Minimum Wages, State Ownership, and Corporate Environmental Policies

Tao Chen, Xi Xiong, and Kunru Zou*

Abstract

Exploring the minimum wage policy discontinuities at county borders, we find that minimum wage hikes induce industrial firms to pollute more and reduce their abatement efforts. State ownership mitigates these negative effects, suggesting its role in addressing externality. The adverse environmental impacts are attenuated by the staggered increase in pollution discharge fees across provinces. These effects are stronger for firms with higher minimum wage sensitivity, lower market power, and greater financial constraints, and for firms that are the subsidiaries of non-listed companies. Overall, our findings highlight the unintended environmental consequences of labor market policies.

Keywords: minimum wages, state ownership, environmental externality, geographical discontinuity

JEL Classification: G32, H23, J31, J38, Q56

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I. Introduction

To reduce rising income inequality, around 90% of countries worldwide have adopted minimum wage policies (International Labour Organization, 2020). Further, public support for an increase in the minimum wage has recently been growing globally.[1] While the minimum wage raises may reduce income inequality (Cengiz, Dube, Lindner, and Zipperer (2019)), it is unclear who pays for the cost of minimum wage hikes. Studies suggest that raises in minimum wages can harm the intended beneficiaries by price pass-through to low-income households and non-cash compensation reduction for employees (Manning (2021)). However, the environmental costs of minimum wages have received little attention.

We examine the impact of the minimum wage hikes on firms' environmental policies. On the one hand, from a "Darwinian" view of competition, the increased labor cost shocks may reduce firm value and profitability (Luca and Luca (2019)). Consequently, the increased competitive shocks may lead firms that were close to the profit margin to exit and reduce industrial pollution. Moreover, in order to cope with the increased competitive pressure, firms could reduce high-polluting low-profit production to raise firm productivity, thereby leading to a cleaner production process. Therefore, minimum wage hikes may lead to lower industrial pollution.

On the other hand, firms may shift the increased labor costs to stakeholders. They may reduce employment, adjust the non-cash compensation (e.g., insurance) of employees, raise consumer prices, or reduce service quality (Harasztosi and Lindner (2019); Agarwal, Ayyagari, and Kosova (2022); and Gustafson and Kotter (2022)). However, unlike firms in service

[1] Recent trends include significant statutory minimum wage increases in most EU countries, some exceeding 10% (Vacas-Soriano and Kostolny (2022)), and a Pew Research poll showing 67% American support for a USD 15/hour federal minimum wage (Davis and Hartig, 2019). Additionally, several U.S. states have passed legislation to gradually reach a USD 15/hour state minimum wage, as highlighted by the 2019 *Raise the Wage Act*. Although hourly minimum wages are targeted at workers in the leisure and hospitality industries, manufacturing firms are also affected by the (monthly) minimum wage hikes (e.g., Otto Motors (2017)).

industries, manufacturing firms produce tradable goods and may face competition from firms in regions with low minimum wages, making it difficult to pass the increased labor costs on to consumers. Pollution abatement, which requires substantial inputs of energy, labor, and contractual services, is extraordinarily expensive. Moreover, our sample period was also characterized by relatively lax environmental regulations with low pollutant discharge fees and weak environmental enforcement. Thus, industrial firms may find it more straightforward and effective to transfer the increased labor costs onto the environment.[2]

Although firms may pass their labor costs onto the environment by increasing pollutant emissions, firms with and without state ownership may respond differently. While state-owned enterprises (SOEs) are frequently criticized for their low efficiency and productivity, some studies argue that they may be valuable in dealing with social issues such as externalities (Xu, 2011; Hsu, Liang, and Matos, 2021). Therefore, the widespread coexistence of SOEs and non-SOEs across China provides an ideal setting to explore how different ownership types moderate the role of minimum wages in shaping firms' environmental policies.

We obtain pollutant emission data from China's Environmental Survey and Reporting (ESR) database and financial information from the Chinese Industrial Census (CIC) from 1998 to 2013.[3] Following He, Wang, and Zhang (2020), we measure a firm's environmental

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[2] *The China News* reported that many firms would rather pay for the pollution discharge fees than invest in abatement facilities to remove pollutants (https://www.chinanews.com.cn/ny/2014/11-06/6759131.shtml). The government officials from Beijing Environmental Protection Bureau argued that the pollution discharge fees in 2013 were too low to motivate firms to reduce pollution (*China National Radio*, http://news.cnr.cn/native/city/201312/t20131214_514401554.shtml). Later in our cross-sectional analysis, we examine firms' environmental response to an exogenous increase in pollution discharge fees across provinces and years and find that firms with higher pollutant discharge fees are less likely to transfer labor costs onto the environment by increasing pollutant emissions.

[3] We use minimum wage hikes in China to examine the impact of increased labor costs on industrial firms' environmental policies. Chinese industrial firms are suitable for this analysis. First, in the United States, hourly minimum wages mainly impact the salaries of employees in the retail sector. It is thus difficult to evaluate the effect of minimum wages on firms' environmental pollution. By contrast, minimum wage policies in China have been shown to affect manufacturing firms substantially (Hau, Huang, and Wang, 2020). Second, the ESR database provides pollutant emission data for over 420,000 firms across around 3000 counties from year 1998 to 2013. This plant-level emission data with geographical information allows us to examine the effects of minimum wages on industrial pollution.

performance by its chemical oxygen demand (COD) emission, a key measurement of water pollution. Empirically identifying the causal effects of minimum wages on firms' environmental policies involves endogeneity concerns since minimum wages are set based on local economic conditions. To mitigate this concern, we exploit the changes in minimum wages at county borders and compare the environmental performance of geographically proximate firms with different minimum wages (Dube, Lester, and Reich, 2010). We thus construct all contiguous county pairs in China and restrict firms within certain distances from the shared border (e.g., 10 km). We find that firms in regions with higher minimum wages pollute more. In terms of economic significance, a 10% increase in minimum wages leads to a 4.63% increase in COD emissions in the following year. Our baseline results provide important evidence for the policy debate over raising minimum wages globally (Stigler, 1946; Neumark and Wascher, 2008; Jardim, Long, Plotnick, Van Inwegen, Vigdor, and Wething, 2018).

We conduct several robustness checks. Our results remain consistent when employing alternative environmental performance measures (e.g., emissions in other pollutants or emission intensity). Further, we use an alternative sample that matches the firms not only by geographic distance but also by industry and size and get similar results.

Building on these findings, we next investigate how state ownership moderates the relationship between minimum wages and firms' environmental performance. We find that the effects of minimum wages on firms' pollutant emissions are more evident for non-SOEs, compared with the SOEs, supporting the social view of state ownership (Stiglitz, 1993; Besley and Ghatak, 2001).

