column 4), and local newspapers (column 5). This suggests that both market-based and non-market-based mechanisms are at play. Arguably, the rising media coverage intensity generates greater public scrutiny and applies elevated pressure on local politicians and firms.[15]

There is a heterogeneity in the economic magnitude of coverage intensity. The $\chi^2$ statistic testing the difference in coefficients for *Post* between columns 2 and 3 is 19.05 ($p$ = 0.000). After the MCEP establishment, the increased intensity of state-affiliated media coverage on a city's environmental issues is significantly larger than that for market-based media. This suggests that the regulatory event mobilized the scrutiny intensity by state-owned media to a greater extent than the market-based media outlets.

The $\chi^2$ statistic testing the difference in coefficients for *Post* between columns 4 and 5 is 40.26 ($p$ = 0.000). This suggests that the increase in coverage intensity by local news media is significantly larger than that by national media. This lends further support to the treatment event occurring at the city level.

### *5.2 Politician's Career*

[15] Rather than that a rise in media and public scrutiny may lead 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 corporate environmental spending in a treated city. 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.

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 described previously, politicians of MCEPs face elevated political pressure and incentives to achieve environmental protection goals. Their environmental performance is also closely watched and evaluated by the central government. We thus postulate that politicians in treated cities are better incentivized to improve the local environment.

To assess whether the designation of MCEPs leads to a changing incentive for local politicians, we manually collect biographies of city party chiefs from Local Official Directories.[16] In cases where the official bios of local politicians are vague about the detailed career path, we perform extensive internet searches to track their career movement.

Table 6 investigates the effect of MCEP on the likelihood of future promotion. We start by interacting the post MCEP dummy with indicator variables for high local environmental pollution: carbon and industrial sulfur dioxide emissions. *High Carbon* (*High SO*2) is a dummy variable set to one if a city-year's carbon (sulfur dioxide) emission level falls above sample tercile and zero otherwise. In selecting the indicators for environmental quality, we focus on those that either are less likely influenced by the specific locations of the cities so as to be meaningfully comparable across geographic regions and over time or are more relevant to industrial firms.[17]

The coefficient estimates in columns 1-3 of Table 6 suggest that after the MCEP assignment, city officials 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

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

[17] 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.

assignment, politicians whose city has achieved a lower level of SO2 emissions has a 51.99% (= -0.170/0.327) higher propensity of being promoted in the following three years.[18]

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 achieved by the government. 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 2,902 reports on the work of the government issued by 290 cities during the sample period.

We extract and count the types of environment-related indicators mentioned in each 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 whether a pre-set environmental target has subsequently been accomplished.[19] For each city and year, we calculate the fraction of pre-set targets attained. *High % of Environmental Targets Achieved* is a dummy variable set to one if the fraction of targets achieved falls above the top sample tercile.

Column 3 of Table 6 shows a positive coefficient associated with the interaction between the post MCEP dummy and *High % of Environmental Targets Achieved*. This suggests that after the MCEP assignment, local politicians are more likely to be promoted in the next three years if

[18] 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 into different posts even in the early period of their first term.

[19] 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%.

they have fulfilled a larger percentage of pre-set environmental targets. Specifically, officials in a treated city with a higher percentage of environmental targets accomplished have a 21.69% (= 0.077/0.355) higher probability of being promoted in the next three years.

Taken together, the results from Tables 5 and 6 suggest that local politicians face increased public scrutiny and intensified political pressure. Both the media coverage and career incentives appear to help boost their effort to improve the local environment.

### *5.3 Firm-Level Incentives*

When officials are better motivated to improve their cities' environment, they are likely to deploy incentives to directly spur environmental investments, such as providing subsidies, tax credits, and bank loans. We first validate that establishing MCEP leads to a change in city policy. Table 7 Panel A shows that after becoming an MCEP, a city gives out more environmental subsidies to local firms, reduces corporate taxes, and increases bank loans.

Next, we consider whether these incentives materialize for firms engaging in environmental investments. We begin by exploring the effect of environmental investments on firms' tax obligations, calculated as the amount of taxes paid scaled by the firm's revenue. We then interact the post-MCEP dummy with a dummy capturing the extent of the firm's environmental investment. *High EI*(*Total*), *High EI*(*Non-Firm-Specific*), and *High EI*(*Firm-Specific*) are dummy variables set to one if a firm's total, non-firm-specific, and firm-specific environmental investments, respectively, fall above the top sample tercile, and zero otherwise.

Columns 1-3 of Table 7 Panel B show that post MCEP, taxes decrease for these firms that allocate greater resources to environmental projects. For instance, a firm in a treated city pays 14.29% (= -0.011/0.077) less in taxes when spending more on environmental projects compared to a similar firm that invests less in environmental projects (column 1).

Columns 4-6 investigate the effect of environmental investments on attaining government subsidies. From the CSMAR database, we obtain information on the total amount of environmental subsidies a firm receives from the government each year and scale it by the firm's revenue. Since CSMAR's coverage of subsidies begins in 2003, for this set of analyses, the sample period is 2003-2014.

Similarly, we observe that environmental subsidies increase for firms with larger investments in environmental projects after their city is designated as an MCEP. Column 4 suggests that the environmental subsidies deployed to a sample firm in the treated city and with higher environmental investments increase by 116.67% (= 0.049/0.042), which translates into an increase of 2.18 million RMB.

Another common practice for the government to support local businesses is to provide them with easy access to external finance, often by funneling cheap credit through the banking system. Columns 7-9 of Table 7 Panel B examine whether boosting investments in environmental projects results in more bank credits, calculated as the natural logarithm of one plus the total amount of bank loans. We observe that firms in treated cities obtain more bank loans if they engage in larger 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, Table 7 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 mostly benefit shareholders or also directly generate larger externalities. Given that the MCEP establishment alters a firm's investments into non-firm-specific projects that yield larger societal benefits but not firm-specific

ones (Table 2 Panel A), there is suggestive evidence that these financial incentives relax firms' financial constraints, allowing them to shift their investment focus to those that generate more positive externalities.

## 6. Real Consequences

So far, we have provided 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 investments into beneficent 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 highlights 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 subsection, we assess whether the treated cities have indeed benefited from local firms' environmental investments. We estimate the following regression model at the city-year level:

$$y_{c,t} = \beta_0 + \beta_1 Post_{c,t} \times High\ EI_{c,t} + \beta_2 Post_{c,t} + \beta_3 High\ EI_{c,t} + \boldsymbol{\gamma X_{c,t}} + \alpha_c + \delta_t + \epsilon_{c,t},$$

where $y_{c,t}$ captures city $c$'s environmental and economic performance in year $t$ as described below. $High\ EI_{c,t}$ are, respectively, *High EI*(*Total*), *High EI*(*Non-Firm-Specific*), and *High EI*(*Firm-Specific*), calculated as indicator variables set to one if 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, falls above the top sample tercile, and zero otherwise. Vector $\boldsymbol{X_{c,t}}$

includes controls for time-varying city characteristics, such as its GDP growth, fixed assets investment, the size of the service sector, population, the number of colleges, and the number of large industrial firms. Lastly, we control for city fixed effects ($\alpha_c$) and year fixed effects ($\delta_t$). Standard errors are clustered by city.

*6.1.1 Environmental Consequences*

We start by exploring whether a treated city's environment improves once local firms increase their environmental investment. Columns 1-6 of Table 8 Panel A investigate the effect of corporate environmental spending on the pollution level. The dependent variable is the city-year level carbon emission in columns 1-3 and SO2 emission in columns 4-6. The positive and significant coefficient associated with the interaction term in column 2 suggests that post MCEP, a city experiences reduced carbon emission when local firms contribute to larger investments that generate substantial positive environmental externalities. Columns 4-6 show that larger corporate environmental investments, regardless of project types, contribute to reduced industrial toxic emissions following the increased regulatory demand to meet higher environmental targets.

In columns 7-9 of Table 8 Panel A, we consider a direct social consequence of reduced pollution. We calculate *Excess Hospital Need*, which is the number of hospitals in a city minus the average number of hospitals in the previous three years. We find that post MCEP, treated cities with high corporate investments in non-firm-specific and firm-specific projects experience a decline in the excess need for local hospitals. This finding corroborates the evidence of an improved local environment.

Overall, the results suggest that firms' environmental investments, brought about by a more demanding environmental regulation, contribute to the improvement of the local environment and to the reduction of the local healthcare burden.

*6.1.2 Economic Impact*

Improved local environmental quality may make the city more appealing to entrepreneurs. Environmental regulations may make certain industries more profitable, attracting high-quality firms. 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 by 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. Since the systematic coverage of the ATS database begins in 2004, for tests involving this database, the sample period is restricted to 2004-2014.

Similarly to Giannetti et al. (2021), we define the entry of high-quality firms as the percentage change in the proportion of newly registered, high-quality firms among all firms in a city from year $t-1$ to year $t$. 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 8 Panel B reveals that the proportion of high-quality new firms increases only when local firms in the treated city invest more in environmental projects for which the benefits spill directly over to society at large (column 2). Specifically, a treated city with larger non-firm-specific environmental project investments experiences a 181 (= 0.181/0.1) percentage points increase in the growth rate of new high-quality firms.

A direct outcome of attracting more entries of high-quality new firms is the improvement in the local labor market, as highly productive young firms disproportionately create new jobs (Haltiwanger et al. 2017). Columns 4-6 of Table 8 Panel B suggest that post MCEP, a treated city's unemployment declines when local firms invest more in beneficent environmental projects.

Overall, the results in Panels A and B of Table 8 shed light on the social and economic benefits brought about by local firms' engagement in beneficent environmental projects. Not only does the city enjoy reductions in hazardous emissions and healthcare burdens, but also arguably due to the improved environment, it can attract more high-quality new firms and reduce local unemployment.

*6.1.3 Local Firm Composition*

By spurring corporate environmental investment, environmental regulation not only allow a city to attracts high-quality new firms, but also may facilitate green transitions of its existing firms, reshaping local firm composition across different industry sectors.

We first consider to what extent a city relies on heavily polluting firms as its fiscal revenue source once it faces intensified environmental regulations and when its local firms begin to increase their 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.[20] For each city-year, we calculate the fraction of sales of heavily polluting firms relative to all firms in the same city and the fraction of taxes paid by heavily polluting firms relative to all firms in the same city. We extract information and distribution of firms from the ATS database. For this set of analysis, our sample period is from 2004 to 2014.

Columns 1-6 of Table 8 Panel C provide evidence consistent with heavily polluting firms occupying a lower proportion of sales (column 2) and contributing less to tax revenue (columns 4-6) of a treated city when local firms spend more on environmental projects. The negative

[20] 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.

coefficient estimates for the interaction term *Post* × *High EI*(*Non-Firm-Specific*) in column 2 indicates that post MCEP, the proportion of sales coming from heavily polluting firms in cities with larger non-firm-specific environmental investments decreases by 5.29 (= -0.022/0.416) percentage points. Column 5 suggests that the fraction of taxes contributed by heavily polluting firms declines by 12.90 (= -0.024/0.186) percentage points.

