

Leveling Up Your Green Mojo: The Benefits of Beneficent Investment

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Keywords: Project investment; Environmental regulation; Sustainable finance; Environmental

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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, unlike conventional corporate investments, environmental projects often exhibit the characteristics of public goods: while firms bear the costs, the resulting benefits are broadly shared across society and other economic actors, thereby amplifying the free-rider problem (Flammer, Giroux, and Heal 2025). Conceptually, it is difficult for the traditional corporate governance paradigm based on shareholder value maximization to explain shareholders' E&S engagement (e.g., Hart and Zingales 2022). While researchers have emphasized the role of regulation in curbing emissions, less is known about how environmental regulations shape the investment behavior of profit-driven firms or about the long-term viability of the private provision of such public goods.

In this paper, we study within-firm investment responses to environmental regulation. Our goal is to understand to what extent regulatory mechanisms are effective in crowding in environmental investment from the corporate sector, and under what conditions the regulation-induced environmental investment can potentially align firm value with societal benefits (Starks 2023).

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 assess the externalities of an environmental initiative, distinguishing between projects primarily serving a

firm's shareholders with relatively limited direct societal impact, and "beneficent" ones that generate substantial spillover effects for the local community. The latter of which accentuates the potential free-rider problem to a greater extent.

To estimate the impact of regulations on corporate 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 11th 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 pilot cities to strengthen local environmental 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 document evidence supporting the regulatory role in mitigating the free-rider problem in sustainable investment. After a city attains MCEP status and is subjected to more stringent environmental regulations, local firms increase their investments in environmental projects. The effect is mainly driven by beneficent investments – projects that not only benefit the firm but also directly contribute positive externalities to stakeholders and the local community, making them more susceptible to severe free-rider problems. By contrast, investments in projects that primarily

serve the firms themselves do not respond to intensified environmental regulation. This is perhaps not surprising, as profit-maximizing firms may not rely on regulations to incentivize their investments 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. We saturate the empirical models with industry $\times$ year and province $\times$ year fixed effects 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 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 investments in beneficent projects prior to the MCEP assignment. A dynamic difference-in-differences analysis confirms that this identifying assumption is satisfied.

Next, we show that incentive mechanisms accompanied by the MCEP designation facilitate firms' engagement in environmental protection. We first collect and conduct textual analysis on news articles published by 485 major newspapers. Our findings reveal a significant surge in news coverage intensity on local environmental issues—particularly from state-affiliated outlets—following the city's MCEP assignment. This suggests that the regulatory event mobilizes public

scrutiny, especially by state-owned media. Second, politicians in targeted cities are more likely to receive promotions if they achieve pollution reduction or meet a higher proportion of pre-set environmental targets. Lastly, targeted cities deploy greater fiscal incentives for local firms. For each additional *yuan* (roughly 0.138 US dollars) of beneficent investment, local firms receive 1.41 *yuan* in tax cuts and/or 0.059 *yuan* in green subsidies (equivalent to 0.19 and 0.008 US dollars, respectively).¹ To this end, subsidies serve as a more cost-effective tool than tax incentives for attracting private capital to environmental projects with significant externalities.

In the last step of our analysis, we evaluate the real impacts of environmental regulations. Following an MCEP designation, local firms that allocate more resources to beneficent projects experience a 42.86 percentage-point increase in green revenue, a 32.74 percentage-point rise in the share of green patents, and a 14.64 percentage-point reduction in labor investment inefficiency. These firms also achieve higher labor productivity, larger value gains, and lower regulatory risk, indicating that environmental investments are not merely compliance costs.

MCEP cities that crowd in larger corporate environmental investments cut down on pollution and reduce excess hospital needs. Each additional *yuan* invested in beneficent projects yields a social return of 9.53 *yuan* (approximately 1.32 US dollars) through CO₂ emission reductions (Rennert et al. 2022), exceeding the 7.59 *yuan* (or 1.05 US dollars) social gain generated by environmental investments that primarily benefit firms' shareholders. Given that targeted cities on average incur a fiscal concession of 1.47 *yuan* per *yuan* of beneficent investment—accounting for both marginal tax revenue loss and subsidy costs—the monetized environmental benefits from pollution reduction amount to approximately 6.5 times the government's fiscal expenditure. This

¹ Throughout this paper, the exchange rate for the US dollar to Chinese *yuan* is set at 7.2383.

suggests that the policy delivers significant environmental gains, more than adequately compensating for short-term fiscal costs.

Furthermore, targeted cities that successfully mobilize greater beneficent investments from the private sector experience improved local employment and a larger influx of high-quality new firms. There is also a notable shift in the composition of local firms, marked by the growth of firms in green sectors, alongside the decline of firms in non-green industries. As local corporate spending on environmental projects increases, heavily polluting firms contribute a smaller share of tax revenue to MCEP cities. Instead of remaining within polluting industries, they are more likely to transition into non-polluting sectors, arguably further reinforcing the city's environmental and economic transformation.

Our paper contributes to ongoing debates on the costs and benefits of environmental regulations, particularly their effectiveness in incentivizing firms' engagement in environmental initiatives. On one hand, environmental regulation is costly to firm and detrimental to product variety and business formation, which may lead to aggregate economic loss (e.g., Greenstone 2002, Karpoff, Lott and Wehrly 2005, De Simone, Naaraayanan and Sachdeva 2024). As such, localized climate policies induce regulatory arbitrage by firms, often through greenwashing, increasing total firm emissions and undermining the effectiveness of the policy (e.g., Gibson 2019; Ben-David, Kleimeier and Viehs 2021; Bartram, Hou and Kim 2022; Duchin, Gao and Xu 2025). On the other hand, environmental regulations can curb toxic emissions, improve firm performance, and promote social externalities (e.g., Berman and Bui 2001; Aghion et al. 2016; Najjar and Cherniwchan 2021; Brown, Martinsson and Thomann 2022; Chhaochharia, Sen and Xu 2022; Choi et al. 2022; Ramadorai and Zeni 2024). The design and implementation of environmental regulation are also not without challenges (Duflo et al. 2018; Inderst and Opp 2025).

Rather than relying on corporate ESG disclosures or ESG ratings, we manually assemble a dataset on project investment and provide, to the best of our knowledge, the first study to categorize the scope of externalities—thereby quantifying the extent of the free-rider problem—in environmental projects.² Together with city-level MCEP assignments as a source of variation in local regulatory stringency, we can assess the effectiveness of environmental policy in facilitating corporate sustainable investments and directly estimate the costs and benefits of environmental regulations. Our findings suggest that environmental regulation—particularly when reinforced by both fiscal and non-pecuniary incentives—plays a crucial role in mobilizing investment in projects where profit-driven firms may otherwise lack *ex ante* incentives to pursue, especially those associated with substantial positive externalities. This complements the theoretical insight of Inderst and Opp (2025), who argue that regulatory tools can curb greenwashing and enhance welfare when market incentives are misaligned.

Our paper is also related to the 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

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, concerns regarding substantial discrepancies and ongoing data revisions have prompted caution in using ESG ratings as a measure of firms' ESG performance (e.g., Berg, Fabisik and Sautner 2021 and Berg, Kölbel and Rigobon 2022). By contrast, the disclosure of major project investments by public firms in China is mandatory. This disclosure not only contains granular information 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 and greenwashing concerns.

literature by centering on a regulatory event that allows for better identification and exploration of 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.

The rest of the paper is organized as follows. Section 2 introduces the institutional background. Section 3 describes the data and methodology. Sections 4 and 5 explore the effect of regulations on corporate environmental investments. Sections 6 and 7 assess the real consequences of corporate environmental investments and environmental regulations. Section 8 concludes. Variable definitions are in Appendix A. Internet Appendices IA.1 through IA.8 present an example of the Appendix of Ongoing Project, descriptions of the textual analysis, and additional test results.

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 9th FYP (1996-2000) and 10th FYP (2001-2005). Although governments advocate environmental protection 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 resources 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; for the first time, environmental performance became an integral part of the performance evaluation scheme of local politicians (Chen, Li and Lu 2018).³ 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 to expound 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 firms 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).⁴ Located across 31 provinces and covering 60% of the urban population in mainland China, these

³ Starting in December 2005, local government leaders 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.

⁴ See, for instance, <http://www.chinanews.com.cn/gn/news/2007/11-26/1087489.shtml>.

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. Their environmental performance is also subject to public scrutiny and periodic assessments from the central government. As a result, MCEPs face heightened political and public pressure and have stronger incentives to meet environmental protection goals compared to cities not included on the list.

The selections 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.