Investigating the mechanisms through which minimum wages affect corporate environmental performance, we find firms with higher minimum wages do not invest as much in pollution abatement as other firms. Moreover, the effect is more pronounced for non-SOEs, which explains the environmental performance gap between SOEs and non-SOEs.

We next attempt to triangulate our main findings through cross-sectional analyses. First, we examine firms' environmental response to an exogenous increase in pollution discharge fees across provinces and years. We find that firms with higher pollutant discharge fees are less likely to transfer labor costs onto the environment by increasing pollutant emissions, highlighting the effectiveness of pollution charges for environmental governance. We also find firms with average wages closer to local minimum wages and higher labor intensity are more sensitive to minimum wages and pollute more after an increase in minimum wage. The effects of minimum wages on firms' environmental performance are stronger for firms with lower product market power and greater financial constraints (Hong, Kubik, and Scheinkman, 2012; Xu and Kim, 2021). Moreover, firms that are the subsidiaries of listed companies are less likely to transfer the increased labor costs on to the environment.

In addition, we examine the aggregate impact of minimum wages on regional pollutant emissions. We find that minimum wage hikes lead to higher county-level pollution and that the effect is weaker in counties with a higher percentage of SOEs. Moreover, we find that the average profitability of firms is lower for counties with higher minimum wages and that emission constraints of SOEs lower their financial performance.

Our study contributes to several streams of the literature. First, we contribute to the burgeoning literature on the social welfare effects of minimum wages (Card and Krueger, 1994; Clemens, Kahn, and Meer, 2018; Dettling and Hsu, 2021; Asai and Inatani, 2022). Prior literature documents a price pass-through of minimum wages to consumers, and firm owners may also bear the costs (MaCurdy, 2015; Bell and Machin, 2018). However, little is known about whether firms pass the increased labor costs on to the environment by decreasing pollutant abatement efforts. We therefore provide the first evidence on the unintended environmental consequences of minimum wages.[4]

Second, our findings add to the literature on how labor-market conditions influence corporate policies. Existing studies have explored the impact of labor policies on firms' capital expenditures (Autor, Kerr, and Kugler, 2007; Michaels, Beau Page, and Whited, 2019; Bai, Fairhurst, and Serfling, 2020), financing choices (Agrawal and Matsa, 2013; Simintzi, Vig, and Volpin, 2015; Serfling, 2016), M&A activities (John, Knyazeva, and Knyazeva, 2015; Dessaint, Golubov, and Volpin, 2017; Tian and Wang, 2021), household spending (Aaronson, Agarwal, and French, 2012), innovation (Acharya, Baghai, and Subramanian, 2014; Gao, Hsu, and Zhang, 2023; Tian and Xu, 2022), and gender diversity (Liu, Makridis, Ouimet, and Simintzi, 2022). Our study adds to the discussion on how labor market policies are associated with corporate environmental policies.

Third, we contribute to the literature on the controversy of state ownership. On the one hand, SOEs are viewed as having weak corporate governance and poor financial performance (Megginson, Nash, and Van Randenborgh, 1994). On the other hand, researchers argue that SOEs are created for strategic purposes and are more responsible for social welfare than non-SOEs (Karolyi and Liao, 2017). Our findings support the social view of SOEs by showing that they are less likely to pass their increased labor costs onto the environment.

[4] Our study also reveals the unintended environmental impacts of non-climate policies like minimum wages. Existing studies in climate finance focus on the effects of regulatory enforcements, corporate governance, and financial tools on firms' pollutant emissions, and investors' trading related to toxic emissions (Greenstone, 2002; Hong, Karolyi, and Scheinkman, 2020; Krueger, Sautner, and Starks, 2020; Bolton and Kacperczyk, 2021; Giglio, Kelly, and Stroebel, 2021; Bai and Ru, 2022; Chu and Zhao, 2022; Houston, Lin, Shan, and Shen, 2022; Houston and Shan, 2022; Jing, Keasey, Lim, and Xu 2022; Li, Xu, and Zhu, 2022; Chen, Chen, Lou, Song, and Wu, 2023; Dasgupta, Huynh, and Xia, 2023). For instance, Bartram, Hou, and Kim (2021) show that the cap-and-trade program in California leads firms to shift their production and emissions to unregulated states. Flammer (2021) documents that green bond issuers reduce their CO_2 emissions and achieve high environmental ratings. Duchin, Gao, and Xu (2022) show that firms divest pollutive plants in response to environmental risk incidents. Our study highlights the role of non-environmental policies in firms' environmental performance (Asai, 2020; Bellon, 2021).

II. Institutional Background, Data and Summary Statistics

In this section, we describe the institutional background, datasets, sample construction, and descriptive statistics. We used three datasets: (1) firm-level emission and financial data, (2) county-level minimum wage data, and (3) county border map data.

A. Institutional Background

China's minimum wage policies were first approved in 1993 and its minimum wage system came into force after the promulgation of a new labor law a year later. This was a milestone in China's labor administration development (Casale and Zhu, 2013; Geng, Huang, Lin, and Liu, 2021). The new labor law provided a legal framework for governing the labor market, which included a minimum wage fixing mechanism for China's workforce. According to Article 48 of the Labor Law (1994), minimum wages are stipulated by the governments of the country's provinces, autonomous regions, and municipalities and reported to the State Council.[5] The administrative departments of labor and social security in each province are responsible for setting the local minimum wage based on local conditions, such as the minimum cost of living, average wage, and labor productivity. The minimum wage varies substantially across cities and counties within the same province. For example, in 2011, there were 108 minimum wages across Mainland China. Between 1998 and 2013, the average annual minimum wage increase was 12%. However, despite this rapid growth in minimum wages, this period was marked by relatively lenient environmental regulations and a strong focus on economic development.

While the Chinese government has acknowledged inadequate enforcement as a key factor contributing to the country's deteriorating environmental situation, the gap between

[5] See the Labor Law (1994) of the People's Republic of China at http://www.gov.cn/banshi/2005-05/25/content_905.htm.

policy intentions and practical enforcement during our study period remains a critical issue. The 9th, 10th, and 11th Five-Year Plans (FYPs) emphasized the importance of strengthening environmental enforcement and compliance. Despite these intentions and the implementation of various enforcement actions, such as the closure or penalization of highly polluting industries, the overall effectiveness of these measures was limited. Their limited effectiveness stems from several factors, including the lack of coherence among environmental regulations, conflicting interests at different levels of the administration, and insufficient technical capacity and resources available to environmental institutions to carry out their duties. In 2004, for example, the Zhejiang Environmental Protection Bureau conducted a survey that highlighted issues in environmental law enforcement, such as non-compliance with regulations, lenient enforcement, and a failure to investigate violations. [6]

Between 1998 and 2013, the impact of lax environmental regulation in China manifested profoundly in both air and water pollution. This era saw major Chinese cities frequently blanketed in smog, a direct result of industries emitting dangerously high levels of air pollutants. In parallel, the nation's water bodies faced a similar crisis. Many Chinese rivers and lakes, such as the Huai River and Taihu Lake, suffered heavy pollution in the 2000s and 2010s.[7] Given this backdrop of lenient environmental enforcement and a strong emphasis on economic development, transferring labor costs onto the environment is a feasible option for manufacturing firms.