Lastly, we consider how heavily polluting firms reduce their exposure in polluting sectors amid more stringent environmental regulations and larger environmental investments by their regional peers. Bisceglia, Piccolo, and Schneemeier (2023) theorize that firms' green investments can crowd in those of peer firms if there is strategic complementarity in their green investments. We postulate that heavily polluting firms, most of which operate in traditional industries, begin to expand into non-polluting industries after their cities strengthen the effort to improve the local environment and local peers contribute more resources for responsible investments. From the Chinese Research Data Service Platform database (also known as the CNRDS database), 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 calculate the number of M&A targets in non-polluting industries by polluting firms in a city and a year.

Columns 7-9 of Table 8 Panel C show that post MCEP, heavily polluting firms in a treated city acquire more non-polluting targets when local firms spend more on environmental projects. This suggests that heavily polluting firms expand into non-polluting sectors rather than stay within polluting industries. Arguably, such a transition adds to the overall improvement of their city's environment.

The entry of high-quality new firms and the green transitions of existing firms, prompted by environmental regulations, may reshape the distribution of firms across green and non-green industries. Leveraging the ATS database, we also explore the local industry dynamics following the designation of the MCEP. We consider the number of firms in the green and non-green sectors, calculated as the natural logarithm of one plus the number of firms operating in green and non-green industries in a city in a year, respectively. Additionally, we calculate the growth rates of firms in both sectors.

Panel D of Table 8 reveals that, following the MCEP, targeted cities experience a significant increase in both the number of firms in green sectors (column 1) and the proportion of green firms (column 2). By contrast, there is evidence of local firms departing from non-green sectors, as both the number of firms in non-green sectors (column 3) and the proportion of such firms decline (column 4) in these cities post-MCEP. Taken together, environmental regulation may lead to a change in the profitability of environmental-related project investments, attracting new entrants and facilitating the migration of non-green firms into green sectors.

***6.2 Does the Firm Benefit?***

The results in Table 7 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 if such regulatory incentives are short-lived, and thus the effect becomes transitory. While the results that longer-term projects are invested (Table 2 Panel B) and local industry dynamics (Panels B-D of Table 8) help dispel this concern, in this subsection, we evaluate potential channels to infer whether engaging in environmental investments yields long-term benefits. For this set of analyses, the sample is at the firm-year level.

We estimate the following regression model:

$$y_{i,c,t} = \beta_0 + \beta_1 Post_{i,c,t} \times High\ EI_{i,c,t} + \beta_2 Post_{i,c,t} + \beta_3 High\ EI_{i,c,t} + \boldsymbol{\gamma X_{i,c,t}} + \alpha_i + \tau_t + \epsilon_{i,t},$$

where $y_{i,c,t}$ captures the performance of firm $i$ located in city $c$ in year $t$ as described below. $High\ EI_{i,c,t}$ are dummy variables set to one, respectively, if a firm's *EI*(*Total*), *EI*(*Non-Firm-Specific*), and *EI*(*Firm-Specific*) fall above the top sample terciles. Vector $\boldsymbol{X_{i,c,t}}$ 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 ($\alpha_i$) and year fixed effects ($\tau_t$). Standard errors are clustered by firm.

*6.2.1 Revenue Sources of Environmental Investments*

Table 9 Panel A investigates the impact of corporate environmental investments on a firm's revenue sources. In columns 1-3, we examine whether investments in environmental projects enable firms in conventional, non-green sectors to generate increased green revenue, thereby potentially aligning environmental benefits with private economic incentives.

We define a firm's green revenue as the aggregated reported revenue derived from its environmentally sustainable operations and initiatives. This revenue is then scaled by the firm's total operating revenue. The green revenue data is extracted from detailed breakdowns of the revenue sources of publicly listed companies in the WIND database, identified by searching for environment-related keywords. Since targeted cities deploy incentives, as shown in Table 7, which may directly boost a firm's green revenue, for this set of analysis, we control, additionally, environmental subsidies, taxes, and access to bank loans.

The estimates in columns 1-2 suggest that after a city is subjected to heightened environmental regulations, green revenue constitutes a larger proportion of revenue sources for

firms in non-green sectors who allocate more resources to environmental projects. Specifically, column 2 indicates that following the establishment of MCEP, firms with substantial non-firm-specific environmental investments experience a 42.86 (= 0.003/0.007) percentage point increase in green revenue. By contrast, column 3 suggests that while local non-green firms generally experience an increase in their green revenue share post-MCEP, additional spending on firm-specific environmental projects does not significantly contribute to expanding their green revenue. This result is not entirely surprising, as such investments are likely intended to reduce costs rather than enhance revenue. This corroborates our baseline results in Panel A of Table 2, where firms in targeted cities show a greater shift towards non-firm-specific environmental project investments over firm-specific ones.

Environmental investments not only help firms directly boost their green revenue, but columns 4-9 also demonstrate that firms investing more in environmental projects produce more patents, with a higher proportion of these being green patents. For instance, firms that invest more in non-firm-specific environmental projects experience a 32.74 (= 0.074/0.226) percentage-point increase in the fraction of green patents following their city's MCEP assignment (column 8). This may explain why local firms are willing to engage in public-good-type investments such as beneficial environmental projects. Put differently, through these investments, firms may acquire expertise and technical knowledge, which can ultimately lead to financial gains. These findings are consistent with prior research documenting that polluting firms boost their R&D investments to expand their capacity to absorb external knowledge and technical know-how (e.g., Brown, Martinsson and Thomann 2021).

Taken together, the results in Panel A of Table 9 suggest that effective environmental regulations can motivate firm commitment to green initiatives and sustainability by making

environmental investments — and ultimately, the green transition — more profitable in both the short and long term. Arguably, even if non-firm-specific environmental projects do not directly reduce production costs or expand sales, the knowledge and technology developed during the course of project investment and implementation enable firms to file more patents, particularly green patents, which in turn translate into higher firm value.

*6.2.2 Labor Productivity*

Environmental investments may benefit a firm beyond green revenue and patent creation. A high-quality environment, brought by corporate investments in environmental protection, can render local firms a more productive and efficient labor force. To explore this possibility, we first consider the firm's employment growth rate. Columns 1-3 of Table 9 Panel B show that post MCEP, firms that invest more in environmental projects decrease their hiring rates. To evaluate whether retaining fewer employees is detrimental to labor performance, we estimate the Pinnuck-Lillis (2007) measure of labor investment inefficiency, 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 beneficent environmental projects after the MCEP. Specifically, firms in a treated city that spend more on non-firm-specific environmental projects experience a 14.64 (= -0.035/0.239) percentage points decrease in labor investment inefficiency (column 5).

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 that spend more on environmental projects. While the effect prevails across all project types (columns 7-9), investing more in projects that generate greater externalities produces a larger effect on labor productivity than those with a smaller direct

social impact.[21] This corroborates with the city-level evidence in Table 8 that the former type of project helps improve the local environment and attracts firm entry to a greater extent. Taken together, the results suggest that firms in MCEP cities with larger environmental investments are able to save more on labor costs, improve the efficiency of their labor investment, and boost labor productivity.

*6.2.3 Valuation*

A larger green revenue, an increased number of patents, and a more productive workforce ultimately lead to higher firm value. The estimates in columns 1-3 of Table 9 Panel C suggest that after their city is targeted for heightened environmental regulations, local firms that allocate more resources to environmental projects — particularly those with broader societal benefits — achieve higher valuations, as captured by Tobin's Q. Following the establishment of MCEP, firms with larger non-firm-specific environmental investment experience a 5.10 (= 0.190/3.723) percentage points increase in Tobin's Q (column 2).

There is also evidence that a firm's environmental investment helps mitigate its downside risks amid regulatory uncertainty. We measure the negative tail effect on stock returns by the frequency of days a stock return falls two standard deviations below the sample mean.[22] Columns 4-6 of Table 9 Panel C reveal a positive and significant coefficient estimate associated with the post-MCEP dummy. This is consistent with the prior findings that intensified environmental regulations elevate the regulatory climate risk (Krueger, Sautner and Starks2020), thereby amplifying the tail risks associated with returns (Ilhan, Sautner and Vilkov 2021). Nevertheless, the interaction terms between the post-MCEP dummy and the dummies for large environmental

[21] The $p$-value for the $\chi^2$-statistics testing the difference in coefficients associated with the interaction terms between columns 8 and 9 is 0.048, significant at the 5% level.
[22] Alternative cutoffs (one standard deviation and three standard deviations below the mean) do not alter our findings.

project investments are negative and significant. This suggests that boosting environmental investments may help firms mitigate the negative impact of regulatory risk.

Overall, the findings in Table 9 highlight a mechanism through which environmental project investments can affect firm performance, independent of the persistence of (or lack thereof) government-based incentives.

## 7. Conclusion

In this paper, we study within-firm investment response to changes in environmental regulations. We construct a manually collected dataset of project investments by Chinese listed companies and conduct textual analyses to identify those that are related to environmental protection. To reflect the "public goods" nature of environmental projects, we further distinguish between those that mostly add value to shareholders and "beneficent" ones, i.e., environmental projects that also generate large direct societal benefits.

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 issues intensifies. Local politicians 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 young firms. There is a change in local firm

composition, as targeted cities grow their green sectors and rely less on tax revenue from heavily polluting firms. 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 revenue and green patent outputs, smaller downside risk, and higher labor productivity than other firms in the same city. Our findings highlight the role of regulatory mechanisms in enabling ESG investment to be both value- and *values*-enhancing (Starks 2023).

## References


Aghion, P., A. Dechezlepretre, D. Hemous, R. Martin, and J. Van Reenen. 2016. Carbon taxes, path dependency, and directed technical change: Evidence from the auto industry. *Journal of Political Economy* 124, 1-51.

Akey, P. and I. Appel. 2020. Environmental externalities of activism. Working Paper, University of Toronto.

Ardia, D., K. Bluteau, K. Boudt, and K. Inghelbrecht. 2023. Climate change concerns and the performance of green vs. brown stocks. *Management Science* 69(12), 7151-7882.

Baker, A. D. Larcker, and C. Wang. 2022. How much should we trust staggered difference-in-differences estimates? *Journal of Financial Economics* 144, 370-395.

Bartram, S. K. Hou, and S. Kim. 2022. Real effects of climate policy: Financial constraints and spillovers. *Journal of Financial Economics* 143, 668-696.

Ben-David, I., Y. Jang, S. Kleimeier, and M. Viehs. 2021. Exporting pollution: Where do multinational firms emit CO2?. *Economic Policy* 36(107), 377–437.

Berg, F., K. Fabisik, and Z. Sautner. 2021. Is history repeating itself? The (un)predictable past of ESG ratings. Working Paper, Massachusetts Institute of Technology.

Berg, F., J. Kölbel, and R. Rigobon. 2022. Aggregate confusion: The divergence of ESG ratings. *Review of Finance* 26(6), 1315-1344.

Bertrand, M., M. Bombardini, R. Fisman, and F. Trebbi. 2020. Tax-exempt lobbying: Corporate philanthropy as a tool of political influence. *American Economic Review* 110, 2065-2102.

Bhattacharya, U., N. Galpin, R. Ray, and X. Yu. 2009. The Role of the Media in the Internet IPO Bubble, *Journal of Financial and Quantitative Analysis* 44(3), 657-682.

Bisceglia, M., A. Piccolo, and J. Schneemeier. 2023. Externalities of responsible investments. Working Paper, Indiana University.

Borusyak, K., X. Jaravel, and J. Spiess. 2024. Revisiting event-study designs: Robust and efficient estimation. *Review of Economic Studies* 91(6), 3253–3285.