Appendix B tabulates the distribution and timing of the MCEPs, collected from the Notice of the State Council on Issuing and Distributing the National Environmental Protection "Eleventh Five-Year Plan". The spatial distribution of MCEPs is presented in Internet Appendix IA.1. It is evident that the distribution of the MCEPs does not cluster in certain specific regions.

Internet Appendix IA.2 confirms that the selection of MCEPs is not significantly influenced by a city's pre-existing environmental conditions. Put differently, the cities with the

highest pollution intensity are not automatically included in the list. More importantly, MCEP selection does not depend on prior local corporate environmental investments.⁵

3. Data Sources and Sample Construction

From the China Stock Market and Accounting Research (CSMAR) database, we compile a sample of 2,740 firms (24,854 firm-year observations) listed on the Shanghai and Shenzhen Stock Exchanges during the 2001–2014 period. For each firm, we obtain its annual report from which we manually extract the Appendix of Ongoing Projects. The Appendix reports new projects which the firm has initiated during the fiscal year, as well as incremental investments made in existing unfinished ones.⁶ Our 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 in 144,042 projects.

3.1 Environmental and Non-Environmental 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 finance literature, this dictionary-based method is suitable when researchers have good prior knowledge about what they are looking

⁵ As detailed in Section 4, our baseline analyses control for firm-, industry $\times$ year-, and province $\times$ year fixed effects to mitigate the impact of firm-specific characteristics, local economic shocks, and industry dynamics on MCEP selections. Our dynamic analysis testing pre-existing trends helps to rule out the possibility of anticipatory responses. We also show that the baseline findings are robust to various matched samples and to sample restrictions by (1) removing China's four centrally administered municipalities—Beijing, Shanghai, Tianjin, Chongqing—and (2) excluding the top-decile of “most polluted” cities and/or the bottom decile of “best performing” cities, based on their average SO₂ and CO₂ emissions from 2004 to 2006. This confirms that our results are not disproportionately influenced by outlier cases or cities with extreme pollution levels or environmental performance.

⁶ As part of the annual report, the Appendix of Ongoing Projects adheres to the same disclosure standards and audit requirements. It generally includes the name and the nature of the projects, the amount invested, and potentially other relevant information such as expected completion dates or milestones. Nevertheless, the level of detail in project descriptions varies. In Internet Appendix IA.3, we provide a snapshot of Konka Group's Appendix of Ongoing Projects as an illustrative example.

for (Fisher, Martineau and Sheng 2022; Sheng, Xu, and Zheng 2023). In this paper, the dictionary-based method is proper because our focus is on environment-related keywords.

In general, extracting environment-related information from text sources can be challenging. Discussions on climate- or environment-related issues employ niche language and often involve substantial ambiguity, and the vocabulary used is fast-moving (Sautner et al. 2023). 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.⁷

We start with a random sample of 30,000 projects. A team of 5 research assistants (RAs) read the project name descriptions and perform internet searches if necessary, extracting environmentally meaningful words and short phrases. This allows us to compile a bag of words consisting of 467 unique environment-related words and phrases (see Internet Appendix IA.4). 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.⁸ Any classification noise, as long as it is not systematic, will work against finding the results.

⁷ 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.

⁸ See related discussions in Bhattacharya et al. (2009).

To address these challenges, we randomize project classification 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 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.⁹

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 key distinction between environmental projects and traditional corporate investments is that the former generates externalities with direct societal impact. To reflect the “public goods” aspect of environmental investment, we assess the degree of externalities produced by a project.

⁹ It is common that individual firms report both geographically identifiable projects and projects without location information within the same fiscal year. Our findings are robust when using firms with complete project location data.

A project may primarily benefit a firm's shareholders without delivering substantial and direct economic or social value to the broader community. Examples include the installation of water-saving systems or solar panel roofing in production plants, investments in energy-efficient thermal insulation bricks for factory exteriors, the launch of an energy-saving fluorescent lamp production line, and the installation of high-efficiency boilers and furnaces. While these initiatives enhance shareholder value by reducing costs or increasing sales, their environmental benefits offer limited direct access to the wider society. 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 considered *beneficent*, bringing in a significant spillover to stakeholders. Examples include investments in sewage treatment stations, anti-corrosion water and floor works, and exhaust gas treatment systems, all of which not only benefit firms but also provide direct environmental advantages to surrounding 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* or *smaller 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.

Internet Appendix IA.5 presents the industry distributions of firm-specific and non-firm-specific environmental projects, detailing the number of firms within each industry that undertake these initiatives and those that invest in both types of projects. While environmental projects span a range of industries, manufacturing, energy, and materials sectors attract disproportionately more environmental investments in 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.¹⁰ 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 ($EI(Firm-Specific)$).

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 results interpretation, we report both unscaled and scaled forms of our variables for environmental investments. On average, a firm

¹⁰ In subsection 4.2.2, we show that our baseline findings remain robust when normalizing a firm's environmental investment by its capital expenditure, total assets, or operating cash flows.

spends 29.627 million *yuan* per year (1.028% of revenue) on environmental projects, representing 7.619% of capital expenditure (Capex) and 17.028% of ongoing project investments (untabulated). Firms spend an average of 14.871 million *yuan* (0.542% of revenue) on beneficent projects, accounting for 4.201% of Capex and 7.876% of ongoing project investments. They allocate 9.73 million *yuan* (0.347% of revenue) to projects directly boosting shareholder value, representing 3.053% of Capex and 5.795% of ongoing project investments.¹¹

An average sample firm has assets of 6.238 billion *yuan* 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 *yuan*, necessitates an investment of 52.4 million *yuan* per year, and lasts for 1.66 years. Not surprisingly, non-firm-specific projects tend to be bigger (82.17 million *yuan*) compared to firm-specific ones (76.02 million *yuan*), 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 untabulated comparisons, an average firm spends 19.08 million *yuan* on environmental projects before the MCEP designation. Post MCEP, this spending increases to 37.317 million *yuan*. Among firms that have made environmental investments at least once during the sample period, an average firm spends 123.761 million *yuan* post-MCEP, more than double the 58.561 million *yuan* spent on environmental projects prior to MCEP.

¹¹ Among firms with at least one environmental investment during the sample period, environmental spending comprises 3.297% of revenue, 23.87% of Capex, and 48.69% of ongoing projects annually. For these firms, beneficent projects account for 1.74% of revenue, 13.159% of Capex, and 22.52% of ongoing projects, while firm-specific projects represent 1.11% of revenue, 9.56% of Capex, and 16.57% of ongoing projects.

4. MCEP Assignment and Corporate Environmental Investment

4.1 Corporate Reactions to Environmental Regulations

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:

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

where $y_{i,t}$ is a measure of environmental project investment by firm i 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 $X_{i,c,t}$ 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). $X_{i,c,t}$ 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 (α_i), year fixed effects (τ_t), and in some specifications, industry $\times$ year fixed effects ($\theta_{b,t}$) and province $\times$ year fixed effects ($\delta_{p,t}$). The inclusion of industry $\times$ 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 $\times$

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 firms alter their environmental investment policies when facing intensified local environmental regulations. Columns 1-4 suggest that following the MCEP assignment, firms in a treated city allocate more capital to environmental projects. Specifically, an average local firm raises its total environmental spending by 16.971 million *yuan* post-MCEP, marking a 29.77% ($= 0.306/1.028$) increase from its mean (column 4).

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 suggests that the increase in beneficent investments corresponds to 31.55% ($= 0.171/0.542$) of the mean. Based on the 5,546.03 million *yuan* post-MCEP average revenue, a local firm spends 9.484 ($= 0.171/100 \times 5,546.03$) million *yuan* more on these beneficent ones following heightened environmental regulations. On the other hand, a change in environmental regulation does not significantly alter the firm’s investments in firm-specific projects (columns 9-12). Column 12 indicates that the increase in firm-specific investments accounts for 19% ($= 0.066/0.347$) of its mean and is not statistically significant. 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.

Overall, Table 2 Panel A provides evidence that local firms react to a rising intensity of environmental regulations by increasing their environmental investments. The effect is driven mainly by their investment in projects with greater societal impacts. In fact, non-firm-specific

investments exhibit the strongest percentage response to the MCEP assignment. These findings imply that environmental regulation is desirable for promoting projects where profit-driven firms may ex ante lack incentive to invest, particularly those exposed to significant free-rider problems.

Figure 1 illustrates the above observed policy effect by plotting the lead and lag coefficients estimated through a dynamic difference-in-differences analysis, over a period of seven years prior to and three years following the treatment. It is evident that total and non-firm-specific environmental investments display a significant rise and remain elevated only after the MCEP assignment, whereas firm-specific investment exhibits no post-treatment shift.