In theory, facing minimum wage hikes, firms could choose to reduce the non-wage compensation of employees, transfer the increased labor costs to consumers, fire redundant employees, or employ a more efficient production process. However, there are valid reasons why increasing pollution may be a more practical and appealing option than these alternatives.

[6] The original article can be accessed from https://www.gov.cn/govweb/jrzg/2007-03/01/content_537958.htm.
[7] Please refer to the detailed description by Wikipedia at https://en.wikipedia.org/wiki/Lake_Tai.

Non-cash benefits, including health insurance, retirement plans, and paid time off, are predominantly offered to professional workers in larger companies. In contrast, employees in manufacturing sectors often have limited access to these benefits. Feng (2013) found that the actual contribution rate for pension and medical insurance is only 10.82% for industrial firms in China. This disparity makes it challenging for industrial firms to mitigate the impact of increased wages through adjustments in non-cash compensation.

Post-WTO entry, China's role as the "world's factory" led to a booming manufacturing sector and an increased need for labor force since the 2000s. The rapid expansion in industries like electronics, textiles, and automotive outstripped the available labor supply, making it improbable for firms to have redundant employees to lay off.

The transition to more efficient 'green' technologies is also challenging for Chinese manufacturing firms. In developing countries such as China, where environmental standards are less stringent, manufacturing firms often rely on older, less environmentally friendly technologies, and sometimes even import second-hand machinery of this nature (Blackman, 2006). It is both difficult and less economical for these firms to upgrade their production efficiency in response to minimum wage hikes.

In summary, faced with the challenges of reducing non-cash compensations and passing costs to consumers, coupled with lax environmental enforcement and government emphasis on economic development, industrial firms may find it a feasible and straightforward option to increase pollutant emissions.

B. Firm-level Emission and Financial Data

To measure the firm's pollutant emissions, we use China's Environmental Survey and Reporting (ESR) database maintained by the Ministry of Environmental Protection and the National Bureau of Statistics. The ESR database is the most comprehensive dataset on industrial pollution in China and is used by the government to monitor the polluting activities of industrial firms. ESR records the pollutant emission at the plant level. Plants' inclusion in the ESR database depends on their chemical oxygen demand (COD) emission and sulfur dioxide (SO_2) emission rankings. Plants with higher ranks (i.e., higher pollutant emissions), which jointly contributed to 85% of all the emissions in one county, are covered by the ESR database (He et al., 2020). Our sample period goes from 1998 to 2013. Each year, polluting plants first self-report their pollution information and then the numbers are randomly checked by local Environmental Protection Bureaus. Like the Toxic Release Inventory (TRI) database for the U.S. plants, ESR data cannot be used in environmental penalty decisions except for cases of misreporting; this alleviates the concern that plants may underreport their pollution numbers to avoid regulatory punishment.

The ESR database provides information on plants' pollutant emissions, industrial output, and abatement efforts. It covers emissions of several pollutants, including chemical oxygen demand (COD), sulfur dioxide (SO_2), ammonia nitrogen (NH_3-N), and industrial gas discharge. Following He et al. (2020) and He, Xie, and Zhang (2020), we use COD emissions as our primary measure of a plant's pollutant emissions for two reasons. First, the central government always sets COD emission targets in its five-year plans,[8] as such emission is the primary indicator to evaluate the environmental performance of local governments. Second, COD emissions are prevalent in most polluting industries, while other pollutants (e.g., NO_x) may be concentrated in specific industries (e.g., the petrochemical industry). We use the natural

[8] For example, in the 10th and 11th Five-Year Plans for National Environmental Protection (2001–2005 and 2006–2010, respectively), the central government targeted reducing total COD emissions by 10% in each period. In the 12th Five-Year Plan for National Environmental Protection (2011–2015), COD is listed as the most important performance indicator of environmental protection. In terms of environmental hazards, a higher COD level is associated with a greater amount of oxidizable organic material, which reduces dissolved oxygen levels.

logarithm of one plus the COD emissions in kilograms to measure a plant's pollutant emissions.[9]

In addition to pollutant emissions, the ESR database documents the number of pollutant treatment facilities owned by a plant and a plant's pollutant treatment capacity. We scale the number of treatment facilities and a plant's treatment capacity by its industrial output to measure the extent to which its intervention investment meets production requirements. Since our primary pollution metric (COD emissions) measures water pollution, we focus on a plant's wastewater treatment capacity and wastewater treatment facilities.

Besides taking pollution information from the ESR database, we obtain industrial firms' financial information from 1998 to 2013 from the Chinese Industrial Census (CIC) data maintained by the National Bureau of Statistics.[10] The CIC database covers all industrial firms with annual sales of more than RMB 5 million (about USD 700,000) until 2009 and RMB 20 million (about USD 3 million) thereafter.[11] CIC also covers the firm's financial information at the establishment level. Given the granular data provided by ESR and CIC, all our analyses are conducted at the establishment (i.e., industrial firm) level. For each firm-year, we have a firm's size, leverage, profitability, total wage bill, number of employees, ownership type, and address. To address the outliers in the dataset, we winsorize all the ratio variables by 0.1% at both ends.

We match firms in ESR and CIC by their organization codes and firm names. For each ESR firm in each year, we match a CIC firm with the same organization code in the same year. We then match a CIC firm with the same firm name for the remaining unmatched ESR firms.

[9] Following Liu, Shen, Welker, Zhang, and Zhao (2021), we also used the SO_2 emission, NH_3-N emission as well as industrial waste gas discharge for a robustness check and found similar results.
[10] 2013 is the last year to have the financial information and firm addresses available for CIC firms.
[11] Many variables in the 2010 CIC dataset are missing. We obtain Bureau van Dijk's (BvD) data to back out the financial information to overcome this issue. Since BvD records numbers in USD, we use the official historical average USD/RMB exchange rates to convert them into RMB. This allows us to uncover financial information for 310,000 CIC firms in 2010.