Brown, J., G. Martinsson, and C. Thomann. 2022. Can environmental policy encourage technical change? Emissions taxes and R&D investments. *Review of Financial Studies* 35(10), 4518-4560.

Callaway, B. and P.H.C. Sant'Anna. 2021. Difference-in-Differences with multiple time periods. *Journal of Econometrics* 225 (2), 200–230

Chen, Y., P. Li, and Y. Lu. 2018. Career concerns and multitasking local bureaucrats: Evidence of a target-based performance evaluation system in China. *Journal of Development Economics* 133, 84-101.

Chen, T., H. Dong, and C. Lin. 2020. Institutional shareholders and corporate social responsibility. *Journal of Financial Economics* 135, 483-504.

Chhaochharia, V., R. Sen, and J. Xu. 2022. Regulation-induced CSR. Working Paper. University of New South Wales.

Choi, S., R. Levine, R. Park, and S. Xu. 2022. Environmental regulation, pollution, and shareholder wealth. Working Paper, UC Berkeley.

Christensen, H., L. Hail, and C. Leuz. 2021. Mandatory CSR and sustainability reporting: Economic analysis and literature review. *Review of Accounting Studies* 26(3), 1176-1248.

Dai, R. H. Liang, and L. Ng. 2021. Socially responsible corporate customers. *Journal of Financial Economics* 142(2), 598-626.

de Chaisemartin, C. and X. D'Haultfoeuille. 2023. Two-way fixed effects and differences-in-differences with heterogeneous treatment effects: A survey. *The Econometrics Journal*, 26(3), C1-C30.

De Simone, R., S. L. Naaraayanan, K. Sachdeva. 2024. Opening the brown box: Production responses to environmental regulation. Working Paper, London Business School.

Duchin, R., J. Gao, and Q. Xu. 2024. Sustainability or greenwashing: Evidence from the asset market for industrial pollution. *Journal of Finance* forthcoming.

Duflo, E., M. Greenstone, R. Pande, and N. Ryan. 2018. The value of regulatory discretion: Estimates from environmental inspections in India. *Econometrica* 86(6), 2123–2160.

Dyck, A., K. Lins, L. Roth, and H. Wagner. 2019. Do institutional investors drive corporate environmental and social responsibility? International evidence. *Journal of Financial Economics* 131(3), 693-714.

Engle, R. F., S. Giglio, B. Kelly, H. Lee, and J. Stroebel. 2020. Hedging climate change news. *Review of Financial Studies* 33(3), 1184-1216.

Fisher, A. C. Martineau, and J. Sheng. 2022. Macroeconomic attention and announcement risk premia. *Review of Financial Studies* 35(11), 5057-5093.

Flammer, C., T. Giroux, and G. Heal. 2023. Biodiversity finance. Working Paper, Columbia University.

Gande, A. K. John, V. Nair, and L. Senbet. 2020. Taxes, institutions and innovation: Theory and international evidence. *Journal of International Business Studies* 51(9), 1413-1442.

Gantchev, N., M. Giannetti, and R. Li. 2022. Does money talk? Divestitures and corporate environmental and social policies. *Review of Finance* 26(6), 1469-1508.

Giannetti, M., G. Liao, and X. Yu. 2015. The brain gain of corporate boards: Evidence from China. *Journal of Finance* 70(4), 1629-1682.

Giannetti, M., G. Liao, J. You, and X. Yu. 2021. The externalities of corruption: Evidence from entrepreneurial activity in China. *Review of Finance* 25(3), 629-667.

Gibson, M. 2019. Regulation-induced pollution substitution. *Review of Economics and Statistics* 101(5), 827-840.

Hainmueller, J. 2012. Entropy balancing for causal effects: A multivariate reweighting method to produce balanced samples in observational studies. *Political Analysis* 20, 25-46.

Haltiwanger, J., R. Jarmin, R. Kulick, and J. Miranda. 2017. High-growth young firms contribution to job, output, and productivity growth. *In Measuring Entrepreneurial Businesses: Current Knowledge and Challenges* 11–62. University of Chicago Press.

Hart, O. and L. Zingales. 2022. The new corporate governance. *University of Chicago Business Law Review* 1: 195-216.

Heath, D., D. Macciocchi, R. Michaely, and M. Ringgenberg. 2023. Does socially responsible investing change firm behavior? *Review of Finance* 27(6), 2057-2083.

Hsu, P., H. Liang, and P. Matos. 2023. Leviathan Inc. and corporate environmental engagement. *Management Science* 69(12), 7151-7882.

Hsu, P., K. Li, and C. Tsou. 2023. The pollution premium. *Journal of Finance* 78(3), 1343-1392.

Ilhan, E., Z. Sautner, and G. Vilkov. 2021. Carbon tail risk, *Review of Financial Studies* 34(3), 1540–1571.

Jackson, H. and M. J. Roe. 2009. Public and private enforcement of securities laws: Resource-based evidence. *Journal of Financial Economics* 93, 207-238.

Karpoff, J., J. Lott, and E. Wehrly. 2005. The reputational penalties for environmental violations: Empirical evidence. *Journal of Law and Economics* 68, 653-675.

Krueger, P., Z. Sautner, and L. Starks. 2020. The importance of climate risk for institutional investors. *Review of Financial Studies* 33(3), 1067-1111.

Leary, M. T. and M. Roberts. 2014. Do peer firms affect corporate financial policy? *Journal of Finance* 69, 139-178.

Li, H. and L. Zhou. 2005. Political turnover and economic performance: The incentive role of personnel control in China. *Journal of Public Economics* 89, 1743–1762.

Masulis, R. and S. Reza. 2015. Agency problems of corporate philanthropy. *Review of Financial Studies* 28(2), 592-636.

Najjar, N. and J. Cherniwchan. 2021. Environmental regulations and the cleanup of manufacturing: Plant-level evidence. *Review of Economics and Statistics* 103(3), 476-491.

Pinnuck M. and A. M. Lillis. 2007. Profits versus losses: Does reporting an accounting loss act as a heuristic trigger to exercise the abandonment option and divest employees? *The Accounting Review* 82(4), 1031-1053.

Ramadorai, T. and F. Zeni. 2024. Climate Regulation and emissions abatement: Theory and evidence from firms' disclosures. *Management Science*.

Riley, P. 2019. Three pitfalls to avoid in machine learning. *Nature* 572 (7767), 27-29.

Roth, J. 2022. Pretest with caution: Event-study estimates after testing for parallel trends. *American Economic Review: Insights* 4(3), 305-322.

Sautner, Z., Van Lent, L., Vilkov, G. and Zhang, R., 2023. Firm-level climate change exposure. *Journal of Finance* 78(3), 1449-1498.

Seltzer, L., L. Starks, and Q. Zhu. 2022. Climate regulatory risks and corporate bonds. Working Paper. University of Texas at Austin.

Sheng, J., N. Xu, and L. Zheng. 2023. Do mutual funds walk the talk? A textual analysis of risk disclosure by mutual funds. Working Paper. University of California Irvine.

Starks, L. 2023. Presidential Adress: Sustainable finance and ESG issues – value versus values. *Journal of Finance* 78(4), 1837-1872.

Sun, L. and S. Abraham. 2021. Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of Econometrics* 225(2), 175-199.

Tate, G. and L. Yang. 2015. The bright side of diversification – Evidence from internal labor markets. *Review of Financial Studies* 28, 2203-2249.

You, J., B. Zhang, and L. Zhang. 2018. Who captures the power of the pen? *Review of Financial Studies* 31 (1), 43-96.

## Appendix A: Variable Definition

| Variable | Definition and Data Source |
|---|---|
| *# of Firms in (Green) Non-Green Sectors* | The natural logarithm of the number of firms operating in (green) non-green sectors in a city-year, respectively. Source: ATS and CSMAR. |
| *# of Large Industrial Firms* | The natural logarithm of the number of large-scale industrial firms in a city and in a year. Source: CSMAR database. |
| *# of Patents* | The natural logarithm of one plus the average number of patents from year $t$ to year $t+3$. Source: CNRDS. |
| *% of Green Patents* | The average fraction of total patents being green patents from year $t$ to year $t+3$. Source: CNRDS. |
| *Advertising Expenses* | The sum of advertisement expenses of listed firms in a city-year, scaled by the sum of operating revenue of these firms, multiplied by 100. Source: CSMAR database. |
| *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 natural logarithm of one plus the total amount of bank loans. Sources: CSMAR database. |
| *Board Independence* | The number of independent directors divided by board size. Source: CSMAR database. |
| *Cash* | Cash and cash equivalents divided by total assets. Source: CSMAR database. |
| *Carbon* | The natural logarithm of carbon emissions. Source: CCED database. |
| *Downside Risk* | The frequency of daily stock returns that fall two standard deviations below the mean in a firm-year. Source: CSMAR database. |
| *Dummy for EI(Total)* | A dummy variable set to one once the firm begins investing in any environmental protection project, and zero otherwise. Sources: CSMAR database and manual collection. |
| *Dummy for EI(Non-Firm-Specific)* | A dummy variable set to one once the firm begins investing in non-firm-specific environmental protection projects, and zero otherwise. Sources: CSMAR database and manual collection. |
| *Dummy for EI(Firm-Specific)* | A dummy variable set to one once the firm begins investing in firm-specific environmental protection projects, and zero otherwise. Sources: CSMAR database and manual collection. |
| *EI(Total)* | At firm-year level, this variable is calculated as the amount of corporate investment in environmental protection projects, scaled by operating revenue, and multiplied by 100. At city-year level, this variable is the sum of environmental project investments by all firms in a city, scaled by the sum of their operating revenue, 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 environmental protection projects that also directly benefit stakeholders, scaled by operating revenue, and multiplied by 100. At city-year level, this variable is the sum of stakeholder-oriented environmental project investments by all firms |

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| | in a city, scaled by the sum of their operating revenue, 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 environmental protection projects that generate direct benefit to shareholders, scaled by operating revenue, and multiplied by 100. At city-year level, this variable is the sum of shareholder-oriented environmental project investments by all firms in a city, scaled by the sum of their operating revenue, 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-year, 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 percentage change in the fraction of high-quality new firms in a city from year $t-1$ to year $t$. A new firm is considered high-quality if it is newly registered and its TFP is in the top quartile of the sample in a year. Source: ATS database. |
| *ETC* | The sum of entertainment and travel expenses of all listed firms divided by the sum of their sales in a city-year, multiplied by 100. Source: CSMAR database. |
| *Excess Hospital Needs* | The number of hospitals (in 10,000), in a city year minus the average number of hospitals in the previous three years. Source: CNRDS database. |
| *Fixed Asset Investment (Service Sector, 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 natural logarithms of local population, and the number of colleges. Source: China Entrepreneur Investment Club. |
| *GDP Growth* | The year-on-year change in a city's GDP. Source: CSMAR database. |
| *Green Revenue* | A firm's aggregated reported revenue derived from its environmentally sustainable operations and initiatives, scaled by its total operating revenue. Source: WIND database. |
| *Growth of Firms in Green (Non-Green) Sectors* | The percentage change of the proportion of firms in green (non-green) sectors relative to the total number of firms in a city-year, respectively. Source: ATS and CSMAR. |
| *High % of Environmental Targets Achieved* | A dummy variable set to one if the fraction of pre-set city-level environmental targets accomplished in a year falls above the top sample tercile, and zero otherwise. Sources: China Statistical Yearbooks and local governments' websites. |
| *High Carbon* | A dummy variable set to one if a city-year's carbon emission falls above the top sample tercile, and zero otherwise. Source: CCED database. |