Due to their beneficial nature, non-firm-specific projects generally require larger capital investment and longer completion timeframes. Corroborating with the above evidence, Panel B of Table 2 reveals that local firms modify their investment strategies following their city's MCEP assignment, allocating more funds to long-term projects, particularly those with substantial societal benefits. A project is classified as long-term if its duration is at least three years. In contrast, firms exhibit no significant change in their allocation of resources to shorter-term environmental projects or those primarily benefiting the firms themselves. These findings provide preliminary evidence that environmental regulations can foster sustainable 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 tilted toward them by 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 firms' reactions to environmental regulations across green and non-green sectors, we augment the regression model in Table 2 Panel A 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). Due to the limited number of firms in green sectors during the sample period, we conduct this set of tests using a propensity score matched sample to mitigate potential biases arising from differences in sample sizes. Results are similar if we estimate these tests using the full sample.

Table 3 shows that, following heightened environmental regulations, firms in non-green sectors increase their environmental investments to a greater extent than their matched counterparts in green sectors (column 1) and allocate significantly more funds to non-firm-specific projects (column 2). In contrast, both sectors exhibit a comparable rise in firm-specific project investments (column 3). These findings suggest that the regulatory effect likely stems from the increased participation of firms in non-green sectors, prompting them to boost their environmental investments and expand into green industries.

Compared to private firms, whose objective is to maximize profit and market value for shareholders, state-owned enterprises (SOEs) often shoulder social welfare obligations and thus are more responsive to environmental issues (Hsu, Liang, and Matos 2023). For this reason, we directly control state ownership in all regressions.¹² In Table 3, we explicitly compare the

¹² 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.

investment dynamics between SOE and non-SOE sectors, augmenting the regression model in Table 2 Panel A by interacting the post-MCEP dummy with an indicator variable for a non-SOE.

Column 4 indicates that, while both sectors in treated cities increase total environmental spending, non-SOEs ramp up environmental investment to a larger extent. Column 5 suggests that both SOE and non-SOE sectors boost their investments in non-firm-specific projects post-MCEP.¹³ In terms of firm-specific environmental projects, non-SOEs increase their investment to a larger extent than SOEs (column 6).

4.2 Robustness

In Internet Appendix IA.6, we describe various robustness tests and report the test results in Table IA.3. Below we summarize these findings.

4.2.1 Matched Samples

In our main analysis, we control for firm and year fixed effects, as well as industry $\times$ year and province $\times$ year fixed effects. This allows us to mitigate the potential confounding effects driven by unobserved firm-specific, industry-specific, and region-specific dynamics. To further account for observable differences between firms in MCEP and non-MCEP cities, we form matched samples using propensity score matching (PSM), coarsened exact matching (CEM), and entropy-balanced matching, and re-estimate our baseline models in Panel A of Table 2.

The results in Panel A of Table IA.3 confirm that the effect of MCEP assignment on corporate environmental investment remains robust across matched samples.

4.2.2 Alternative Scalars

In our main analysis, we normalize environmental investment by revenue to assess the extent of a firm's overall income allocated to projects with environmental externalities.

¹³ The F -statistics testing the sum of the coefficient estimates of $Post \times Non-State$ and $Post$ are 6.73, significant at the 1% level.

Alternatively, we measure the share of capital investment and cash flows directed toward environmental projects by dividing a firm's environmental investment by its capital expenditure and operating cash flows, respectively. Since project investments ultimately materialize into assets, we also consider normalizing environmental investment by total assets.

Panel B of Table IA.3 reveals 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 includes not only firms without environmental investment but also firms that eventually initiated or have already carried out such investments. To mitigate the concern that firm-specific shocks correlated with the timing of the MCEP may drive our findings, we exclude firms without environmental investment throughout the sample period. As such, 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.

We then explore the impact of MCEP on the likelihood of firms engaging in environmental investments. Panel C of Table IA.3 presents results consistent with our baseline findings. Firms in MCEP cities are more likely to initiate investments in environmental projects, with a greater tendency to select projects that generate broader societal benefits. In contrast, their investment policies regarding environmental projects that primarily benefit shareholders remain unchanged.

4.2.4 Project Locations and the Timing of MCEP Assignment

We identify a firm's exposure to changes in local environmental regulations based on the location of its headquarters. A firm may register its business in one city but choose to operate in

another. In such cases, the firm may be misclassified into the treatment group when the city where it is registered becomes an MCEP, while the city where it conducts most of its business does not face intensified environmental regulations. Panel D of Table IA.3 reveals that our results remain robust when we exclude firm-year observations where business locations differ from registration locations, or when we exclude firm-year observations in the year an MCEP is established.

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 firm's headquarters city. As described earlier, many firms do not always disclose the 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 project investments to the firm-year level when conducting the baseline analysis.

In Panel E of Table IA.3, we further address this concern with two 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. Second, since we can identify locations for 17.82% of the projects, we re-estimate our baseline regressions using the subset of projects with available location data. Our findings are robust.

Overall, Panels A through E of Table IA.3 indicate that our findings are not sensitive to sample restrictions nor to the assignment of all projects to a firm's headquarters city. Although no single approach may be without limitations, the consistency of inferences across multiple methodologies lends confidence in our baseline findings.

4.2.5 Falsification Tests

Firms may adjust environmental strategies influenced by events like the 2009 Copenhagen Accord, which preceded MCEP designations and raised global awareness of climate challenges.

Our findings thus may capture firms' reactions to the 2009 Copenhagen Accord instead of the staggered MCEP assignments. In Panel F of Table IA.3, we redefine the post dummy to capture investments from 2009 onward. The results in columns 1-3 indicate that the 2009 Copenhagen Accord is unlikely to be the primary driver for the change in corporate environmental investment.

It is also possible that macroeconomic factors or confounding events drive changes in firm investment strategies, irrespective of their relation to environmental protection. To rule out this possibility, we regress the post-MCEP dummy on firms' non-environmental investments. Results from column 4 of Table IA.3 Panel F indicate no significant effect on traditional types of investment, confirming that the impact of MCEP is specific to environmental projects.¹⁴

Lastly, to further mitigate the concern that omitted variables, rather than the MCEP regulatory event itself, explain our findings, 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 MCEP assignment dates. We then re-estimate the baseline regressions with these placebo dates. The results in Panel G of Table IA.3 confirm that the timing of MCEP assignments supports the regulatory effect on corporate environmental investments.

4.2.6 TWFE and Stacked Estimators

While the two-way fixed effects (TWFE) regressions are the most commonly used approach in economics to estimate the effects of policies, 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 (e.g., Baker, Larcker and Wang 2022; de Cahisemartin

¹⁴ 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.

and D’Haultfoeuille 2022). Following Baker, Larcker and Wang (2022), we re-estimate our baseline tests using the standard TWFE and stacked regression without time-varying covariates.¹⁵ In the stacked-cohort estimation, we compare each treated cohort to cities that have not yet been treated during the relevant pre-period, stacking the data by cohort. This would ensure a valid “not-yet-treated” reference group for each cohort’s event window and help isolate within-cohort changes while controlling for cross-time and cross-cohort differences. Panel H of Table IA.3 in Internet Appendix IA.6 shows that our findings are robust.

4.2.7 *Pre-existing Trend*

Figure 1 plots the coefficients estimated from a dynamic difference-in-differences analysis over the years $t - 7$ through $t + 3$, where t denotes the year in which the firm’s headquarters city attains MCEP status. The results indicate that local corporate environmental investments did not display different trends prior to the regulatory event.

To further validate this finding, we conduct a dynamic analysis using the Borusyak, Jaravel, and Spiess (2024) estimators, which apply cohort-specific reweighting to ensure that later-treated units do not serve as controls for earlier cohorts. Panel I of Table IA.3 confirms the robustness of our parallel trends assumption when employing these more efficient estimators for staggered treatments (de Chaisemartin and D’Haultfoeuille 2023).

4.2.8 *Zero-Valued Outcomes: Poisson Regression*

To account for the non-trivial share of zero-investment observations and potential heteroskedasticity, we re-estimate our baseline model using Poisson pseudo-maximum likelihood (PPML) with the same controls, firm and year fixed effects. Panel J of Table IA.3 in Internet

¹⁵ This approach helps “understand the robustness of the effect estimates and the degree to which they rely on the inclusion of controls.” See Baker, Larcker and Wang (2022), page 394 and footnote 3.

Appendix IA.6 shows that PPML estimates closely mirror our OLS-based percentage gains, confirming that our main findings are not driven by excess zeros or variance-related biases.

5. Mechanisms

The results so far suggest that firms allocate more resources to environmental projects in response to increasingly stringent local environmental regulations. To gain insights into how these regulatory changes shape corporate environmental investments, particularly beneficent initiatives, 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.