After matching, we obtain a sample of 695,741 firm-year observations with 182,178 unique firms from 1998 to 2013. Throughout our sample period, the ESR–CIC matched sample comprises about 73% of the total industrial output of all the firms in the ESR database. See Figure A1 of the Internet Appendix for the total industrial output over the years for the ESR and ESR–CIC matched samples.

C. County-level Minimum Wage Data

Our county-level minimum wage data are obtained by combining the three datasets from the Ministry of Human Resources and Social Security, China Research Data Services, and China Open. A manual check shows that the minimum wages in the three datasets are consistent. Our minimum wage dataset covers the minimum wages of 2,852 counties from 1998 to 2013. The average minimum wage increases substantially during our sample period. In 1998, the average minimum monthly wage was around RMB 200, which increased to RMB 1,100 in 2013. The average annual increase is around 12%. More than 45% of county–years have a minimum wage increase of over 10% from the previous year. Figure 1 displays the geographic distribution of minimum wages across counties in 2000, 2005, and 2010. As shown in Figure 1, many neighboring counties have different minimum wages, with 60% of county–years having minimum wages at least 10% higher than one of their bordering counties. These enormous time-series and cross-sectional variations provide an ideal setting to examine the effect of minimum wage policies on firms' activities. The county-year minimum wage panel and ESR–CIC firm-year panel are linked by the county code. For most of the analyses, we use the end-of-year minimum wage as the minimum wage for the firm.

[Insert Figure 1 about here]

D. County Border Map Data

The county border map is obtained from the Resource and Environment Science and Data Center of the Chinese Academy of Sciences. This map covers 2,866 counties across the 31 provinces, autonomous regions, and municipalities in Mainland China. When the borders of two counties touch, we treat them as neighboring county pairs. We identify 16,300 neighboring county pairs, with the average county having 5.7 neighboring counties. Altogether, 1,970 counties' neighboring counties are in the same province by themselves.

Next, we merge the ESR–CIC matched firm-year panel with the neighboring county pair data based on geographic information. We obtain a firm's geographic coordinates (longitude and latitude) based on its address using the application program interface (API) from AutoNavi (Gaode Map), a leading digital map and navigation provider in China. After merging the firm-year panel and county pair data, each firm may appear in the merged sample several times if the firm's county has several neighboring counties. After matching, we obtain a sample of 4,014,614 observations at the firm-year-neighboring county pair level. We then calculate the firm's distance to the border shared by neighboring county pairs. The average distance between ESR–CIC matched firms and county pair borders in the firm-year-county pair sample is 20.34 km with a standard deviation of 19.79. For the firms in county A, we use the firms in county A's neighboring counties as controls to estimate the minimum wage effects. Firms close to the border but on different sides of it (i.e., geographically proximate firms) are likely to have similar local economic conditions despite being subject to different minimum wage policies. These neighboring firms from neighboring counties serve as controls. Therefore, we restrict our sample to firms within 10 km of the neighboring county pair's border.[12]

E. Summary Statistics

[12] Fewer than one-thirds of the firms in the ESR–CIC matched sample are located within 10 km of the border shared by neighbouring counties. In a robustness check, we also examine those firms located within 5 km and 15 km of the border shared by the county pairs and find similar results.

Table 1 presents the summary statistics of the variables used in our analysis. Panel A reports the summary statistics at the firm-year level before constructing the firm-year-county pair sample. In Panel B, our working sample, we focus on firms within 10 kilometers from the border of neighboring counties. In total, 935,594 firm-year-country pair observations across 5,887 county pairs are included in our baseline analysis. In the firm-year level data, the means of *MinWage* and *CODEmission* are 6.269 and 7.315, respectively. These values are similar in the firm-year-county pair sample, where the means are 6.279 for *MinWage* and 7.312 for *CODEmission*, indicating consistency across the samples. SOEs comprise nearly one-fifth (17.9%) of the observations. Average firm size (i.e., *Size*) is 11.050, slightly larger than the average firm size in other papers using the CIC database (e.g., Ru, 2018; Huang, Pagano, and Panizza, 2020). This is consistent with the sampling criteria of the ESR database, which typically covers firms with high production levels. In Table A1 of the Internet Appendix, we group firms by their minimum wages and present the summary statistics at the subsamples. Firms with higher minimum wages have higher mean values of *Wage/Worker* and *CODEmission*, while the mean values of *WaterCapacity* and *WaterFacility* are lower.

[Insert Table 1 about here]

III. Empirical Strategy and Findings

A. Empirical Design

Following the boundary discontinuity framework, we examine the effects of minimum wages on firms' environmental policies by comparing the environmental policies of firms close to the border but on different sides of it. The premise of the framework is that firms close to the border have similar characteristics and face similar economic conditions despite being subject to different minimum wages (the regressor of interest). For firms in each county, we use the firms in neighboring counties as controls. We construct a county pair sample for each border shared by two counties. We restrict the sample to firms within 10 km of the shared border to ensure that firms from different regions are comparable. The regression samples are at the firm-year-neighboring county pair level. The empirical specification is as follows:

$$CODEmission_{i,p,t} = \alpha + \beta \times MinWage_{i,t-1} + \gamma \times Controls_{i,p,t} + Firm\ FE + County\ Pair\ FE + Industry \times Year\ FE + Province \times Year\ FE + \varepsilon_{i,p,t} \quad (1)$$

where the subscripts *i, p*, and *t* denote a firm, county pair, and year, respectively, and $CODEmission_{i,p,t}$ is the natural logarithm of one plus firm *i*'s COD emissions in kilograms. $Controls_{i,p,t}$ denotes a vector of the firm and macro-economic variables. We include firm size, profitability, leverage, and total industrial output to control for the firm's time-variant characteristics. To account for the effects of local economic conditions, we include the log of GDP per capita and GDP growth at the city level. The data of macroeconomic variables are obtained from the China City Statistical Yearbooks. Please refer to Appendix Table for variable definitions.

Our specification further includes a series of fixed effects. We include province-year fixed effects to account for regional trends. Controlling for regional trends mitigates the concern that environmental pollution is accompanied with economic growth and regions with higher economic growth may set higher minimum wages. We include industry-year fixed effects to control for industry trends (e.g., technological advancement for removing pollutants). The inclusion of firm fixed effects mitigates the concern that our results may be driven by certain types of firms. The county pair fixed effects are responsible for the time-invariant heterogeneities around the shared border of two neighboring counties. Since the presence of a single firm in multiple county pairs induces a mechanical correlation across county pairs, we cluster the standard errors at the county pair level.