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|---|---|
| *High SO2* | A dummy variable set to one if a city-year's industrial sulfur dioxide (SO2) emission falls above the top sample tercile, and zero otherwise. Source: CSMAR database. |
| *Institutional Holdings* | The fraction of tradable shares held by institutional investors. Source: CSMAR database. |
| *Labor Investment Inefficiency* | Pinnuck and Lillis's (2007) measure of labor investment inefficiency. 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 average employee wage. 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. |
| *Non-Green* | A dummy variable set to one if a firm is in a conventional, non-green sector, and zero otherwise. Green sectors are defined based on the China Securities Regulatory Commission 2012 industry classification code "N" (water conservancy, environment, and public facilities management). Sources: CSMAR databases. |
| *# of Firms in (Green) Non-Green Sectors* | The natural logarithm of the number of firms operating in (green) non-green sectors in a city-year, respectively. Source: ATS and CSMAR. |
| *Non-Polluting Targets Acquired by Polluting Firms* | The natural logarithm of one plus the number of M&A targets operating in non-heavily polluting industries acquired by heavily polluting firms. Sources: CNRDS and CSMAR databases. |
| *Political Connection* | The natural logarithm of the number of chairmen of board and CEOs of listed firms in a city-year with political connections. Source: CSMAR database. |
| *Polluting Firms' Proportion of Sales* | The proportion of sales generated by heavily polluting firms relative to all firms in a city-year. Sources: CSMAR and ATS databases. |
| *Polluting Firms' Proportion of Taxes* | The proportion of taxes paid by heavily polluting firms relative to all firms in a city-year. Sources: CSMAR and ATS 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 attains its MCEP status, 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, and zero otherwise. Source: Manual collection. |
| *Promotion* | A dummy variable set to one if a city's 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. |
| *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 environmental subsidies that a firm receives from the government in a year, scaled by its revenue, multiplied by 100. Source: CSMAR database. |
| *SO2* | The natural logarithm of industrial sulfur dioxide (SO2) emissions. Source: CSMAR database. |

| | |
|---|---|
| *Taxes* | The amount of taxes paid scaled by sales. Source: CSMAR database. |
| *Tobin's Q* | The firm's market value of assets divided by its book value of assets. Source: CSMAR database. |
| *Unemployment* | The unemployment growth in a city from year $t-1$ to year $t$. Source: CNRDS database. |

## Appendix B: Timing of the Events

The table below describes the distribution of "major cities for environmental protection" (MCEPs) in each province. Column 1 reports the total number of cities for each province. Columns 2 and 4 report the numbers of MCEPs, respectively, in 2007 and in 2010. Columns 3 and 5 report the fraction of cities in a province being designated as MCEPs.

| Province | # of Cities | MCEPs in 2007 | | MCEPs in 2010 | |
|---|---|---|---|---|---|
| | | # of MCEPs | % of MCEPs | # of MCEPs | % of MCEPs |
| | (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: City Characteristics and the Likelihood of MCEP Assignment

This table relates ex-ante city characteristics to the likelihood of its designation as an MCEP. The unit analysis is at city level. The dependent variable is a dummy variable set for one if a city is assigned to be an MCEP in 2007, and zero otherwise. The independent variables are a city's characteristics averaged over the pre-MCEP period of 2004-2006. *GDP Growth* is the year-on-year change in a city's GDP, *Fixed Asset Investment*, *Service Sector*, *Population*, and *Colleges* are, respectively, a city's fixed assets investments scaled by its GDP, service sector output scaled by its GDP, the natural logarithms of local population, and the number of colleges. *# of Large Industrial Firms* is the natural logarithm of the number of large-scale industrial firms in a city. *Carbon* and *SO2* are, respectively, the natural logarithm of carbon emissions and industrial sulfur dioxide (SO2) emissions. *Polluting Firms' Proportion of Taxes* is the proportion of taxes paid by heavily polluting firms relative to all firms in a city. *Environmental Investment* is the sum of environmental investments made by all firms in a city scaled by its GDP. *% of Polluting Firms* is the fraction of polluting firms relative to the total number of firms in a city. Columns 1 and 2 report the OLS and logit regression estimates, respectively. Variable definitions are in 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: | Dummy for MCEP | |
|---|---|---|
| | OLS | Logit |
| | (1) | (2) |
| GDP Growth | -0.522 | 0.010 |
| | (-0.73) | (0.00) |
| Fixed Asset Investment | -0.129 | -2.010 |
| | (-0.45) | (-0.80) |
| Service Sector | 0.145 | 8.392 |
| | (0.25) | (1.64) |
| Population | -0.117 | -0.657 |
| | (-1.46) | (-1.00) |
| Colleges | 0.175*** | 1.873*** |
| | (3.45) | (3.47) |
| # of Large Industrial Firms | 0.090** | 0.633* |
| | (2.04) | (1.71) |
| Carbon | 0.084 | 0.867 |
| | (1.22) | (1.49) |
| SO2 | 0.042 | 0.318 |
| | (0.72) | (0.57) |
| Polluting Firms' Proportion of Taxes | 0.130 | 1.573 |
| | (0.46) | (0.75) |
| Environmental Investment | 0.102 | 1.271 |
| | (0.98) | (1.51) |
| % of Polluting Firms | -0.602 | -6.190 |
| | (-1.10) | (-1.42) |
| Observations | 137 | 137 |
| $R^2$ (Pseudo $R^2$) | 0.468 | 0.508 |

## Appendix D: 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 | 163 | 22 | 43 | 16 | 12 |
| Mining | 359 | 38 | 299 | 40 | 32 |
| Agricultural and sideline food processing | 161 | 26 | 77 | 19 | 17 |
| Food manufacturing | 109 | 20 | 63 | 15 | 13 |
| Wine, beverage and refined tea manufacturing | 208 | 27 | 147 | 21 | 18 |
| Textile | 106 | 18 | 51 | 14 | 10 |
| Textile, clothing, apparel | 31 | 10 | 1 | 1 | 0 |
| Leather, fur, feathers and their products and footwear | 14 | 2 | 11 | 4 | 2 |
| Wood processing and wood, bamboo, rattan, palm and grass products | 9 | 3 | 6 | 3 | 2 |
| Furniture manufacturing | 12 | 1 | 4 | 2 | 0 |
| Paper and paper products | 285 | 20 | 157 | 15 | 15 |
| Printing and recorded media reproduction | 18 | 4 | 9 | 3 | 2 |
| Petroleum processing, coking and nuclear fuel processing | 149 | 10 | 145 | 9 | 8 |
| Chemical raw materials and chemical products manufacturing | 1,007 | 96 | 908 | 104 | 81 |
| Pharmaceutical products | 743 | 96 | 555 | 101 | 61 |
| Chemical fiber manufacturing | 129 | 15 | 81 | 12 | 10 |
| Rubber and plastic products | 64 | 19 | 49 | 15 | 8 |
| Non-metallic mineral products | 438 | 41 | 481 | 42 | 34 |
| Ferrous metal smelting and rolling processing | 1,199 | 28 | 1,011 | 28 | 28 |
| Non-ferrous metal smelting and rolling processing | 619 | 38 | 373 | 39 | 32 |
| Metal products | 67 | 9 | 80 | 14 | 4 |
| General equipment | 284 | 31 | 102 | 23 | 17 |
| Special equipment | 176 | 40 | 104 | 31 | 17 |
| Automotive | 78 | 24 | 103 | 22 | 11 |
| Railroad, marine, aerospace and other transportation equipment | 64 | 13 | 44 | 12 | 7 |
| Electrical machinery and equipment | 321 | 75 | 249 | 53 | 26 |
| Computer, communications and other electronic equipment | 341 | 73 | 291 | 70 | 42 |
| Instrumentation manufacturing | 10 | 5 | 14 | 4 | 2 |
| Other manufacturing | 10 | 2 | 4 | 3 | 1 |
| Comprehensive utilization of waste resources | 66 | 4 | 23 | 4 | 3 |
| Production and supply of electricity, heat, gas and water | 1,494 | 84 | 806 | 72 | 69 |
| Construction | 195 | 33 | 103 | 24 | 19 |
| Wholesale and retail | 231 | 47 | 146 | 49 | 26 |
| Transportation, warehousing and postal | 148 | 29 | 159 | 25 | 13 |

| | | | | | |
|---|---|---|---|---|---|
| Accommodation and catering | 11 | 3 | 8 | 2 | 1 |
| Information technology, software, and information technology service | 127 | 33 | 111 | 24 | 13 |
| Real estate | 150 | 34 | 106 | 26 | 14 |
| Leasing and business services | 55 | 13 | 21 | 11 | 6 |
| Scientific research and technical service | 27 | 7 | 12 | 3 | 2 |
| Water conservancy, environment, and public facilities management | 329 | 27 | 60 | 18 | 14 |
| Education | 3 | 2 | 10 | 3 | 0 |
| Health and social work | 7 | 4 | 9 | 3 | 1 |
| Culture, sports, and entertainment | 53 | 14 | 41 | 11 | 7 |
| Other | 73 | 7 | 35 | 8 | 4 |
| Total | 10,143 | 1,147 | 7,112 | 1,018 | 704 |

**Figure 1: The Distribution of MCEPs**

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

## Table 1: Descriptive Statistics

This table provides summary statistics for the variables of interest in our sample. Panel A summarizes the main characteristics of sample firms for the firm-year panel. Panel B shows the summary statistics of environmental projects. Panel C compares sample firms' environmental investments before and after their cities attain the MCEP status. The sample period is 2001-2014. Variable definitions are in Appendix A.