For each city-year, we count the number of news articles mentioning the name of the city in association with environmental issues.¹⁶ We then 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 Zhang 2018), we distinguish between state-affiliated and market-oriented news outlets, as well as between national and regional

¹⁶ 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.7 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.4) 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.

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 4 show a rise in media coverage intensity across all types of news outlets for a city's environmental issues after it attains MCEP status, which arguably generates greater public scrutiny and applies increased pressure on local politicians and firms.¹⁷ There is a heterogeneity in the economic magnitude of coverage intensity. Following MCEP establishment, state-affiliated media (column 2) show a significantly greater increase in coverage compared to market-based media (column 3), suggesting that the regulatory event mobilized scrutiny by state-owned media more than by market-based outlets. Additionally, local news media (column 5)

¹⁷ 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, $Post \times EI(Total)$, $Post \times EI(Firm-Specific)$, and $Post \times EI(Non-Firm-Specific)$. 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.

exhibit a significantly larger rise in coverage intensity than national media (column 4). This lends further support to the treatment event occurring at the city level.¹⁸

5.2 *Politician's Career*

Existing literature has documented ample evidence that the actions of Chinese local leaders, who supervise the design and implementation of various policies and deploy resources across local firms, are guided by career concerns (e.g., Li and Zhou 2005). In the context of our analysis, when MCEP politicians face heightened political pressure and public scrutiny to meet environmental protection goals, with their performance closely monitored by the central government, they are more effectively incentivized to improve local environment.

We manually collect biographies of city party chiefs from Local Official Directories.¹⁹ 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 5 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 SO₂)* is a dummy variable set to one if a city-year's carbon (sulfur dioxide) emission level falls above the sample tercile and zero otherwise.²⁰

Columns 1-3 of Table 5 reveal 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 MCEP politicians whose city has achieved a lower level of

¹⁸ The χ^2 statistic testing the difference in coefficients for *Post* between columns 2 and 3 is 19.05 ($p = 0.000$), and between columns 4 and 5 is 40.26 ($p = 0.000$).

¹⁹ See (in Chinese), <https://ldzl.people.com.cn/dfzlk/front/firstPage.htm>.

²⁰ 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. 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.

SO₂ emissions have a 51.99% ($= -0.170/0.327$) higher propensity of being promoted in the following three years.²¹

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.²² 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 5 shows a positive coefficient associated with the interaction between the post MCEP dummy and *High % of Environmental Targets Achieved*. This suggests that

²¹ 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.

²² 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%.

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 4 and 5 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 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 and tax credits.²³ 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. To facilitate the interpretation of the results and the quantification of regulatory costs, we 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 6 show that post-MCEP, taxes decrease for these firms that allocate greater resources to environmental projects. Column 1 indicates that 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 2 suggests that post-MCEP, firms with higher non-firm-specific environmental investments experience a 1.1% reduction in taxes (scaled by revenue), compared to firms with

²³ In Internet Appendix IA.8, we validate that establishing MCEP leads to a change in city policy. Table IA.4 in this appendix shows that after becoming an MCEP, a city gives out more environmental subsidies to local firms, reduces corporate taxes, and increases bank loans.

lower investment in such projects. This reduction translates into a tax saving of 61.02 ($= 1.1\% \times 5,546.9$) million *yuan* per firm, with post-MCEP firm revenue averaging approximately 5,546.9 million *yuan*. The pre-MCEP difference in non-firm-specific environmental investment between high- and low-investing firms amounts to 43.21 million *yuan*. This implies that, to incentivize each additional *yuan* invested in such projects, the government incurs a marginal tax concession cost of 1.41 *yuan* ($= 61.02/43.21$).

Columns 4–6 of Table 6 examine the impact of environmental investments on securing government subsidies. Using the CSMAR database, we obtain annual environmental subsidy data for firms, scaled by revenue. As CSMAR’s coverage of subsidies begins in 2003, the sample period for this analysis 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. For instance, column 4 indicates 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 2.72 ($= 0.049\% \times 5,546.9$) million *yuan* per firm.

Column 5 of Table 6 suggests that, post-MCEP, firms in the high non-firm-specific environmental investment group, on average, received 0.046% more green subsidies (scaled by revenue) from the government than firms in the low investment group. This translates into a green subsidy of 2.55 ($= 0.046\% \times 5,546.9$) million *yuan* per firm. Put differently, incentivizing each additional *yuan* invested in projects with greater societal benefits would require a marginal green subsidy of 0.059 *yuan* ($= 2.55/43.21$).

Overall, it appears that firms harvest (short-term) benefits from their environmental investments through lower taxes and garner more environmental subsidies. There is evidence that

subsidies are relatively more cost-effective than tax cuts (0.059 *yuan* versus 1.41 *yuan* per *yuan* invested) in mobilizing non-firm-specific environmental investment.

Interestingly, firms pay less taxes and obtain more environmental subsidies when investing in environmental projects, regardless of the externalities produced. As MCEP establishment directs a firm's investments towards projects with broader societal benefits rather than those generating mostly firm-specific gains (Table 2 Panel A), these financial incentives likely ease firms' financial constraints, allowing them to shift their focus on initiatives with larger positive externalities.

6. Does the Firm Benefit?

The results in Table 6 suggest that, by spending on environmental projects, firms can lower their tax bills and secure more green subsidies. 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) help dispel this concern, we now 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:

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

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 $X_{i,c,t}$ 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 (α_i) and year fixed effects (τ_t). Standard

errors are clustered by firm.

6.1 Revenue Sources of Environmental Investments

Table 7 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 extract information on green revenue from detailed breakdowns of the revenue sources of publicly listed companies in the WIND database. This revenue is then scaled by the firm's total operating revenue. Since targeted cities deploy incentives (Table 6), which may directly boost a firm's green revenue, we also control for environmental subsidies and taxes in the analysis.

Columns 1–2 indicate that under heightened environmental regulations, local firms in non-green sectors investing more in environmental projects derive a larger share of their revenue from green sources. Specifically, firms in treated cities with substantial beneficent investments have a 42.86 ($= 0.003/0.007$) percentage-point increase in green revenue (column 2). By contrast, 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 (column 3). 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 investments over firm-specific ones.

Environmental investments also allow firms to 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 initiatives 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 2022).

Taken together, the results in Panel A of Table 7 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 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 7 Panel B show that post MCEP, firms that invest more in environmental projects decrease their hiring rates. By contrast, labor investment inefficiency (Pinnuck and Lillis 2007) – calculated as the absolute deviation of actual net hiring from its expected level – declines for these firms spending more on beneficent environmental projects after the MCEP (columns 4-6). 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 Tate and Yang's (2015) measure of labor productivity. We find that labor output increases significantly for firms in treated cities that spend more on environmental projects. While the effect prevails across all project types (columns 7-9), investing more in projects with greater externalities produces a larger effect on labor productivity than those with a smaller direct social impact.²⁴

Taken together, the results in Panel B of Table 7 suggest that firms in MCEP cities with larger environmental investments save more on labor costs, improve the efficiency of their labor investment, and boost labor productivity.

6.3 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 7 Panel C suggest that local firms that allocate more resources to environmental projects, particularly those with broader societal benefits, achieve higher valuations. Specifically, they experience a 5.10 (= $0.190/3.723$) percentage-point 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.²⁵ Columns 4-6 of Table 7 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

²⁴ The p -value for the χ^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.

²⁵ Alternative cutoffs (one standard deviation and three standard deviations below the mean) do not alter our findings.

regulations elevate the regulatory climate risk (Krueger, Sautner and Starks 2020), 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 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 7 highlight a mechanism through which environmental project investments can affect firm performance, independent of the persistence of (or lack thereof) government-based incentives.

7. Does the City Benefit?

So far, we show that firms increase their spending on environmental projects in response to more stringent local environmental regulations, and that such regulatory events boost investments into beneficent projects. However, this does not necessarily imply that such investments translate into aggregate welfare improvement. 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.

We assess whether the treated cities have indeed benefited from local firms' environmental investments by estimating the following city-year level regression model:

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

where $y_{c,t}$ captures city c 's 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 $X_{c,t}$ 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 (α_c) and year fixed effects (δ_t). Standard errors are clustered by city.

7.1 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 emissions 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.

Columns 7-9 of Table 8 Panel A 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 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.