B. Labor Cost Results

Our research builds on the assumption that minimum wage hikes significantly increase firms' labor costs, and firms adjust their environmental policies in response. Therefore, we first examine the effects of minimum wage policies on employees' wages. Prior studies find that Chinese firms largely comply with minimum wage policies, with fewer than 3.5% of full-time workers earning less than the legal monthly minimum wages (Ye, Gindling, and Li, 2015). In addition, anecdotal evidence suggests that changes in the minimum wage indeed affect the labor costs of manufacturing firms. For example, *The China Times* reported that minimum wage increases in 14 provinces in 2010 raised firms' labor costs in the textile and garment industry and squeezed their profits. *The Economic Observer* surveyed manufacturing firms in the Pearl River Delta economic zone and found that manufacturing firms face intense labor cost pressure from the dramatic increase in minimum wages.[13]

Our empirical analysis of the extent to which minimum wages affect firms' labor costs follows our baseline analysis in equation (1). Table 2 presents the regression results. In Columns 1 and 2, 3 and 4, and 5 and 6, we restrict the sample to firms located within 5 km, 10 km, and 15 km of the shared border of neighboring counties, respectively. The dependent variable *Wage/Worker* is the natural logarithm of the yearly wage expenditure of the manufacturing firm over the total number of employees. The coefficients on *MinWage* in all the Columns are significantly positive. For example, in Column 1, the coefficient of *MinWage* is 0.100 at the 1% significance level, which means that a 10% increase in minimum wages leads to a 1% (= 10%*0.100) increase in firms' average wages. These results suggest that firms' labor costs rise with an increase in the minimum wage, consistent with the findings in Hau et al. (2020).

[Insert Table 2 about here]

[13] See the detailed discussions of the effects of minimum wages on manufacturing firms in the textile and garment industry in https://www.chinatimes.net.cn/article/14289.html and in the Pearl River Delta economic zone in http://news.sohu.com/20100414/n271513014.shtml.

C. Baseline Results and Robustness

Table 3 reports the results from the baseline regressions. In Column 1, the coefficient estimate of *MinWage* is positive and significant at the 5% level, suggesting that firms facing higher minimum wages increase their COD emissions. These results are not driven by industry or provincial trends such as province-level environmental regulations, since industry-year and province-year fixed effects are controlled for in the regressions. The coefficients barely change when we further control for firm-level characteristics such as firm size, leverage, profitability, and industrial output, as well as for macroeconomic conditions such as GDP per capita and GDP growth. Consistent with the literature on industrial firms' pollutant emissions (Xu and Kim, 2021), we find that larger firms (*Size*) with higher production levels (*IndOutput*) emit higher volumes of chemical pollutants. Moreover, firms' COD emission is negatively correlated with GDP per capita, suggesting that firms' emissions fall as economic development proceeds. In Columns 4 and 6, when we restrict the sample to firms located within 10 km or 15 km of the shared border of neighboring counties, we continue to find that the coefficients of *MinWage* are positive at the 1% significance level. In terms of economic significance, the coefficient of *MinWage* is 0.463, indicating that a 10% increase in minimum wages corresponds to a 4.63% (10%*0.463) increase in COD emissions.[14]

[Insert Table 3 about here]

Our findings from the baseline analysis reveal that industrial firms indeed change their environmental policies by emitting more pollutants when they face higher minimum wages, complementing the literature on manufacturing firms' response to minimum wages in China (Hau et al., 2020). In other words, the cost of minimum wages may be partly paid by the environment. Our baseline results also highlight the effects of non-climate policies on a firm's

[14] Our results remain quantitatively and qualitatively similar if we exclude firms with zero emissions. In Table A2 of the Internet Appendix, we replace the end-of-year minimum wages by the average monthly minimum wages and find similar results.

environmental performance.

To validate the sensitivity of our baseline results, we conduct a battery of robustness tests. Our sample period is characterized by a phenomenal economic growth. To mitigate the concern that minimum wages and firms' pollutant emissions (and industrial output) rise simultaneously with this economic growth, we examine the effects of minimum wages of firms' emission intensity. We measure firms' pollution intensity using the natural logarithm of COD emitted over industrial output. As shown in Panel A of Table 4, the coefficients on *MinWage* are positively significant in all three Columns, suggesting that firms' pollution intensity rises with an increase in minimum wages.[15]

Next, we corroborate our baseline findings by exploring additional pollutants, including the emissions of SO_2, NH_3-N, and industrial waste gas discharge (*GasDischarge*). SO_2 is the primary cause of acid rain. A high NH_3-N level in water makes it difficult for aquatic organisms to sufficiently excrete the toxicant, leading to an internal toxicant buildup in them, and potentially, their death. As in our baseline analysis, we take the natural logarithm of the pollutant emission level and use this as the dependent variable in our regressions. For brevity, we report the results based on the sample of firms located within 10 km of the shared border of the neighboring counties. As shown in Panel B of Table 4, the coefficients of *MinWage* are significantly positive (Columns 1 and 2), suggesting that firms increase their SO_2 and NH_3-N emissions when they face higher minimum wages. In Column 3, we also find that higher minimum wages lead to higher industrial gas discharges. Overall, our baseline results are robust to using the other pollutants covered by the ESR database.

While our methodology effectively controls local economic conditions through the geographical discontinuity of minimum wages, it may lead to a larger sample size, potentially

[15] Results in Table A3 of the Internet Appendix show that the effects of minimum wages on firms' production are not statistically significant. This further mitigates the concern that our baseline results are driven by the increase in firms' production.

impacting the significance of the independent variable. Therefore, we further restrict our sample not only by geographic distance but also by industry and size. Specifically, for each firm *i* in industry X in county A, located within 5/10/15 km from the border shared with neighboring county B, we matched it with a firm *j* in industry X in county B, also within the same distance range from the border. Crucially, firm *j* is the closest in size to firm *i* among all eligible firms in county B. Panel C of Table 4 presents the results using the industry and size matched sample. The coefficients of *MinWage* are all positive and significant, suggesting an impact of minimum wages on increased pollution with a refined sample.

Due to limitations in the coverage of the ESR and CIC datasets, our sample period is restricted to the years between 1998 and 2013. To alleviate concerns about the external validity of our findings, we perform additional analyses using aggregated city-level pollution data spanning from 2000 to 2021. These additional analyses in Table A4 of the Internet Appendix reveal a consistent trend: higher minimum wages were associated with increased pollutant emissions. This suggests that the potential environmental impacts of minimum wage policies extend beyond the sample period of 1998 - 2013, during which time China experienced rapid GDP growth.