### Panel A: Firm-Year Level Characteristics

| Variable | N | Mean | Median | Std. Dev. |
|---|---|---|---|---|
| EI (million RMB) | | | | |
| Total | 21,872 | 29.627 | 0.000 | 127.002 |
| Non-Firm-Specific | 21,872 | 14.871 | 0.000 | 72.129 |
| Firm-Specific | 21,872 | 9.730 | 0.000 | 47.570 |
| EI(Total) | 21,872 | 1.028 | 0.000 | 3.806 |
| EI(Non-Firm-Specific) | 21,872 | 0.542 | 0.000 | 2.404 |
| EI(Firm-Specific) | 21,872 | 0.347 | 0.000 | 1.582 |
| Post | 21,872 | 0.578 | 1.000 | 0.494 |
| Assets (billion RMB) | 21,872 | 6.238 | 2.065 | 14.454 |
| Leverage | 21,872 | 0.469 | 0.471 | 0.226 |
| ROA | 21,872 | 0.059 | 0.057 | 0.070 |
| Cash | 21,872 | 0.176 | 0.132 | 0.146 |
| Market to Book | 21,872 | 0.556 | 0.538 | 0.245 |
| Age (# of years) | 21,872 | 13.059 | 13.000 | 5.312 |
| State | 21,872 | 0.527 | 1.000 | 0.499 |
| Board Independence | 21,872 | 0.377 | 0.375 | 0.099 |
| Institutional Holdings | 21,872 | 0.496 | 0.534 | 0.256 |
| Taxes | 21,862 | 0.077 | 0.060 | 0.060 |
| Subsidies | 20,525 | 0.042 | 0.000 | 0.168 |
| Bank Loans | 21,872 | 5.731 | 0.000 | 8.864 |
| Green Revenue | 21,872 | 0.007 | 0.000 | 0.049 |
| # of Patents | 21,872 | 1.230 | 0.693 | 1.453 |
| % of Green Patents | 21,872 | 0.226 | 0.000 | 0.787 |
| Employment Growth | 20,467 | 0.133 | 0.020 | 0.564 |
| Labor Investment Inefficiency | 18,472 | 0.239 | 0.129 | 0.409 |
| Labor Productivity | 21,796 | 9.956 | 9.952 | 1.477 |

## Table 1 continued.

### Panel B: Environmental Project Characteristics

| | All Projects | | Non-firm-specific Projects | | Firm-specific Projects | |
|---|---|---|---|---|---|---|
| | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. |
| Size of a project (million RMB) | 80.112 | 241.226 | 82.173 | 246.637 | 76.019 | 228.669 |
| Annual investment (million RMB) | 52.401 | 154.549 | 54.257 | 162.438 | 49.723 | 143.428 |
| Project duration (# of years) | 1.655 | 1.061 | 1.654 | 1.057 | 1.644 | 1.063 |

### Panel C: Univariate Comparison

| | Before MCEP | After MCEP | Difference |
|---|---|---|---|
| Full sample | | | |
| EI(Total) (million RMB) | 19.08 | 37.317 | 18.237*** |
| EI(Non-Firm-Specific) (million RMB) | 10.2 | 18.277 | 8.077*** |
| EI(Firm-Specific) (million RMB) | 6.519 | 12.071 | 5.552*** |
| The sample of firms that have made environmental investments | | | |
| EI(Total) (million RMB) | 58.561 | 123.761 | 65.200*** |
| EI(Non-Firm-Specific) (million RMB) | 31.305 | 60.617 | 29.312*** |
| EI(Firm-Specific) (million RMB) | 20.009 | 40.032 | 20.023*** |

## 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. In Panel A, the dependent variable is *EI*(*Total*) in columns 1-4, *EI*(*Non-Firm-Specific*) in columns 5-8, and *EI*(*Firm-Specific*) in columns 9-12. In Panel B, we compute total, non-firm-specific, and firm-specific environmental investments in long-term projects in columns 1-6, and total, non-firm-specific, and firm-specific environmental investments in shorter-term projects in columns 7-12. An environmental project is classified as long-term if its duration equals or exceeds 3 years. 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. Control variables in Panels B and C are identical to those in Panel 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: Environmental Investment

| Dependent Variable: | EI(Total) | | | | EI(Non-Firm-Specific) | | | | EI(Firm-Specific) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Post | 0.331*** | 0.292** | 0.367*** | 0.306** | 0.196*** | 0.179** | 0.207*** | 0.171** | 0.055 | 0.042 | 0.076 | 0.066 |
| | (2.88) | (2.43) | (3.10) | (2.44) | (2.76) | (2.35) | (2.84) | (2.17) | (1.06) | (0.78) | (1.40) | (1.16) |
| Size | 0.498*** | 0.552*** | 0.474*** | 0.530*** | 0.242*** | 0.265*** | 0.254*** | 0.273*** | 0.147*** | 0.169*** | 0.127*** | 0.152*** |
| | (6.96) | (7.74) | (6.62) | (7.36) | (6.02) | (6.49) | (6.24) | (6.59) | (4.58) | (5.29) | (3.99) | (4.71) |
| Leverage | -0.535** | -0.485* | -0.428* | -0.394 | -0.093 | -0.103 | -0.054 | -0.060 | -0.220** | -0.204** | -0.183* | -0.182* |
| | (-2.19) | (-1.96) | (-1.72) | (-1.54) | (-0.61) | (-0.66) | (-0.35) | (-0.38) | (-2.32) | (-2.13) | (-1.90) | (-1.85) |
| ROA | -1.676*** | -1.593*** | -1.766*** | -1.752*** | -0.649** | -0.707** | -0.753*** | -0.830*** | -0.484** | -0.417** | -0.475** | -0.446** |
| | (-3.57) | (-3.26) | (-3.64) | (-3.47) | (-2.30) | (-2.42) | (-2.60) | (-2.78) | (-2.46) | (-2.09) | (-2.37) | (-2.18) |
| Cash | -0.736*** | -0.736*** | -0.677*** | -0.665** | -0.631*** | -0.641*** | -0.570*** | -0.560*** | -0.056 | -0.076 | -0.052 | -0.078 |
| | (-2.96) | (-2.84) | (-2.70) | (-2.54) | (-4.12) | (-4.03) | (-3.69) | (-3.49) | (-0.53) | (-0.70) | (-0.49) | (-0.72) |
| Market to Book | -0.617*** | -0.743*** | -0.543*** | -0.712*** | -0.186 | -0.205 | -0.192 | -0.218 | -0.205** | -0.273*** | -0.178* | -0.266*** |
| | (-3.03) | (-3.40) | (-2.62) | (-3.14) | (-1.55) | (-1.59) | (-1.55) | (-1.62) | (-2.21) | (-2.77) | (-1.90) | (-2.65) |
| Age | -0.415 | -0.250 | -0.523 | -0.450 | -0.402** | -0.286 | -0.261 | -0.171 | -0.062 | -0.008 | -0.116 | -0.105 |
| | (-1.44) | (-0.84) | (-1.62) | (-1.32) | (-2.26) | (-1.56) | (-1.34) | (-0.84) | (-0.51) | (-0.06) | (-0.87) | (-0.73) |
| State | -0.122 | -0.116 | -0.159 | -0.131 | -0.075 | -0.085 | -0.089 | -0.090 | -0.037 | -0.025 | -0.043 | -0.019 |
| | (-0.97) | (-0.93) | (-1.23) | (-1.01) | (-0.90) | (-1.02) | (-1.04) | (-1.05) | (-0.70) | (-0.48) | (-0.79) | (-0.36) |
| Board Independence | -0.045 | -0.166 | 0.143 | -0.028 | -0.173 | -0.241 | -0.118 | -0.202 | 0.174 | 0.128 | 0.257 | 0.193 |
| | (-0.11) | (-0.42) | (0.36) | (-0.07) | (-0.71) | (-0.97) | (-0.48) | (-0.80) | (1.01) | (0.75) | (1.47) | (1.11) |
| Institutional Holdings | 0.003 | -0.008 | 0.081 | 0.060 | 0.320** | 0.320** | 0.304** | 0.318** | -0.245** | -0.285*** | -0.195** | -0.246** |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (0.01) | (-0.03) | (0.35) | (0.25) | (2.13) | (2.06) | (2.01) | (2.03) | (-2.54) | (-2.87) | (-1.99) | (-2.42) |
| GDP Growth | -0.197 | -0.207 | 0.345 | 0.440 | -0.131 | -0.178 | 0.097 | 0.128 | -0.011 | 0.009 | 0.172 | 0.242 |
| | (-0.40) | (-0.42) | (0.43) | (0.54) | (-0.42) | (-0.57) | (0.21) | (0.27) | (-0.05) | (0.04) | (0.48) | (0.64) |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | No | No | No | Yes | No | No | No | Yes | No | No | No |
| Industry × Year FE | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes |
| Province × Year FE | No | No | Yes | Yes | No | No | Yes | Yes | No | No | Yes | Yes |
| Observations | 21,872 | 21,872 | 21,872 | 21,872 | 21,872 | 21,872 | 21,872 | 21,872 | 21,872 | 21,872 | 21,872 | 21,872 |
| $R^2$ | 0.437 | 0.459 | 0.452 | 0.474 | 0.444 | 0.464 | 0.458 | 0.478 | 0.379 | 0.405 | 0.398 | 0.421 |

**Panel B: Project Duration**

| Project Type: | Long-term Projects | | | | | | Short-term Projects | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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) | (7) | (8) | (9) | (10) | (11) | (12) |
| Post | 0.193*** | 0.173** | 0.075** | 0.052 | 0.024 | 0.034 | 0.072 | 0.059 | 0.046 | 0.037 | 0.012 | 0.016 |
| | (2.83) | (2.30) | (2.06) | (1.23) | (0.93) | (1.16) | (1.24) | (0.93) | (1.47) | (1.05) | (0.53) | (0.63) |
| Control Variables | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No |
| Industry × Year FE | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes |
| Province× Year FE | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes |
| Observations | 21,872 | 21,872 | 21,872 | 21,872 | 21,872 | 21,872 | 21,872 | 21,872 | 21,872 | 21,872 | 21,872 | 21,872 |
| $R^2$ | 0.402 | 0.440 | 0. 428 | 0.459 | 0.381 | 0.423 | 0.333 | 0.378 | 0.328 | 0.376 | 0.294 | 0.339 |

## Table 3: Who React More to Heightened Environmental Regulations?

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 and 4, *EI*(*Non-Firm-Specific*) in columns 2 and 5, and *EI*(*Firm-Specific*) in columns 3 and 6. *Non-Green* is a dummy variable set to one if a firm operates in a conventional, non-green sector, and zero if it operates in a green sector. *Non-State* is a dummy variable set to one if a firm is not government-controlled or government-owned, and zero otherwise. The regression estimates are based on a PSM matched sample in columns 1-3 and on the full sample in columns 4-6. Variable definitions are in Appendix A. All models include a set of control variables identical to those in Table 2 Panel A, 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) | EI(Total) | EI(Non-Firm-Specific) | EI(Firm-Specific) |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Post × Non-Green | 2.202** | 1.230** | 0.034 | | | |
| | (2.52) | (2.07) | (0.14) | | | |
| Post × Non-State | | | | 0.188* | 0.018 | 0.125*** |
| | | | | (1.84) | (0.28) | (2.87) |
| Post | 0.885 | 0.473 | 0.385* | 0.231* | 0.186** | -0.012 |
| | (1.16) | (0.82) | (1.68) | (1.83) | (2.40) | (-0.22) |
| Non-State | | | | 0.036 | 0.066 | -0.02 |
| | | | | (0.28) | (0.77) | (-0.36) |
| 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 | 483 | 483 | 483 | 21,872 | 21,872 | 21,872 |
| $R^2$ | 0.630 | 0.657 | 0.232 | 0.437 | 0.444 | 0.379 |