Lastly, we monetize these environmental benefits by estimating the social cost of carbon dioxide (SC-CO₂), calculated as the economic cost of damages associated with an additional tonne of CO₂ emitted.²⁶ A widely used measure by governments, academics, and international agencies

²⁶ We focus on CO₂ emission reductions as a conservative lower-bound when estimating the benefits from improved environment. This is because CO₂ is universally recognized as the primary greenhouse gas driving global warming and climate change and is a central target of international agreements such as the Paris Agreement. This global consensus facilitates the development of a clear regulatory and policy framework and supports the establishment of

to evaluate the impacts of climate policies and regulations (Nordhaus 2014 and 2017), SC-CO₂ captures the monetized damages to society resulting from an incremental metric tonne of CO₂ emission. While regional SC-CO₂ estimates exist, they vary widely and carry considerable uncertainty (Nordhaus 2017); because CO₂ emissions contribute to global warming and generate global externalities, we employ the full global SC-CO₂ in our analysis to capture the total social benefits of emissions reductions under the MCEP policy. To alleviate concerns regarding the evolving nature of SC-CO₂ estimation, along with critiques of input parameter uncertainties and sensitivity to political influences and assumptions, we adopt the more scientifically independent SC-CO₂ estimates of Rennert et al. (2022). Their analysis reports a mean SC-CO₂ estimate of \$185 per tonne of CO₂ (or 1,338.91 *yuan* per tonne), with a 5%–95% range of \$44–\$413 per tonne (in 2020 US dollars). This corroborates the recently updated estimate of \$190 per metric tonne from the U.S. Environmental Protection Agency (EPA) at a 2.5% discount rate.

Column 2 of Table 8 Panel A shows that cities with high non-firm-specific environmental investment experience a 7.9% reduction in logged CO₂ emissions relative to cities with lower investment. At the pre-policy average of logged CO₂ emissions of 2.73 (or an average emission of 15.33 million tonnes), the decline in emissions translates into roughly 1.211 (=7.9% × 15.33) million tonnes. Given the difference in non-firm-specific environmental investment between high- and low-investment cities—amounting to 170.12 million *yuan*—the marginal reduction in CO₂ emissions per *yuan* invested is 0.00712 tonnes (= 1.211/170.12), resulting in a monetized social

standardized methodologies for quantifying the benefits of CO₂ reductions. This global consensus facilitates a clear regulatory and policy framework as well as the establishment of standardized methods for quantifying the benefits of CO₂ reductions. As such, CO₂ emissions have widely accepted and well-established frameworks for social cost estimation, including those proposed by the U.S. Environmental Protection Agency and various international organizations (IPCC 2021; EPA 2023).

value of 9.53 *yuan* ($= 0.00712 \times 1,338.91$). Put differently, one additional *yuan* of non-firm-specific investment generates 9.53 *yuan* in social value through CO₂ emission reduction.

By contrast, cities with high firm-specific investment experience a 4.2% reduction in logged CO₂ emissions relative to cities with lower investment (column 3). Since the difference in firm-specific investment between high and low-investment cities is 113.55 million *yuan*, the benefit from CO₂ emission reduction generated by each *yuan* investment in firm-specific projects averages 7.59 *yuan* ($= 4.2\% \times 15.33 \times 1,338.91/113.55$). That is, non-firm-specific environmental investments generate a larger social benefit of 9.53 *yuan* per *yuan* invested through CO₂ emission reductions, compared to 7.59 *yuan* for firm-specific investments.

Nevertheless, achieving these environmental benefits involves fiscal costs, as governments typically provide subsidies and tax incentives to induce private-sector investment. In subsection 5.3, we estimate that each additional *yuan* of non-firm-specific investment requires 1.41 *yuan* in tax cuts and 0.059 *yuan* in green subsidies. Consequently, the total government fiscal concession—including the marginal tax revenue loss and marginal subsidy cost—for mobilizing one *yuan* of non-firm-specific investment is approximately 1.47 *yuan*. The monetized social benefits of 9.53 *yuan* per *yuan* invested are thus 6.49 ($= 9.53/1.47$) times the cost of incentivizing the private provision of public goods. In other words, the environmental gains—measured as reductions in the social costs of CO₂ emissions—are roughly 6.5 times the fiscal cost incurred by the government. This suggests that, despite the short-term fiscal sacrifice, the policy generates significant environmental benefits that can more than offset the lost revenue and increased subsidy payments.

7.2 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.

Following Giannetti et al. (2021), we classify a firm to be high quality if its total factor productivity falls into the top quartile of the sample during the year. We then calculate 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 .

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-point 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 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 highlight 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.

7.3 Local Firm Composition

By spurring corporate environmental investment, environmental regulation not only allows a city to attract 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.²⁷ 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. Firm-level information is from the ATS database. For this set of analyses, 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 coefficient estimate for the interaction term $Post \times High\ EI(Non-Firm-Specific)$ 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.

²⁷ 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”.

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. 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, 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 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.²⁸ Arguably, such transitions add 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 calculate 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

²⁸ Heavily polluting firms entering unfamiliar green sectors may lack comparative advantage and incur value losses. In untabulated regressions, we find that pre-MCEP cross-sector M&A into non-polluting industries is associated with a 0.5 percentage point decline in ROA. However, after cities attain MCEP status, the observed profitability penalty dissipates. Thus, while green-sector migration may initially harm these firms' operating performance, the reinforced regulations and fiscal incentives under MCEP mitigate these transition costs.

green firms (column 2). By contrast, there is evidence of local firms departing from non-green sectors by migrating into green sectors within the same jurisdiction, 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.²⁹

8. Conclusion

This paper investigates within-firm investment response to changes in environmental regulations using a manually collected dataset of project investments by Chinese listed companies. To reflect the “public goods” nature of environmental projects, we distinguish between those that mostly add value to shareholders and “beneficent” ones, i.e., environmental projects that also generate large direct societal benefits.

Leveraging a regulatory event leading to heightened pollution prevention and control across different cities at different times, we show that firms increase their environmental investments, particularly in “beneficent investments.” We identify mechanisms that likely bolster the effectiveness of these regulations: intensified media scrutiny of local environmental issues, career-driven promotion incentives for city politicians, and substantial fiscal concessions, including tax breaks and direct subsidies that reduce the net cost of green projects.

Importantly, we show that 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. With larger corporate environmental investments, cities experiencing more stringent environmental regulations reduce pollution and

²⁹ In our setting, a possible regulation leakage and greenwashing is less likely permanent, as the MCEP was quickly adopted to all prefecture level cities in 2012.

improve employment to a greater extent. They also attract more productive young firms, grow their green sectors, and rely less on tax revenue from heavily polluting firms. Heavily polluting firms speed up expansion into non-polluting sectors.

Finally, our welfare analysis estimates support the view that public spending (e.g., fiscal concessions such as subsidies and tax breaks) alongside regulatory oversights crowd in private environmental investment and generate large social returns. One *yuan* of public fund can mobilize private capital and deliver environmental benefits exceeding 6 times the original outlay. This multiplicative effect reinforces the economic rationale for targeted public support in the green transition. Our study identifies potential mechanisms through which regulatory measures can incentivize corporate-sector environmental investment that is value-enhancing and at the same time generate broader social benefits (Starks 2023).

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Appendix A: Variable Definition

Variable	Definition and Data Source
<i># of Firms in (Green) Non-Green Sectors</i>	The natural logarithm of the number of firms operating in (green) non-green sectors in a city-year, respectively. Source: ATS and CSMAR.
<i># of Large Industrial Firms</i>	The natural logarithm of the number of large-scale industrial firms in a city and in a year. Source: CSMAR database.
<i># of Patents</i>	The natural logarithm of one plus the average number of patents from year t to year $t + 3$. Source: CNRDS.
<i>% of Green Patents</i>	The average fraction of total patents being green patents from year t to year $t + 3$. Source: CNRDS.
<i>Advertising Expenses</i>	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.
<i>Age</i>	The natural logarithm of one plus of the difference between the current year and the founding year of the firm. Source: CSMAR database.
<i>Board Independence</i>	The number of independent directors divided by board size. Source: CSMAR database.
<i>Cash</i>	Cash and cash equivalents divided by total assets. Source: CSMAR database.
<i>Carbon</i>	The natural logarithm of carbon emissions. Source: CCED database.
<i>Downside Risk</i>	The frequency of daily stock returns that fall two standard deviations below the mean in a firm-year. Source: CSMAR database.
<i>EI(Total)</i>	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.
<i>EI(Non-Firm-Specific)</i>	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 in a city, scaled by the sum of their operating revenue, multiplied by 100. Sources: CSMAR database and manual collection.
<i>EI(Firm-Specific)</i>	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.
<i>Employment Growth</i>	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.