[Insert Table 4 about here]

D. Moderating Effect of Ownership Type

In this sub-section, we explore the moderating effect of ownership type on the relationship between minimum wages and a firm's environmental performance. State-owned enterprises (SOEs) are essential components of the Chinese economy, with 180,976 SOEs presented in our sample from 1998 to 2013. These SOEs contributed to over one-quarter of total industry output for all above-scale manufacturing firms. However, previous studies provide mixed views on the role of SOEs (Stiglitz, 1993; Shleifer, 1998). On the one hand, SOEs have always been criticized for their poor corporate governance as well as lower efficiency and productivity (La

Porta and Lopez-de-Silanes, 1999; Firth, Fung, and Rui, 2006; Fan, Wong, and Zhang, 2007). Selling the state-owned shares to the private sector (i.e., privatization) may improve SOEs' efficiency (Megginson and Netter, 2001; Liao, Liu, and Wang, 2014; Ru and Zou, 2022). On the other hand, SOEs may be valuable for tasks other than financial performance (Xu, 2011; Lin, Lu, Zhang, and Zheng, 2020). For example, Bai, Lu, and Tao (2006) find that SOEs are capable of hiring excess labor during economic downturns to maintain social stability. More recently, Hsu et al. (2021) show that SOEs are more responsive to sustainability issues. Since SOEs are typically backed by state resources, subsidies, and soft-budget constraints, they may put more effort into addressing externalities than private enterprises (Carney and Child, 2013; Boubakri, El Ghoul, Guedhami, and Megginson, 2017). In the following analyses, we therefore explore the role of state ownership in addressing environmental externalities when facing competitive shocks from minimum wages.

To test the moderating effects of state ownership, we split the sample into SOEs and non-SOEs and estimate the effects of minimum wages on pollutant emissions in each subsample. To test the statistical significance, we conduct a full sample regression with *MinWage* interacting with an SOE indicator. Results are reported in Table 5. In Panel A of Table 5, we first focus on COD emission level and intensity. In Columns 1 and 2, the coefficient of *MinWage* is 0.601 at the 1% significance level in the non-SOE sample, while it is statistically insignificant for SOEs. This finding suggests that the impact of minimum wages on COD emissions is less evident for SOEs. In Column 3, the coefficient of the interaction between *MinWage* and *SOE* is -0.452 at the 1% significance level, suggesting that the effects of minimum wages on COD emissions are indeed significantly lower for SOEs. In terms of economic significance, the effect of *MinWage* on COD emissions is 82.2% lower for SOEs. In Columns 4 – 6, we examine the moderating effects of state ownership on the relationship between minimum wages and COD emission intensity. Consistent with our expectations, the coefficient of *MinWage* is 0.339 at the 1% significance level for the non-SOEs, while it is statistically insignificant for SOEs. Moreover, the coefficient of the interaction between *MinWage* and *SOE* is -0.191 at the 1% significance level, confirming the different responses of SOEs and non-SOEs when they face minimum wage hikes.

In Panel B of Table 5, we include additional industrial pollutants variables such as SO_2 emissions, NH_3-N emissions, and industrial waste gas discharges. The coefficients of *MinWage* in Columns 1, 4, and 7 are significantly positive for non-SOEs, while they are insignificant for SOEs in the corresponding Columns. The coefficients of the interaction between *MinWage* and *SOE* are significantly negative at the 1% level in Columns 3, 6, and 9, suggesting that, relative to SOE firms, non-SOE firms emit more SO_2, NH_3, and industrial waste gas when experiencing local minimum wage increases. For robustness, in Table A5 of the Internet Appendix, we examine the effects of minimum wages on firms' emission intensity of other pollutants (e.g., SO_2) and find similar results.

[Insert Table 5 about here]

Overall, the results in Table 5 reveal the moderating effects of state ownership on the relationship between minimum wages and industrial pollution. Our findings suggest that SOEs are better than non-SOEs at absorbing environmental externalities when facing competitive shocks from minimum wages. These results complement the prior literature on the value of SOEs in non-profitability-related tasks (Stiglitz, 1993).

E. Underlying Mechanisms

Firms generally undertake "end-of-pipe" adjustments to remove pollutants and thus reduce emissions. When the local minimum wage increases, they may reduce "end-of-pipe" interventions such as investment in the wastewater treatment system in response to increased labor costs. Following He et al. (2020), we thus measure firms' abatement efforts using the number of wastewater treatment facilities and wastewater treatment capacity in tons per day.

We scale the absolute number by firms' industrial output to measure whether their "end-of-pipe" intervention investments meet production requirements. Results are reported in Table 6. In Columns 1 and 2, we estimate the effects of minimum wages on firms' water treatment facilities for the non-SOEs and SOEs separately. In Column 1, the coefficient of *MinWage* is -0.069 at the 5% significance level. This suggests that the non-SOEs reduce their investment in wastewater treatment facilities in response to minimum wage hikes. In Column 2, the coefficient of *MinWage* is statistically insignificant. In Column 3, the coefficient of *MinWage* is significantly negative, and the coefficient of the interaction between *MinWage* and *SOE* is 0.021 at the 5% significance level. In Columns 4 – 6, we examine whether the effects of minimum wages on firms' wastewater treatment capacity depend on their ownership type. We find that the coefficient of *MinWage* is significantly negative in Column 4 but insignificant in Column 5. Moreover, the coefficient of the interaction between *MinWage* and *SOE* is 0.057 at the 5% significance level.

[Insert Table 6 about here]

The findings in Table 6 suggest that the impact of minimum wages on firms' abatement efforts depends on firms' ownership type. Although firms may not sell their wastewater treatment facilities in response to minimum wage increases, those facing competitive shocks from minimum wage raises may not invest in pollution abatement as much as other firms. Moreover, when facing minimum wage hikes, non-SOEs are more likely to reduce their pollution abatement investment. Taken together, the results in Table 6 help to explain the environmental performance gap between SOEs and non-SOEs documented in Table 5.

F. Heterogeneity Analysis

In the previous analyses, we find that firms reduce their pollution abatement efforts and emit higher volumes of pollutants in response to minimum wage hikes. However, firms' response to environmental policies may depend on environmental regulations, their sensitivity to minimum wages, product market power, financial conditions, and public scrutiny. We now explore these cross-sectional dimensions.

1. Pollution Discharge Fees

Although firms may pass their labor costs onto the environment by increasing pollutant emissions, their environmental policies might depend on environmental regulation and/or pollution discharge fees. This sub-section explores the moderating effects of pollution discharge fees on the relationship between minimum wages and industrial pollution.