## Table 4: 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 the entropy balanced matching approach in columns 7-9. In Panel B, we scale a firm's environmental investments by Capex (columns 1-3), total assets (columns 4-6), and operating cash flows (columns 7-9). In Panel C, we estimate the likelihood that a firm invests in an environmental project. In Panel D, we exclude firm-year observations whose business locations and the location of registration are inconsistent in columns 1-3. We exclude firm-year observations that occur in the event years in columns 4-6. In Panel E, we restrict the sample to focused firms only in columns 1-3 and consider a subsample of projects with city locations in columns 4-6. For the latter, the unit of observation is project-year. Panel F reports the results from two placebo tests. In columns 1-3, we redefine the post dummy to be one for years in and after the passage of the 2009 Copenhagen Accord, and zero otherwise. In column 4, we replace environmental investments with non-environmental project investments as the dependent variable. Panel G reports the summary statistics based on 100 simulated pseudo-MCEP dates. Column 1 reports the coefficient estimates and *T*-statistics for *EI*(*Total*), *EI*(*Non-Firm-Specific*), and *EI*(*Firm-Specific*) using the actual MCEP dates (columns 1, 5, and 9 of Table 2 Panel A). We randomly generate 100 dates within the sample period as the pseudo-MCEP dates and re-estimate Table 2 columns 1, 5, and 9 individually. 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 H, we replicate the regressions in Table 2 Panel A without including time-varying control variables in columns 1-3 and estimate a stacked regression without control variables in columns 4-6. In Panel H, we report the Borusyak, Jaravel and Spiess's (2024) estimators for dynamic effect, with indicator variables for years $t-7$, $t-6$, …, $t$, up to year $t+3$, where $t$ is the year of MCEP designation. Variable definitions are in 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 | 0.320** | 0.225*** | 0.020 | 0.379** | 0.224** | 0.077 | 0.286** | 0.172** | 0.054 |
| | (2.37) | (2.82) | (0.32) | (2.33) | (2.10) | (1.05) | (2.46) | (2.49) | (0.98) |
| 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 | 14,872 | 14,872 | 14,872 | 9,354 | 9,354 | 9,354 | 21,872 | 21,872 | 21,872 |
| $R^2$ | 0.389 | 0.399 | 0.323 | 0.475 | 0.479 | 0.437 | 0.412 | 0.416 | 0.377 |

## Table 4 continued.

### Panel B: Alternative Scalars

| Normalized by: | Capex | | | Total Assets | | | Operating Cash Flows | | |
|---|---|---|---|---|---|---|---|---|---|
| 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 | 1.339** | 0.915* | 0.418 | 0.103** | 0.056* | 0.020 | 3.508* | 2.587** | 0.020 |
| | (1.97) | (1.96) | (1.02) | (2.12) | (1.88) | (0.77) | (1.66) | (2.15) | (0.02) |
| 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 | 20,910 | 20,910 | 20,910 | 21,872 | 21,872 | 21,872 | 16,687 | 16,687 | 16,687 |
| $R^2$ | 0.408 | 0.398 | 0.370 | 0.422 | 0.413 | 0.380 | 0.356 | 0.364 | 0.352 |

### 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) | (10) | (11) | (12) |
| Post | 0.038*** | 0.032*** | 0.034*** | 0.031*** | 0.023** | 0.025** | 0.026** | 0.028** | 0.017 | 0.015 | 0.015 | 0.015 |
| | (3.52) | (2.95) | (3.05) | (2.75) | (2.03) | (2.22) | (2.41) | (2.54) | (1.63) | (1.44) | (1.43) | (1.37) |
| Control Variables | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | No | No | No | Yes | No | No | No | Yes | No | No | No |
| Industry × Year FE | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes |
| Province× Year FE | No | No | Yes | Yes | No | No | Yes | Yes | No | No | Yes | Yes |
| Observations | 15,548 | 15,548 | 15,548 | 15,548 | 15,548 | 15,548 | 15,548 | 15,548 | 15,548 | 15,548 | 15,548 | 15,548 |
| $R^2$ | 0.631 | 0.655 | 0.644 | 0.667 | 0.724 | 0.740 | 0.733 | 0.749 | 0.756 | 0.769 | 0.762 | 0.775 |

## Table 4 continued.

### Panel D: Alternative Sample Restrictions

| Sample: | Excluding observations with inconsistent business and registration locations | | | Excluding observations in the event year | | |
|---|---|---|---|---|---|---|
| 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 | 0.311*** | 0.239*** | 0.025 | 0.413*** | 0.255*** | 0.067 |
| | (2.61) | (3.26) | (0.47) | (3.24) | (3.22) | (1.12) |
| 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 | 20,723 | 20,723 | 20,723 | 20,319 | 20,319 | 20,319 |
| $R^2$ | 0.448 | 0.447 | 0.389 | 0.442 | 0.456 | 0.379 |

### Panel E: Project Locations

| Sample: | Focused Firms | | | Considering Project Locations | | |
|---|---|---|---|---|---|---|
| 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 | 0.290* | 0.218** | 0.003 | 0.141** | 0.064* | 0.023 |
| | (1.81) | (2.25) | (0.03) | (2.20) | (1.74) | (0.87) |
| 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 | 11,688 | 11,688 | 11,688 | 34,093 | 34,093 | 34,093 |
| $R^2$ | 0.452 | 0.455 | 0.398 | 0.318 | 0.300 | 0.316 |

### Panel F: Falsification Tests

| Dependent Variable: | EI(Total) | EI(Non-Firm-Specific) | EI(Firm-Specific) | Non-EI |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Post Copenhagen Accord | 0.071 | 0.049 | 0.005 | |
| | (0.93) | (1.03) | (0.16) | |
| Post | | | | 0.796 |
| | | | | (1.59) |
| Control Variables | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes |
| Year FE | No | No | No | Yes |
| Observations | 21,872 | 21,872 | 21,872 | 21,872 |
| $R^2$ | 0.436 | 0.444 | 0.378 | 0.393 |

## Table 4 continued.

### Panel G: Summary Statistics based on 100 Simulated MCEP Dates

| | MCEP Date | Mean | 5% | 25% | Median | 75% | 95% |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| EI(Total) | 0.331 | -0.003 | -0.087 | -0.027 | 0.001 | 0.025 | 0.066 |
| | (2.88) | (-0.08) | (-1.99) | (-0.61) | (0.01) | (0.57) | (1.51) |
| EI(Non-Firm-Specific) | 0.196 | -0.000 | -0.044 | -0.019 | -0.003 | 0.019 | 0.041 |
| | (2.76) | (-0.02) | (-1.61) | (-0.66) | (-0.09) | (0.68) | (1.45) |
| EI(Firm-Specific) | 0.055 | 0.002 | -0.030 | -0.011 | 0.001 | 0.012 | 0.036 |
| | (1.06) | (0.09) | (-1.56) | (-0.56) | (0.03) | (0.63) | (1.84) |

### Panel H: 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 | 0.328*** | 0.200*** | 0.051 | 0.320*** | 0.197*** | 0.047 |
| | (2.85) | (2.82) | (1.00) | (2.78) | (2.79) | (0.92) |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 21,872 | 21,872 | 21,872 | 31,031 | 31,031 | 31,031 |
| $R^2$ | 0.434 | 0.441 | 0.378 | 0.406 | 0.418 | 0.358 |

## Table 4 continued.

**Panel I: Borusyak, Jaravel and Spiess's (2024) Estimators for Dynamic Effect**

| Dependent Variable: | EI(Total) | EI(Non-Firm- Specific) |
|---|---|---|
| | (1) | (2) |
| $t-7$ | 0.876 | 0.425 |
| | (1.29) | (0.85) |
| $t-6$ | 1.288 | 0.604 |
| | (1.20) | (0.76) |
| $t-5$ | 1.543 | 0.547 |
| | (1.10) | (0.56) |
| $t-4$ | 2.083 | 0.959 |
| | (1.41) | (0.94) |
| $t-3$ | 3.229 | 1.617 |
| | (1.62) | (1.15) |
| $t-2$ | 3.812 | 1.729 |
| | (1.56) | (0.99) |
| $t-1$ | 3.849 | 1.658 |
| | (1.39) | (0.86) |
| $t$ | 0.375* | 0.358*** |
| | (1.86) | (2.87) |
| $t+1$ | 0.616*** | 0.380*** |
| | (3.07) | (2.74) |
| $t+2$ | 0.589*** | 0.445*** |
| | (2.94) | (3.50) |
| $t+3$ | 0.615** | 0.483*** |
| | (2.57) | (3.38) |
| Firm FE | Yes | Yes |
| Year FE | Yes | Yes |
| Observations | 11,690 | 11,690 |

## Table 5: 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. *# of Large Industrial Firms* is natural logarithm of the number of large-scale industrial firms in a city-year. In column 1, we consider news reports from all media outlets. *ETC* is the total entertainment and travel expenses of all firms divided by the sum of total sales of these firms, in a city-year, multiplied by 100. *Advertising Expenses* is the sum of advertising expenses of listed firms in a city-year, scaled by the sum of revenue of these firms, multiplied by 100. *Political Connection* is the natural logarithm of number of chairmen of board and CEOs of list firms in a city-year with political connections. 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. Variable definitions are in 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 | | | | |
|---|---|---|---|---|---|
| Media Outlet Type: | All outlets | State-affiliated | Market-based | National | Local |
| | (1) | (2) | (3) | (4) | (5) |
| Post | 0.404*** | 0.536*** | 0.305*** | 0.291*** | 0.651*** |
| | (6.71) | (8.82) | (5.54) | (5.20) | (10.64) |
| GDP Growth | -0.410** | -0.273* | -0.376** | -0.458*** | -0.171 |
| | (-2.51) | (-1.76) | (-2.56) | (-2.96) | (-1.17) |
| Fixed Asset Investment | -0.188 | -0.129 | -0.251** | -0.225** | -0.257** |
| | (-1.59) | (-1.17) | (-2.37) | (-2.03) | (-2.20) |
| Service Sector | 0.364 | 0.763* | 0.162 | 0.221 | 0.960** |
| | (0.77) | (1.73) | (0.38 | (0.48) | (2.20) |
| Population | 0.167 | 0.238* | 0.107 | 0.108 | 0.242* |
| | (1.16) | (1.73) | (0.84) | (0.75) | (1.83) |
| Colleges | 0.205*** | 0.204*** | 0.164*** | 0.174*** | 0.188*** |
| | (3.89) | (4.74) | (3.50) | (3.47) | (4.75) |
| # of Large Industrial Firms | 0.119 | 0.069 | 0.063 | 0.106 | 0.020 |
| | (1.53) | (0.94) | (0.93) | (1.52) | (0.27) |
| ETC | 0.527*** | 0.345** | 0.374** | 0.331* | 0.366** |
| | (2.68) | (2.06) | (2.12) | (1.71) | (2.25) |
| Advertising Expenses | 0.098*** | 0.086** | 0.071*** | 0.077** | 0.066** |
| | (2.87) | (2.25) | (2.94) | (2.34) | (2.19) |
| Political Connection | 0.472*** | 0.392*** | 0.458*** | 0.442*** | 0.426*** |
| | (10.04) | (8.25) | (10.80) | (9.71) | (9.52) |
| City FE | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes |
| Observations | 3,916 | 3,916 | 3,916 | 3,916 | 3,916 |
| $R^2$ | 0.876 | 0.842 | 0.858 | 0.866 | 0.798 |

## Table 6: Politician's Career

This table reports the results analyzing the likelihood of local politicians' career promotions. The sample period is 2001-2014 for columns 1 and 3 and is 2003-2014 for column 2. The unit of observation is a city-year. The dependent variable is an indicator variable for whether a city official is promoted in the following three years. All models include a set of control variables (*GDP Growth*, *Fixed Asset Investment*, *Service Sector*, *Population*, *Colleges*, and # *of Large Industrial Firms*), a constant, and fixed effects as described in the table, but the coefficients are not tabulated. Variable definitions are in 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) |
| Post × High Carbon | -0.143** | | |
| | (-2.10) | | |
| Post × High SO2 | | -0.170*** | |
| | | (-3.14) | |
| Post × High % Environmental Targets Achieved | | | 0.077* |
| | | | (1.96) |
| High Carbon | -0.086 | | |
| | (-1.23) | | |
| High SO2 | | 0.106** | |
| | | (2.23) | |
| High % Environmental Targets Achieved | | | -0.021 |
| | | | (-1.05) |
| Post | 0.031 | 0.025 | -0.051 |
| | (0.56) | (0.54) | (-1.00) |
| Control Variables | Yes | Yes | Yes |
| City FE | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes |
| Observations | 2,480 | 3,136 | 2,799 |
| $R^2$ | 0.487 | 0.495 | 0.490 |