<i>Environmental News</i>	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.
<i>Entry of High-quality New Firms</i>	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.
<i>ETC</i>	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.
<i>Excess Hospital Needs</i>	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.
<i>Fixed Asset Investment (Service Sector, Population, Colleges)</i>	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.
<i>GDP Growth</i>	The year-on-year change in a city's GDP. Source: CSMAR database.
<i>Green Revenue</i>	A firm's aggregated revenue from its environmentally sustainable operations and initiatives, scaled by its total operating revenue. Source: WIND database.
<i>Growth of Firms in Green (Non-Green) Sectors</i>	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.
<i>High % of Environmental Targets Achieved</i>	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.
<i>High Carbon</i>	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.
<i>High SO2</i>	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.
<i>Institutional Holdings</i>	The fraction of tradable shares held by institutional investors. Source: CSMAR database.
<i>Labor Investment Inefficiency</i>	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.
<i>Labor Productivity</i>	The natural logarithm of a firm's sales divided by the average employee wage. Source: CSMAR database.
<i>Leverage</i>	Total liabilities divided by total assets. Source: CSMAR database.
<i>Market to Book</i>	Market value of assets divided by the replacement value of assets.

	Source: CSMAR database.
<i>Non-Green</i>	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.
<i># of Firms in (Green) Non-Green Sectors</i>	The natural logarithm of the number of firms operating in (green) non-green sectors in a city-year, respectively. Source: ATS and CSMAR.
<i>Non-Polluting Targets Acquired by Polluting Firms</i>	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.
<i>Political Connection</i>	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.
<i>Polluting Firms’ Proportion of Sales</i>	The proportion of sales generated by heavily polluting firms relative to all firms in a city-year. Sources: CSMAR and ATS databases.
<i>Polluting Firms’ Proportion of Taxes</i>	The proportion of taxes paid by heavily polluting firms relative to all firms in a city-year. Sources: CSMAR and ATS databases.
<i>Post</i>	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.
<i>Promotion</i>	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.
<i>ROA</i>	Net profit divided by total assets. Source: CSMAR database.
<i>Size</i>	The natural logarithm of total assets. Source: CSMAR database.
<i>State</i>	A dummy variable set to one if a firm is government controlled or owned, and zero otherwise. Source: CSMAR database.
<i>Subsidies</i>	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.
<i>SO2</i>	The natural logarithm of industrial sulfur dioxide (SO2) emissions. Source: CSMAR database.
<i>Taxes</i>	The amount of taxes paid scaled by sales. Source: CSMAR database.
<i>Tobin’s Q</i>	The firm’s market value of assets divided by its book value of assets. Source: CSMAR database.
<i>Unemployment</i>	The unemployment growth in a city from year $t - 1$ to year t . Source: CNRDS database.

Appendix B: Distribution of MCEPs

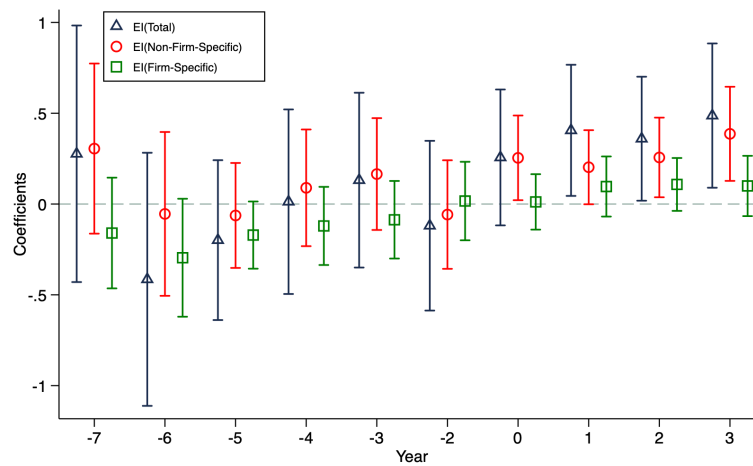
Column 1 reports the number of cities in a province. Columns 2 and 4 report the numbers of MCEPs in 2007 and in 2010, respectively. Columns 3 and 5 report the fraction of MCEPs in a province.

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%

Figure 1: Event-Study Estimates of MCEP Impact on Environmental Investment

This figure illustrates the dynamic effects of MCEP designation on total ($EI(Total)$), non-firm-specific ($EI(Non-Firm-Specific)$), and firm-specific ($EI(Firm-Specific)$) environmental investment. The horizontal axis shows years relative to the year of MCEP designation (year 0), with negative values indicating pre-designation “lead” years and positive values indicating post-designation “lag” years. Vertical bars around each marker represent 95 percent confidence intervals, clustered at the city and year level. Panel A traces these coefficients using all cities that have not yet received MCEP status as the control group. Panel B repeats the exercise within a 1:1 propensity-score matched (PSM) sample to ensure balance on key observables.

Panel A: Full Sample



Panel B: Matched Sample

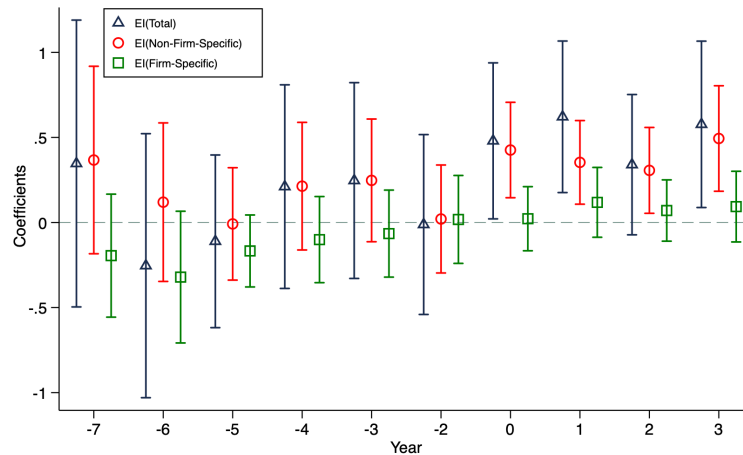


Table 1: Descriptive Statistics

The sample period is 2001-2014. Panel A summarizes the main characteristics of sample firms for the firm-year panel. Panel B shows the summary statistics of environmental projects. 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

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

Table 2: MCEP Assignment and Corporate Environmental Investment

The sample period is 2001-2014. The unit of observation is a firm-year. The dependent variable is *EI(Total)* in columns 1-4 of Panel A, columns 1-2, 7-8 of Panel B, *EI(Non-Firm-Specific)* in columns 5-8 of Panel A, columns 3-4, 9-10 of Panel B, and *EI(Firm-Specific)* in columns 9-12 of Panel A and columns 5-6, 11-12 in Panel B. All models include 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: 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*** (2.88)	0.292** (2.43)	0.367*** (3.10)	0.306** (2.44)	0.196*** (2.76)	0.179** (2.35)	0.207*** (2.84)	0.171** (2.17)	0.055 (1.06)	0.042 (0.78)	0.076 (1.40)	0.066 (1.16)
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	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

Table 2 continued.

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*** (2.83)	0.173** (2.30)	0.075** (2.06)	0.052 (1.23)	0.024 (0.93)	0.034 (1.16)	0.072 (1.24)	0.059 (0.93)	0.046 (1.47)	0.037 (1.05)	0.012 (0.53)	0.016 (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 Reacts 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 $\times$ Non-Green	2.202** (2.52)	1.230** (2.07)	0.034 (0.14)			
Post $\times$ Non-State				0.188* (1.84)	0.018 (0.28)	0.125*** (2.87)
Post	0.885 (1.16)	0.473 (0.82)	0.385* (1.68)	0.231* (1.83)	0.186** (2.40)	-0.012 (-0.22)
Non-State				0.036 (0.28)	0.066 (0.77)	-0.02 (-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: Media Attention

This table reports the results analyzing media coverage of a city's environmental issues. The sample period is 2001-2014. The unit of observation is a city-year. The dependent variable is the natural logarithm of one plus the number of news articles covering a city's environmental issues. In column 1, we consider news reports from all media outlets. In columns 2 through 5, we consider news reports from, respectively, state-owned media, market-based media, national media, and local media. All models include a constant and fixed effects as described in the table, but the coefficients are not tabulated. 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*** (6.71)	0.536*** (8.82)	0.305*** (5.54)	0.291*** (5.20)	0.651*** (10.64)
GDP Growth	-0.410** (-2.51)	-0.273* (-1.76)	-0.376** (-2.56)	-0.458*** (-2.96)	-0.171 (-1.17)
Fixed Asset Investment	-0.188 (-1.59)	-0.129 (-1.17)	-0.251** (-2.37)	-0.225** (-2.03)	-0.257** (-2.20)
Service Sector	0.364 (0.77)	0.763* (1.73)	0.162 (0.38)	0.221 (0.48)	0.960** (2.20)
Population	0.167 (1.16)	0.238* (1.73)	0.107 (0.84)	0.108 (0.75)	0.242* (1.83)
Colleges	0.205*** (3.89)	0.204*** (4.74)	0.164*** (3.50)	0.174*** (3.47)	0.188*** (4.75)
# of Large Industrial Firms	0.119 (1.53)	0.069 (0.94)	0.063 (0.93)	0.106 (1.52)	0.020 (0.27)
ETC	0.527*** (2.68)	0.345** (2.06)	0.374** (2.12)	0.331* (1.71)	0.366** (2.25)
Advertising Expenses	0.098*** (2.87)	0.086** (2.25)	0.071*** (2.94)	0.077** (2.34)	0.066** (2.19)
Political Connection	0.472*** (10.04)	0.392*** (8.25)	0.458*** (10.80)	0.442*** (9.71)	0.426*** (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 5: 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 (0.56)	0.025 (0.54)	-0.051 (-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 6: Firm-Level Incentives

This table reports the results analyzing the firm-level fiscal incentives of environmental investment. The sample period for taxes is 2001-2014, and for environmental subsidies is 2003-2014. 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 and environmental subsidies that a firm receives from the government in columns 4-6. 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.