In July 2003, a comprehensive pollution charge policy came into effect in China. COD emissions were charged at 0.7 RMB/kg, while the SO_2 emission fee increased to 0.63 RMB/kg in July 2005 from 0.21 RMB/kg in July 2003.[16] In 2007, the State Council set a Comprehensive Work Plan for Energy Conservation and Emission Reduction. This plan aimed to reduce energy consumption per unit of GDP by 20% and the total discharge of major pollutants by 10% during the 11th Five-Year Plan period. In particular, the plan stated that the SO_2 emission fee should increase to 1.26 RMB/kg within three years and that local governments should increase the COD emission fee according to local conditions.

The variations in COD and SO_2 charges across provinces are shown in Panels A and B of Table 7, respectively. These variations in pollution charges provide a valuable setting to test whether the impact of minimum wage hikes on firms' environmental policies depends on discharge fees. As shown in Panel C of Table 7, the coefficients of the interactions between *MinWage* and *COD Charges* and between *MinWage* and *SO_2 Charges* are -0.597 and -0.605, respectively, both at the 1% significance level. These results suggest that firms are keenly aware of the external regulatory environment when trading off labor costs and pollution controls. With the increase in labor costs owing to minimum wage hikes, firms located in provinces with lower

[16] Here, 1 kg of COD translates into one unit of water pollution equivalent and 0.95 kg of SO2 translates into one unit of gas pollution equivalent. Thus, one water (gas) pollution equivalent unit is charged at RMB 0.7 (0.6).

pollution charges are more likely to pass their labor costs onto the environment by increasing pollutant emissions.

[Insert Table 7 about here]

2. Minimum Wage Sensitivity

Firms' response to minimum wages may depend on their sensitivity to the minimum wage policies. Firms hiring more minimum wage workers tend to be more sensitive to minimum wage policies. However, as no payroll information on employees is available, we use two measures to proxy for firms' sensitivity to minimum wages: the distance between firms' average wage and local minimum wages and firms' labor intensity. In this sub-section, we explore the effects of minimum wages along these two dimensions.

The distance to minimum wages equals firms' yearly wage expenditure over the total number of employees minus the local minimum wages. Firms with lower (higher) average wages relative to minimum wages are more (less) likely to hire workers earning minimum wages and are thus more (less) sensitive to the minimum wage hikes. We calculate the firm-year-level distance between firms' average wage and local minimum wages and aggregate it at the two-digit industry-year level. Firms are sorted based on their industry-wide average distance to minimum wage each year. Industries with distance to minimum wages higher than the median industry's distance to minimum wages are defined as high wage distance industries (i.e., they have low sensitivity to minimum wages).

A firm's labor intensity equals the annual wage expenditure over total assets. A higher ratio means higher labor intensity. We calculate two-digit industry-year level labor intensity by considering the average labor intensity across all the firms in each industry in each year. Each year, industries are sorted based on their industry-wide labor intensity. Industries with labor intensity higher than the median industry's labor intensity are defined as high labor intensity industries (i.e., they are highly sensitive to minimum wages).

Panel A and Panel B of Table 8 report the results. In Panel A, the coefficient of *MinWage* is smaller (0.375) in the high distance to minimum wage subsample than that (0.529) in the low distance subsample. In Column 3, the coefficient of the interaction between *MinWage* and *Distance* is -0.138 at the 5% significance level. These results suggest that firms with higher distance to minimum wages are less responsive to minimum wage hikes. Panel B presents the results for labor intensity. In Column 1 of Panel B, the coefficient of *MinWage* is 0.041 and statistically insignificant, while in Column 2, the coefficient of *MinWage* is 0.821 at the 1% significance level. In Column 3, the coefficient of the interaction between *MinWage* and *Labor Intensity* is 0.151 at the 5% significance level. These results suggest that firms with higher labor intensity are more sensitive to the minimum wages and thus emit more pollutants when facing minimum wage hikes.

[Insert Table 8 about here]

3. Product Market Power

Firms with stronger product market power may have greater bargaining power with their downstream customers and thus be more likely to transfer labor costs downstream. For example, Harasztosi and Lindner (2019) find that around 75% of the minimum wage increase in Hungary is paid by consumers through higher prices. We thus expect firms with greater product market power to pass fewer labor costs onto the environment by increasing pollutant emissions, as they instead pass them onto consumers.

Following the literature (e.g., Lindenberg and Ross, 1981; Datta, Iskandar-Datta, and Sigh, 2013), we measure firms' product market power by the Lerner Index, which equals the price-cost margin over total sales. A higher Lerner Index means a higher price-cost margin and thus greater product market power. We calculate the firm-year level Lerner Index and then aggregate it at the two-digit industry-year level. Each year, industries are sorted based on their industry-wide Lerner Index. Industries with Lerner Index higher than the median industry-wide Lerner

Index are defined as those with high product market power. We examine the effects of minimum wages on firms' environmental performance in two subsamples: high Lerner Index industry firms and low Lerner Index industry firms.

Results are presented in Panel C of Table 8. In Column 1, the coefficient of *MinWage* is 0.639 at the 1% significance level for firms with low product market power. By contrast, the coefficient of *MinWage* is much lower and statistically insignificant for firms with high product market power. In Column 3, the coefficient of the interaction between *MinWage* and *PMC* is -0.287 at the 1% significance level, suggesting that firms with low product market power are more likely to pass labor costs onto the environment by increasing pollutant emissions in response to minimum wage hikes.

4. Financial Constraints

Our next set of cross-sectional tests explores firms' heterogeneity in financial constraints. Firms with higher financing costs (i.e., financially constrained firms) are more incentivized to reduce abatement activities and increase pollutant emissions (Xu and Kim, 2021). Following Hadlock and Pierce (2010) and Manova, Wei, and Zhang (2015), we use firm size to proxy for the financial constraint level.[17] We divide our baseline sample into financially constrained and unconstrained firms.

Results are reported in Panel D of Table 8. In Column 1, the coefficient of *MinWage* is 0.283 for less financially constrained firms, significant at the 10% level, whereas the coefficient of *MinWage* is 0.569 for more financially constrained firms, significant at the 1% level. In Column 3, the coefficient of the interaction between *MinWage* and *Small Firm* is positive at the 1% significance level, suggesting that financially constrained firms are more likely to reduce their environmental expenditures in response to minimum wage hikes.

[17] Manova et al. (2015) use firm size to proxy for financial constraints and test its effects on the export performance of Chinese manufacturing firms.

5. Publicly vs Private Owned Firms

Our next set of cross-sectional tests explores the differential responses of publicly listed firms and private firms. To identify whether the establishments in our sample belong to publicly listed or private firms, we utilized a two-step approach. We first gathered a list of subsidiaries of publicly listed firms from their annual reports. Then, using the firm names of these subsidiaries, we obtained their Register Codes from Qichacha.com. These codes allowed us to accurately link the subsidiaries with entries in the Environmental Survey and Reporting (ESR) database.