## Table 7: Firm-Level Incentives

This table reports results of analyzing the firm-level incentives of environmental investment. The sample period for taxes and bank loans is 2001-2014, and for environmental subsidies is 2003-2014. Panel A compares city policies pre and post MCEP. The unit of observation is a city-year. *Taxes* is the sum of tax expenses of all firms divided by the sum of these firms' sales 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 natural logarithm of one plus the sum of bank loans received by all firms in a city-year. Panel B reports the results analyzing the financial consequences for firms engaging in environmental investments. The unit of observation is a firm-year. The dependent variable is a firm's tax expenses scaled by its sales in columns 1-3, environmental subsidies that a firm receives from the government in columns 4-6, and bank loans 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. Variable definitions are in 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 | 0.083 | 0.076 | -0.007*** |
| Subsidies | 0.028 | 0.083 | 0.055*** |
| Bank Loans | 2.955 | 8.153 | 5.198*** |

**Table 7 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 × High EI(Total) | -0.011*** | | | 0.049*** | | | 0.879*** | | |
| | (-9.15) | | | (8.76) | | | (3.59) | | |
| Post × High EI(Non-Firm-Specific) | | -0.011*** | | | 0.046*** | | | 0.799*** | |
| | | (-8.14) | | | (7.20) | | | (3.05) | |
| Post × High EI(Firm-Specific) | | | -0.013*** | | | 0.044*** | | | 0.640** |
| | | | (-9.35) | | | (5.55) | | | (2.13) |
| High EI(Total) | 0.004*** | | | -0.012*** | | | -0.642*** | | |
| | (4.24) | | | (-3.15) | | | (-3.49) | | |
| High EI(Non-Firm-Specific) | | 0.004*** | | | -0.015*** | | | -0.662*** | |
| | | (3.94) | | | (-3.47) | | | (-3.26) | |
| High EI(Firm-Specific) | | | 0.007*** | | | -0.008 | | | -0.620*** |
| | | | (5.88) | | | (-1.36) | | | (-2.80) |
| Post | 0.009*** | 0.008*** | 0.008*** | -0.016*** | -0.011* | -0.007 | -0.847*** | -0.738*** | -0.652** |
| | (6.43) | (5.72) | (5.65) | (-2.81) | (-1.78) | (-1.31) | (-2.97) | (-2.62) | (-2.32) |
| 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 | 21,862 | 21,862 | 21,862 | 20,525 | 20,525 | 20,525 | 21,872 | 21,872 | 21,872 |
| $R^2$ | 0.669 | 0.668 | 0.668 | 0.381 | 0.380 | 0.380 | 0.433 | 0.433 | 0.433 |

## Table 8: Does the City Benefit?

### Panel A: Environmental and Social Impact

This table reports the results analyzing the city's environmental consequences from corporate environmental investments. The sample period is 2001-2014 for columns 1-3 and 7-9, and is 2003-2014 for columns 4-6. The unit of observation is a city-year. The dependent variable is a city's carbon emission in columns 1-3, SO2 emission in columns 4-6, and excess hospital need in columns 7-9. *Excess Hospital Need* is the number of hospitals (in 10,000) in a city-year minus the average number of hospitals in the previous three years. All models include a set of control variables (*GDP Growth*, *Fixed Asset Investment*, *Service Sector*, *Population*, *Colleges*, and *# of Large Industrial Firms*), a constant, and fixed effects as described in the table, but the coefficients are not tabulated. Variable definitions are in 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: | Carbon | | | SO2 | | | Excess Hospital Need | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Post × High EI(Total) | -0.044 | | | -0.141** | | | -0.001 | | |
| | (-1.13) | | | (-2.29) | | | (-0.98) | | |
| Post × High EI(Non-Firm-Specific) | | -0.079** | | | -0.128** | | | -0.001* | |
| | | (-1.99) | | | (-2.15) | | | (-1.70) | |
| Post × High EI(Firm-Specific) | | | -0.042 | | | -0.159*** | | | -0.001** |
| | | | (-1.05) | | | (-2.95) | | | (-2.04) |
| High EI(Total) | 0.004 | | | 0.026 | | | -0.000 | | |
| | (0.17) | | | (0.72) | | | (-0.46) | | |
| High EI(Non-Firm-Specific) | | 0.025 | | | 0.046 | | | -0.000 | |
| | | (0.92) | | | (1.17) | | | (-0.19) | |
| High EI(Firm-Specific) | | | 0.017 | | | 0.106*** | | | -0.000 |
| | | | (0.69) | | | (2.72) | | | (-0.73) |
| Post | -0.021 | -0.006 | -0.024 | 0.022 | 0.015 | 0.025 | -0.001 | -0.001 | -0.001 |
| | (-0.73) | (-0.20) | (-0.82) | (0.48) | (0.33) | (0.61) | (-1.55) | (-1.13) | (-1.02) |
| Control Variables | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| City FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 2,622 | 2,622 | 2,622 | 3,332 | 3,332 | 3,332 | 2,953 | 2,953 | 2,953 |
| $R^2$ | 0.950 | 0.950 | 0.950 | 0.811 | 0.811 | 0.811 | 0.114 | 0.116 | 0.117 |

## Table 8 continued.

### Panel B: Firm Entry and Labor Market

This table reports the results of analyzing the city's economic consequences from corporate environmental investments. The sample period is 2004-2014 for columns 1-3 and 2001-2014 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*, *Population*, *Colleges*, and *# of Large Industrial Firms*), a constant, and fixed effects as described in the table, but the coefficients are not tabulated. Variable definitions are in 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 × High EI(Total) | 0.121 | | | 0.015 | | |
| | (1.64) | | | (0.41) | | |
| Post × High EI(Non-Firm-Specific) | | 0.181** | | | -0.064* | |
| | | (2.43) | | | (-1.76) | |
| Post × High EI(Firm-Specific) | | | 0.044 | | | -0.023 |
| | | | (0.56) | | | (-0.67) |
| High EI(Total) | -0.018 | | | -0.009 | | |
| | (-0.33) | | | (-0.23) | | |
| High EI(Non-Firm-Specific) | | -0.052 | | | 0.008 | |
| | | (-1.05) | | | (0.23) | |
| High EI(Firm-Specific) | | | 0.030 | | | 0.038 |
| | | | (0.54) | | | (1.15) |
| Post | 0.015 | -0.010 | 0.055 | -0.043 | -0.004 | -0.025 |
| | (0.21) | (-0.14) | (0.76) | (-1.18) | (-0.10) | (-0.71) |
| Control Variables | Yes | Yes | Yes | Yes | Yes | Yes |
| City FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,882 | 1,882 | 1,882 | 3,214 | 3,214 | 3,214 |
| $R^2$ | 0.110 | 0.112 | 0.109 | 0.084 | 0.084 | 0.084 |

## Table 8 continued.

### Panel C: Heavily Polluting Firms

This table reports the results analyzing polluting firms. The sample period is 2004-2014 for columns 1-6 and is 2001-2014 for columns 7-9. 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 firms in a city; and is non-polluting M&A targets acquired by heavily polluting firms in a city-year (columns 7-9). All models include a set of control variables (*GDP Growth*, *Fixed Asset Investment*, *Service Sector*, *Population*, *Colleges*, and # *of Large Industrial Firms*), a constant, and fixed effects as described in the table, but the coefficients are not tabulated. Variable definitions are in 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 × High EI(Total) | -0.012 | | | -0.029** | | | 0.113** | | |
| | (-1.55) | | | (-2.12) | | | (2.06) | | |
| Post × High EI(Non-Firm-Specific) | | -0.022*** | | | -0.024* | | | 0.171*** | |
| | | (-2.94) | | | (-1.82) | | | (3.62) | |
| Post × High EI(Firm-Specific) | | | -0.010 | | | -0.025* | | | 0.140*** |
| | | | (-1.31) | | | (-1.91) | | | (2.80) |
| High EI(Total) | 0.006 | | | 0.031*** | | | -0.050* | | |
| | (1.03) | | | (3.13) | | | (-1.94) | | |
| High EI(Non-Firm-Specific) | | 0.006 | | | 0.023** | | | -0.059** | |
| | | (1.05) | | | (2.45) | | | (-2.49) | |
| High EI(Firm-Specific) | | | 0.012** | | | 0.025** | | | -0.028 |
| | | | (2.02) | | | (2.43) | | | (-0.92) |
| Post | -0.005 | -0.001 | -0.006 | -0.001 | -0.002 | -0.001 | -0.034 | -0.072 | -0.055 |
| | (-0.77) | (-0.09) | (-0.99) | (-0.06) | (-0.16) | (-0.13) | (-0.74) | (-1.56) | (-1.22) |
| Control Variables | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| City FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 2,936 | 2,936 | 2,936 | 2,936 | 2,936 | 2,936 | 1,869 | 1,869 | 1,869 |
| $R^2$ | 0.913 | 0.913 | 0.913 | 0.662 | 0.661 | 0.661 | 0.428 | 0.431 | 0.430 |

## Table 8 continued.

### Panel D: Firms in Green and Non-Green Sectors

This table reports the results analyzing the city's economic consequences from corporate environmental investments. The sample period is 2004-2014. The unit of observation is a city-year. The dependent variable is *# of Firms in Green Sectors* (calculated as the natural logarithm of the number of firms operating in green sectors in a city-year) in column 1, *Growth of Firms in Green Sectors* (calculated as the change in the proportion of firms operating in the green sectors) in column 2, *# of Firms in Non-Green Sectors* (calculated as the natural logarithm of the number of firms operating in non-green sectors in a city-year) in column 3, and *Growth of Firms in Non-Green Sectors* (calculated as the change in the proportion of firms operating in non-green sectors) in column 4. The ATS sample includes both listed and non-listed firms. All models include a set of control variables (*GDP Growth*, *Fixed Asset Investment*, *Service Sector*, *Population*, *Colleges*, and *# of Large Industrial Firms*), 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 level are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

| Dependent Variable: | # of Firms in Green Sectors | Growth of Firms in Green Sectors | # of Firms in Non-Green Sectors | Growth of Firms in Non-Green Sectors |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Post | 0.094*** | 0.110*** | -0.055*** | -0.000* |
| | (2.68) | (3.26) | (-3.15) | (-1.86) |
| Control Variables | Yes | Yes | Yes | Yes |
| City FE | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |
| Observations | 2,949 | 2,646 | 2,949 | 2,646 |
| $R^2$ | 0.719 | 0.098 | 0.982 | 0.069 |