Dependent Variable:	Taxes			Subsidies		
	(1)	(2)	(3)	(4)	(5)	(6)
Post × High EI(Total)	-0.011*** (-9.15)			0.049*** (8.76)		
Post × High EI(Non-Firm-Specific)		-0.011*** (-8.14)			0.046*** (7.20)	
Post × High EI(Firm-Specific)			-0.013*** (-9.35)			0.044*** (5.55)
High EI(Total)	0.004*** (4.24)			-0.012*** (-3.15)		
High EI(Non-Firm-Specific)		0.004*** (3.94)			-0.015*** (-3.47)	
High EI(Firm-Specific)			0.007*** (5.88)			-0.008 (-1.36)
Post	0.009*** (6.43)	0.008*** (5.72)	0.008*** (5.65)	-0.016*** (-2.81)	-0.011* (-1.78)	-0.007 (-1.31)
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	21,862	21,862	21,862	20,525	20,525	20,525
R ²	0.669	0.668	0.668	0.381	0.380	0.380

Table 7: 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 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 also control *Taxes and Subsidies*), 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** (2.46)			0.167*** (7.34)			0.091*** (3.77)		
Post × High EI(Non-Firm-Specific)		0.003** (2.24)			0.158*** (6.45)			0.074*** (2.72)	
Post × High EI(Firm-Specific)			0.001 (0.61)			0.173*** (5.77)			0.077** (2.33)
High EI(Total)	0.003*** (3.03)			-0.081*** (-4.44)			-0.024 (-1.29)		
High EI(Non-Firm-Specific)		0.003*** (2.89)			-0.080*** (-4.14)			-0.025 (-1.18)	
High EI(Firm-Specific)			0.001 (0.60)			-0.054** (-2.39)			-0.029 (-1.19)
Post	0.001 (1.03)	0.001 (1.32)	0.002* (1.65)	-0.159*** (-6.70)	-0.139*** (-6.05)	-0.132*** (-5.73)	-0.018 (-0.80)	-0.004 (-0.18)	-0.000 (-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 7 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*** (-2.83)			-0.032** (-2.22)			0.094*** (5.28)		
Post × High EI(Non-Firm-Specific)		-0.044** (-2.01)			-0.035** (-2.07)			0.090*** (4.55)	
Post × High EI(Firm-Specific)			-0.062*** (-2.68)			-0.026 (-1.45)			0.039* (1.91)
High EI(Total)	0.032** (1.97)			0.024* (1.89)			-0.026* (-1.71)		
High EI(Non-Firm-Specific)		0.030 (1.62)			0.026* (1.75)			-0.031* (-1.85)	
High EI(Firm-Specific)			0.024 (1.33)			0.015 (1.06)			-0.002 (-0.13)
Post	0.009 (0.42)	0.001 (0.05)	0.002 (0.09)	0.000 (0.03)	-0.002 (-0.13)	-0.006 (-0.41)	-0.062*** (-3.09)	-0.052*** (-2.66)	-0.036* (-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 7 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** (2.15)			-0.001*** (-3.42)		
Post × High EI(Non-Firm-Specific)		0.190** (2.13)			-0.002*** (-3.37)	
Post × High EI(Firm-Specific)			0.064 (0.68)			-0.001** (-2.27)
High EI(Total)	-0.127* (-1.81)			0.001** (2.24)		
High EI(Non-Firm-Specific)		-0.162** (-2.25)			0.001* (1.70)	
High EI(Firm-Specific)			-0.084 (-1.04)			0.001** (2.46)
Post	-0.118 (-1.09)	-0.103 (-0.98)	-0.064 (-0.61)	0.001*** (2.72)	0.001** (2.54)	0.001** (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

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 variables are a city's carbon emission in columns 1-3, SO2 emission in columns 4-6, and excess hospital need in 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 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 (-1.13)			-0.141** (-2.29)			-0.001 (-0.98)		
Post × High EI(Non-Firm-Specific)		-0.079** (-1.99)			-0.128** (-2.15)			-0.001* (-1.70)	
Post × High EI(Firm-Specific)			-0.042 (-1.05)			-0.159*** (-2.95)			-0.001** (-2.04)
High EI(Total)	0.004 (0.17)			0.026 (0.72)			-0.000 (-0.46)		
High EI(Non-Firm-Specific)		0.025 (0.92)			0.046 (1.17)			-0.000 (-0.19)	
High EI(Firm-Specific)			0.017 (0.69)			0.106*** (2.72)			-0.000 (-0.73)
Post	-0.021 (-0.73)	-0.006 (-0.20)	-0.024 (-0.82)	0.022 (0.48)	0.015 (0.33)	0.025 (0.61)	-0.001 (-1.55)	-0.001 (-1.13)	-0.001 (-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 (1.64)			0.015 (0.41)		
Post × High EI(Non-Firm-Specific)		0.181** (2.43)			-0.064* (-1.76)	
Post × High EI(Firm-Specific)			0.044 (0.56)			-0.023 (-0.67)
High EI(Total)	-0.018 (-0.33)			-0.009 (-0.23)		
High EI(Non-Firm-Specific)		-0.052 (-1.05)			0.008 (0.23)	
High EI(Firm-Specific)			0.030 (0.54)			0.038 (1.15)
Post	0.015 (0.21)	-0.010 (-0.14)	0.055 (0.76)	-0.043 (-1.18)	-0.004 (-0.10)	-0.025 (-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 (-1.55)			-0.029** (-2.12)			0.113** (2.06)		
Post × High EI(Non-Firm-Specific)		-0.022*** (-2.94)			-0.024* (-1.82)			0.171*** (3.62)	
Post × High EI(Firm-Specific)			-0.010 (-1.31)			-0.025* (-1.91)			0.140*** (2.80)
High EI(Total)	0.006 (1.03)			0.031*** (3.13)			-0.050* (-1.94)		
High EI(Non-Firm-Specific)		0.006 (1.05)			0.023** (2.45)			-0.059** (-2.49)	
High EI(Firm-Specific)			0.012** (2.02)			0.025** (2.43)			-0.028 (-0.92)
Post	-0.005 (-0.77)	-0.001 (-0.09)	-0.006 (-0.99)	-0.001 (-0.06)	-0.002 (-0.16)	-0.001 (-0.13)	-0.034 (-0.74)	-0.072 (-1.56)	-0.055 (-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 percentage) 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*** (2.68)	0.110*** (3.26)	-0.055*** (-3.15)	-0.019* (-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

Internet Appendix for
“Levelling Up Your Green Mojo: The Benefits of Beneficent Investment”

This online appendix consists of the following discussions and supplemental figures and tables:

IA.1: The Distribution of MCEPs

Figure IA.1

IA.2: City Characteristics and the Likelihood of MCEP Assignment

Table IA.1

IA.3: An Example of the Appendix of Ongoing Projects

IA.4: A List of Words and Phrases to Identify Environmental Projects in Annual Reports

IA.5: Distribution of Environmental Projects by Industries

Table IA.2

IA.6: Robustness Tests

Table IA.3

IA.7: A List of Words and Phrases to Identify Environment-Related News Articles

IA.8: Changes in City Policies

Table IA.4

Appendix IA.1: The Distribution of MCEPs

In Figure IA.1 below, we present the geographic distribution of major cities for environmental protection (MCEPs) across mainland China. The red dots are cities designated as MCEPs during the sample period.