## Table 9: Does the Firm Benefit?

### Panel A: Does Green Investment Generate Green Benefits?

The sample period is 2001-2014. The unit of observation is a firm-year. The dependent variable is the fraction of a firm's revenue generated from green businesses 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. Columns 1-3 use a sample of firms in non-green sectors. Columns 4-9 use the full sample. All models include a set of control variables (*Size*, *Leverage*, *ROA*, *Cash*, *Market to Book*, *Age*, *State*, *Board Independence*, *Institutional Holdings*, and *GDP Growth* and tests in columns 1-3 control, additionally, *Taxes*, *Subsidies*, and *Bank Loans*), a constant, and fixed effects as described in the table, but the coefficients are not tabulated. Variable definitions are in Appendix A. *T*-statistics based on robust standard errors clustered at the city and year level are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

| Dependent Variable: | Green Revenue | | | # of Patents | | | % of Green Patents | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Post × High EI(Total) | 0.002** | | | 0.167*** | | | 0.091*** | | |
| | (2.46) | | | (7.34) | | | (3.77) | | |
| Post × High EI(Non-Firm-Specific) | | 0.003** | | | 0.158*** | | | 0.074*** | |
| | | (2.24) | | | (6.45) | | | (2.72) | |
| Post × High EI(Firm-Specific) | | | 0.001 | | | 0.173*** | | | 0.077** |
| | | | (0.61) | | | (5.77) | | | (2.33) |
| High EI(Total) | 0.003*** | | | -0.081*** | | | -0.024 | | |
| | (3.03) | | | (-4.44) | | | (-1.29) | | |
| High EI(Non-Firm-Specific) | | 0.003*** | | | -0.080*** | | | -0.025 | |
| | | (2.89) | | | (-4.14) | | | (-1.18) | |
| High EI(Firm-Specific) | | | 0.001 | | | -0.054** | | | -0.029 |
| | | | (0.60) | | | (-2.39) | | | (-1.19) |
| Post | 0.001 | 0.001 | 0.002* | -0.159*** | -0.139*** | -0.132*** | -0.018 | -0.004 | -0.000 |
| | (1.02) | (1.32) | (1.65) | (-6.70) | (-6.05) | (-5.73) | (-0.80) | (-0.18) | (-0.02) |
| 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 | 20,185 | 20,185 | 20,185 | 21,872 | 21,872 | 21,872 | 21,872 | 21,872 | 21,872 |
| $R^2$ | 0.735 | 0.735 | 0.734 | 0.856 | 0.856 | 0.856 | 0.45 | 0.449 | 0.449 |

## Table 9 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. Variable definitions are in Appendix A. *T*-statistics based on robust standard errors clustered at the city and year 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 × High EI(Total) | -0.053*** | | | -0.032** | | | 0.094*** | | |
| | (-2.83) | | | (-2.22) | | | (5.28) | | |
| Post × High EI(Non-Firm-Specific) | | -0.044** | | | -0.035** | | | 0.090*** | |
| | | (-2.01) | | | (-2.07) | | | (4.55) | |
| Post × High EI(Firm-Specific) | | | -0.062*** | | | -0.026 | | | 0.039* |
| | | | (-2.68) | | | (-1.45) | | | (1.91) |
| High EI(Total) | 0.032** | | | 0.024* | | | -0.026* | | |
| | (1.97) | | | (1.89) | | | (-1.71) | | |
| High EI(Non-Firm-Specific) | | 0.030 | | | 0.026* | | | -0.031* | |
| | | (1.62) | | | (1.75) | | | (-1.85) | |
| High EI(Firm-Specific) | | | 0.024 | | | 0.015 | | | -0.002 |
| | | | (1.33) | | | (1.06) | | | (-0.13) |
| Post | 0.009 | 0.001 | 0.002 | 0.000 | -0.002 | -0.006 | -0.062*** | -0.052*** | -0.036* |
| | (0.42) | (0.05) | (0.09) | (0.03) | (-0.13) | (-0.41) | (-3.09) | (-2.66) | (-1.93) |
| 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 | 20,467 | 20,467 | 20,467 | 18,472 | 18,472 | 18,472 | 21,796 | 21,796 | 21,796 |
| $R^2$ | 0.120 | 0.120 | 0.120 | 0.159 | 0.159 | 0.159 | 0.874 | 0.874 | 0.874 |

## Table 9 continued

### Panel C: 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 and downside risk, measured by the frequency of daily stock returns fall two standard deviations below the mean, in columns 4-6. 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 4-6 controls additionally, *Market to Book*. Variable definitions are in Appendix A. *T*-statistics based on robust standard errors clustered at the city and year level are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

| Dependent Variable: | Tobin's Q | | | Downside Risk | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Post × High EI(Total) | 0.182** | | | -0.001*** | | |
| | (2.15) | | | (-3.42) | | |
| Post × High EI(Non-Firm-Specific) | | 0.190** | | | -0.002*** | |
| | | (2.13) | | | (-3.37) | |
| Post × High EI(Firm-Specific) | | | 0.064 | | | -0.001** |
| | | | (0.68) | | | (-2.27) |
| High EI(Total) | -0.127* | | | 0.001** | | |
| | (-1.81) | | | (2.24) | | |
| High EI(Non-Firm-Specific) | | -0.162** | | | 0.001* | |
| | | (-2.25) | | | (1.70) | |
| High EI(Firm-Specific) | | | -0.084 | | | 0.001** |
| | | | (-1.04) | | | (2.46) |
| Post | -0.118 | -0.103 | -0.064 | 0.001*** | 0.001** | 0.001** |
| | (-1.09) | (-0.98) | (-0.61) | (2.72) | (2.54) | (2.23) |
| 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 | 20,326 | 20,326 | 20,326 | 21,872 | 21,872 | 21,872 |
| $R^2$ | 0.473 | 0.473 | 0.473 | 0.259 | 0.259 | 0.258 |

**Internet Appendix for**

**"Levelling Up Your Green Mojo: The Benefits of Beneficent Investment**

This online appendix contains the following:

IA.1: An Example of the Appendix of On-going Projects

IA.2: A List of Words/Phrases to Identify Environmental Projects in Annual Reports

IA.3: A List of Words/Phrases to Identify Environment-related News Articles

## Appendix IA.1: An Example of the Appendix of On-going Projects

This appendix provides a snapshot of the Appendix of On-going Projects in Konka Group's 2019 annual report. Konka Group Co., Ltd. is a Chinese manufacturer of electronics products founded in 1980 and headquartered in Shenzhen, Guangdong Province. The firm has been listed on the Shenzhen Stock Exchange since 1992.

### Panel A: The Appendix of On-going Projects in Konka's 2019 Annual Report (in Chinese)

| 项目 | 年末余额 | | | 年初余额 | | |
|---|---|---|---|---|---|---|
| | 账面余额 | 减值准备 | 账面价值 | 账面余额 | 减值准备 | 账面价值 |
| 东港市城市内河流域综合整治工程项目 | 715,838,346.63 | | 715,838,346.63 | 451,789,427.70 | | 451,789,427.70 |
| 阜南县全域污水治理工程项目 | 592,295,248.19 | | 592,295,248.19 | | | |
| 甘肃省肃北蒙古族自治县马鬃山镇供水工程项目 | 571,112,712.15 | | 571,112,712.15 | 552,055,516.50 | | 552,055,516.50 |
| 鲁山县沙河生态修复与提升（一期）工程项目 | 511,792,398.90 | | 511,792,398.90 | | | |
| 黄陂乡镇污水处理一体化项目 | 385,214,225.65 | | 385,214,225.65 | | | |
| 江西纳米微晶二线 | 336,485,492.44 | | 336,485,492.44 | 303,533,244.21 | | 303,533,244.21 |
| 潍坊滨海经济技术开发区中央城区综合提升项目 | 329,745,585.38 | | 329,745,585.38 | 261,826,586.30 | | 261,826,586.30 |
| 安康绿色智能工厂 | 143,320,357.80 | | 143,320,357.80 | | | |
| 铜川项目 | 99,720,949.28 | | 99,720,949.28 | | | |
| 莱州第二污水厂 | 90,971,785.34 | | 90,971,785.34 | | | |
| 宜宾康佳高科技产业园 | 86,183,539.65 | | 86,183,539.65 | | | |
| 大邑项目 | 79,258,722.98 | | 79,258,722.98 | 400,000.00 | | 400,000.00 |
| 光明项目 | 39,753,607.36 | | 39,753,607.36 | 153,577,240.57 | | 153,577,240.57 |
| 新风微晶玉石二线 | 6,033,682.90 | | 6,033,682.90 | 365,069,872.84 | | 365,069,872.84 |
| 其他工程 | 303,817,713.87 | | 303,817,713.87 | 88,619,642.68 | | 88,619,642.68 |
| 合计 | 4,291,544,368.52 | | 4,291,544,368.52 | 2,176,871,530.80 | | 2,176,871,530.80 |

## Appendix IA.1 continued.

**Panel B: The Appendix of On-going Projects in Konka's 2019 Annual Report (in English Translation)**

| Project Name | End-of-Year Balance | | | Beginning-of-Year Balance | | |
|---|---|---|---|---|---|---|
| | Book Balance | Impairment Provision | Book Value | Book Balance | Impairment Provision | Book Value |
| Donggang City Urban Inland River Basin Comprehensive Cleanup Project | 715,838,346.63 | | 715,838,346.63 | 451,789,427.70 | | 451,789,427.70 |
| Funan County Comprehensive Sewage Treatment Project | 592,295,248.19 | | 592,295,248.19 | | | |
| Mazongshan Town Subei Mongolian Autonomous County Gansu Province Water Supply Project | 571,112,712.15 | | 571,112,712.15 | 552,055,516.50 | | 552,055,516.50 |
| Lushan County Shahe Ecological Restoration and Enhancement (Phase I) Project | 511,792,398.90 | | 511,792,398.90 | | | |
| Huangpi Township Sewage Treatment Integration Project | 385,214,225.65 | | 385,214,225.65 | | | |
| Jiangxi Province Second Phase Nanocrystalline Production Line | 336,485,492.44 | | 336,485,492.44 | 303,533,244.21 | | 303,533,244.21 |
| Weifang Binhai Economic and Technological Development Zone Central Urban Area Comprehensive Enhancement Project | 329,745,585.38 | | 329,745,585.38 | 261,826,586.30 | | 261,826,586.30 |
| Ankang City Green Intelligent Factory | 143,320,357.80 | | 143,320,357.80 | | | |
| Tongchuan City Project | 99,720,949.28 | | 99,720,949.28 | | | |
| Laizhou City Second Sewage Treatment Plant | 90,971,785.34 | | 90,971,785.34 | | | |

| | | | | |
|---|---|---|---|---|
| Yibin City Konka High-Tech Industrial Park | 86,183,539.65 | 86,183,539.65 | | |
| Dayi County Project | 79,258,722.98 | 79,258,722.98 | 400,000.00 | 400,000.00 |
| Guangming District (Shenzhen City) Project | 39,753,607.36 | 39,753,607.36 | 153,577,240.57 | 153,577,240.57 |
| Xin Feng Micron Crystal Jade Stone Second Production Line | 6,033,682.90 | 6,033,682.90 | 365,069,872.84 | 365,069,872.84 |
| Other Projects | 303,817,713.87 | 303,817,713.87 | 88,619,642.68 | 88,619,642.68 |
| Total | 4,291,544,368.52 | 4,291,544,368.52 | 2,176,871,530.80 | 2,176,871,530.80 |

## Appendix IA.2: 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.2 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.3: 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.3 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 | |

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