Figure IA.1: The Geographic Distribution of MCEPs



Appendix IA.2: City Characteristics and the Likelihood of MCEP Assignment

The table below relates ex ante city characteristics to the likelihood of its designation as an MCEP in 2007. The unit of analysis is at city level.

Table IA.1 reveals that, aside from the number of colleges and the count of large industrial firms, none of the pollution measures (CO₂ and SO₂), a city's fiscal reliance on tax revenue from polluting industries, GDP growth, service-sector share, or prior corporate environmental investment, significantly explains the MCEP designation.

Both the number of colleges and the number of large industrial firms are positively and significantly related to the MCEP assignment. The prominence of colleges likely reflects local administrative and human-capital capacity to implement stringent environmental programs, rather than pollution intensity. Given that the number of large industrial firms, instead of the number of polluting firms, is significantly associated with the MCEP assignment, this may suggest that the selection considers a city's potential capacity of reliance on nonpolluting firms when imposing stringent regulatory initiatives.

Overall, the results indicate that the MCEP designation is not based on the severity of a city's pre-existing environmental conditions. Put differently, cities with the worst environmental pollution are not necessarily included in the list. More importantly, MCEP selection does not depend on prior local corporate environmental investments.

Table IA.1: The Determinants of MCEP Assignment

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 OLS and logit regression estimates, respectively. *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 (-0.73)	0.010 (0.00)
Fixed Asset Investment	-0.129 (-0.45)	-2.010 (-0.80)
Service Sector	0.145 (0.25)	8.392 (1.64)
Population	-0.117 (-1.46)	-0.657 (-1.00)
Colleges	0.175*** (3.45)	1.873*** (3.47)
# of Large Industrial Firms	0.090** (2.04)	0.633* (1.71)
Carbon	0.084 (1.22)	0.867 (1.49)
SO2	0.042 (0.72)	0.318 (0.57)
Polluting Firms' Proportion of Taxes	0.130 (0.46)	1.573 (0.75)
Environmental Investment	0.102 (0.98)	1.271 (1.51)
% of Polluting Firms	-0.602 (-1.10)	-6.190 (-1.42)
Observations	137	137
R ² (Pseudo R ²)	0.468	0.508

Appendix IA.3: An Example of the Appendix of Ongoing Projects

This appendix provides a snapshot of the Appendix of Ongoing Projects in Konka Group's 2019 annual report in Panel A and corresponding English translation in Panel B. 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 Ongoing 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
阜南县全域污水处理工程项目	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.3 continued.

Panel B: The Appendix of Ongoing 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.4: A List of Words and Phrases to Identify Environmental Projects in Annual Reports

This appendix presents a list of Chinese words and phrases used to identify a firm's environmental projects in Panel A and the corresponding English translations in Panel B.

Panel A: Environment-Related Words and Phrases in Annual Reports (in Chinese)

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
治渣	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	蚊虫监测	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	防腐槽	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	干燥棚	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.4 continued.

Panel B: Environment-Related Words and Phrases in Annual Reports (in English)

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.5: 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, in our sample. The last column reports the number of firms investing in both types of environmental projects in each industry.

Table IA.2: Industry Distribution of Environmental Projects

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

Appendix IA.6: Robustness

IA.6.1 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 $\times$ year fixed effects and province $\times$ 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.

In columns 1-3 of Table IA.3 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 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 IA.3 reports the regression results based on these matched samples. The effect of MCEP assignment on corporate environmental investment remains robust when we closely match firms that are affected by the MCEP to those that are not.

IA.6.2 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 IA.3, 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 IA.3 reveal that our findings do not depend on how we scale each firm-year's project investments.

IA.6.3 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 IA.3 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.

IA.6.4 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 IA.3 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 the 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.

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 IA.3 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 IA.3 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 IA.3 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.

IA.6.5 Falsification Tests

Our empirical design explores the staggered designations of MCEP, which affect firms located in treatment cities differently from 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 to be 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 IA.3 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.

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

Table IA.3 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 based on the 100 simulated pseudo-assignment dates (columns 2 through 7) and the corresponding T -statistics (in the parentheses) 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 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.

IA.6.6 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).¹

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, which helps understand the robustness of the effect estimates and the degree to which they rely on the inclusion of controls.

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.

IA.6.7 Pre-existing Trend

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

¹ 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).

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

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

IA.6.8 Zero-Valued Outcomes: Poisson Regression

To account for the non-trivial share of zero-investment observations and potential heteroskedasticity, we re-estimate our baseline model in Panel A of Table 2 using Poisson pseudo-maximum likelihood (PPML) with the same controls, firm and year fixed effects. Panel J of Table IA.3 in Internet Appendix IA.6 shows that our findings are robust.

The coefficient estimate of 0.248 ($z = 2.65$) associated with the post dummy in column 1 implies a 28.1% ($= (e^{0.248} - 1) \times 100$) increase in total environmental investment. The coefficient of 0.251 ($z = 2.19$) in column 2 represents a 28.5% ($= (e^{0.251} - 1) \times 100$) rise in non-firm-specific environmental investment. As before, the effect on firm-specific investment remains economically small and statistically insignificant. Overall, these PPML estimates closely mirror our OLS-based percentage gains (32.2% and 36.2%), confirming that our main findings are not driven by excess zeros or variance-related biases.

Appendix IA.6 continued.

Table IA.3: Robustness

This table reports the results of robustness tests. 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. In Panel J, we estimate Table 2 Panel A using Poisson pseudo-maximum likelihood (PPML) method. 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.

Appendix IA.6 continued.

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** (2.37)	0.225*** (2.82)	0.020 (0.32)	0.379** (2.33)	0.224** (2.10)	0.077 (1.05)	0.286** (2.46)	0.172** (2.49)	0.054 (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

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** (1.97)	0.915* (1.96)	0.418 (1.02)	0.103** (2.12)	0.056* (1.88)	0.020 (0.77)	3.508* (1.66)	2.587** (2.15)	0.020 (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

Appendix IA.6 continued.

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*** (3.52)	0.032*** (2.95)	0.034*** (3.05)	0.031*** (2.75)	0.023** (2.03)	0.025** (2.22)	0.026** (2.41)	0.028** (2.54)	0.017 (1.63)	0.015 (1.44)	0.015 (1.43)	0.015 (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

Appendix IA.6 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*** (2.61)	0.239*** (3.26)	0.025 (0.47)	0.413*** (3.24)	0.255*** (3.22)	0.067 (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* (1.81)	0.218** (2.25)	0.003 (0.03)	0.141** (2.20)	0.064* (1.74)	0.023 (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

Appendix IA.6 continued.

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 (0.93)	0.049 (1.03)	0.005 (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

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 (2.88)	-0.003 (-0.08)	-0.087 (-1.99)	-0.027 (-0.61)	0.001 (0.01)	0.025 (0.57)	0.066 (1.51)
EI(Non-Firm-Specific)	0.196 (2.76)	-0.000 (-0.02)	-0.044 (-1.61)	-0.019 (-0.66)	-0.003 (-0.09)	0.019 (0.68)	0.041 (1.45)
EI(Firm-Specific)	0.055 (1.06)	0.002 (0.09)	-0.030 (-1.56)	-0.011 (-0.56)	0.001 (0.03)	0.012 (0.63)	0.036 (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*** (2.85)	0.200*** (2.82)	0.051 (1.00)	0.320*** (2.78)	0.197*** (2.79)	0.047 (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

Appendix IA.6 continued.

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

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

Appendix IA.6 continued.

Panel J: Zero-Valued Outcomes: Poisson Regression

Dependent Variable:	EI(Total)	EI(Non-Firm- Specific)	EI(Firm-Specific)
	(1)	(2)	(3)
Post	0.248*** (2.65)	0.251** (2.19)	0.142 (1.23)
Control Variables	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	14,369	11,862	10,185
Pseudo R2	0.510	0.506	0.432

Appendix IA.7: A List of Words and Phrases to Identify Environment-related News Articles

This appendix presents a list of Chinese words and phrases used to classify news coverage of a city's environmental issues in Panel A and the corresponding English translations in Panel B.

Panel A: Environment-related Words and Phrases in News Articles (in Chinese)

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.7 continued.

Panel B: Environment-related Words and Phrases in News Articles (in English)

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	

Appendix IA.8: Changes in City Policies

The table below compares city-level regulatory measures, including tax incentives and environmental subsidies, before and after the MCEP designation.

Table IA.4: Changes in City Policies

The sample period for taxes is 2001-2014, and for environmental subsidies is 2003-2014. 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. Variable definitions are in Appendix A. *T*-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	Before MCEP	After MCEP	Difference
Taxes	0.083	0.076	-0.007***
Subsidies	0.028	0.083	0.055***

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