Results are reported in Panel E of Table 8. In Column 1, the coefficient of *MinWage* is 0.505 for private owned firms, significant at the 1% level, whereas the coefficient of *MinWage* is -0.015 for publicly owned firms, insignificant at the 10% level. In Column 3, the coefficient of the interaction between *MinWage* and *Listed* is negative at the 1% significance level, suggesting the differential responses of minimum wage hikes between these types of firms. This could be attributed to the heightened scrutiny and media coverage that publicly listed firms typically face in environmental performance, as suggested by Liang, Qi, Zhang, and Zhu (2022).

G. Aggregate Effects of Minimum Wages

Our findings reveal that minimum wage hikes lead to higher pollutant emissions for individual firms. However, at the regional level, this relationship may not hold consistently, as polluting firms may exit the market due to the competitive pressures of increased labor costs.

In this subsection, we examine the aggregate impact of minimum wages on regional pollution levels as well as the economic consequences (e.g., financial performance), especially for regions with a high SOE ratio. Drawing on the previous results, we hypothesize that counties with a high SOE ratio are less likely to pass their labor cost onto the environment by increasing pollutant emissions. We also conjecture that the emission constraints of SOEs may not be conducive to their economic benefits. We follow the framework in the baseline analysis and compare the pollution of neighboring counties. Specifically, we construct a county pair-year sample to examine the effects of minimum wages on COD emissions and financial performance.

As shown in Column 1 of Table 9, the coefficient of *MinWage* is 0.622 at the 1% significance level, suggesting that firms in counties with higher minimum wages pollute more intensively. Moreover, the coefficient of the interaction between *MinWage* and *SOERatio* is -0.535 at the 1% significance level, suggesting the role of SOEs in absorbing externalities. The results are similar when including regional industrial output and other controls in Column 2. In Columns 3 and 4, we examine the effects of minimum wages on aggregated corporate financial performance.[18] In Column 3, the coefficient of *MinWage* is -2.557 at the 1% significance level, suggesting that shareholders bear a proportion of the labor cost increase due to minimum wage hikes. The coefficient of the interaction between *MinWage* and *SOERatio* is -1.466 at the 1% significance level, suggesting that these SOEs absorb the externalities themselves and perform worse financially.

[Insert Table 9 about here]

IV. Conclusion

We use firm-level pollutant emission data to study how minimum wage hikes influence firms' environmental performance. We hypothesize that an increase in the minimum wage incentivizes firms to reallocate expenditures between employment and environmental abatement, resulting in unintended effects on the environment. Treating the pollutant emissions generated during manufacturing is costly and consumes significant financial resources. Firms reduce their abatement expenditures when they face increased labor costs. Indeed, in China,

[18] We also explore how the minimum wage hikes affect firms' competitive edge using the firm-level analysis. In Table A6 of the Internet Appendix, we find that firms with higher minimum wages may lose their competitive edge over time, highlighting the importance of additional policy considerations.

given that pollution discharge fees are relatively low, they choose to emit the additional pollutants instead of internalizing the pollution treatment costs, thereby imposing additional costs on the environment, society, and public health. Moreover, we find that the negative externalities of minimum wage policies are less pronounced for SOEs, which are created to deal with market failures. The cross-sectional results also show that the documented impacts of the minimum wages are amplified by weak environmental regulations, minimum wage sensitivity, financial constraints, low product market power, and private ownership. These results consistently point to the environmental externalities of minimum wage policies.

Our study provides several policy implications. The literature has largely investigated different payers of minimum wages (i.e., consumers, firm owners, and employees) and firms' responses to minimum wage policies; however, we document the unintended consequences of the minimum wage on corporate environmental policies, thus adding to the debate on the minimum wage policy. We also contribute to the literature on the relationship between labor market frictions and corporate policies. Finally, our results highlight the benefits of state ownership when dealing with externalities. Collectively, our results caution policymakers about the unintended environmental consequences of implementing minimum wage policies.

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Appendix Table for Variable Definitions

Variable	Definition
MinWage	The natural logarithm of the end-of-year monthly minimum wage in each county in the previous year.
CODEmission	The natural logarithm of one plus firms' chemical oxygen demand (COD) emission in kilograms.
SO_2Emission	The natural logarithm of one plus firms' sulfur dioxide (SO_2) emission in kilograms.
NH3-NEmission	The natural logarithm of one plus firms' ammonia nitrogen (NH_3-N) emission in kilograms.
GasDischarge	The natural logarithm of one plus firms' industrial waste gas discharged in 10,000 cubic meters.
CODIntensity	The natural logarithm of firms' COD emissions in kilograms over firms' industrial output in 10,000 RMB.
Wage/Worker	The natural logarithm of yearly total wage expenditure over total number of employees.
WaterCapacity	The wastewater treatment capacity in tons per day over industrial output.
WaterFacility	The number of wastewater treatment facilities over industrial output times 1000.
SOE	An indicator that equals one if a firm is registered as state-owned enterprises (110), collectively owned enterprise (120), state-owned joint venture (141), collectively owned joint venture (142), state and collectively owned joint venture (143), or wholly state-owned company (151) and zero otherwise.
Size	The natural logarithm of total asset.
Profitability	The firm's operating profit over total asset.
Leverage	The total liability over total asset.
IndOutput	The natural logarithm of one plus firms' industrial output in 10,000 RMB.
GDP Per Capita	The GDP over total population in the city where the firm is located.
GDP Growth	The GDP growth in the city where the firm is located.
Distance	An indicator that equals one if the firm is in the high distance to minimum wages industry in this year. The industry wide distance to minimum wages is the average distance between firms' average wage to minimum wages of all firms in the industry.
LaborIntensity	An indicator that equals one if the firm is in the high labor intensity industry in this year. The industry wide labor intensity is measured by the average labor intensity of all firms in this industry. The labor intensity equals firm's yearly total wage expenditure over total assets.

PMC	An indicator that equals one if the firm is in the high product marker power industry in this year. The industry wide product market power is the average Lerner Index of all firms in this industry. The Lerner Index is computed by dividing the difference between operating income and operating expense by operating income.
Small Firm	An indicator that equals one if firm size above the sample median and zero otherwise.
Listed	An indicator that equals one if the firm is a subsidiary of a listed company and zero otherwise.
CODCharges	The per kilograms pollution fees for chemical oxygen demand (COD) emissions at the end of the year.
SO_2Charges	The per kilograms pollution fees for sulfur dioxide (SO_2) emissions at the end of the year.
SOERatio	The percentage of firms that are registered as SOE in each county.
AvgIndOutput	The natural logarithm of total industry output across all industrial firms in each county.

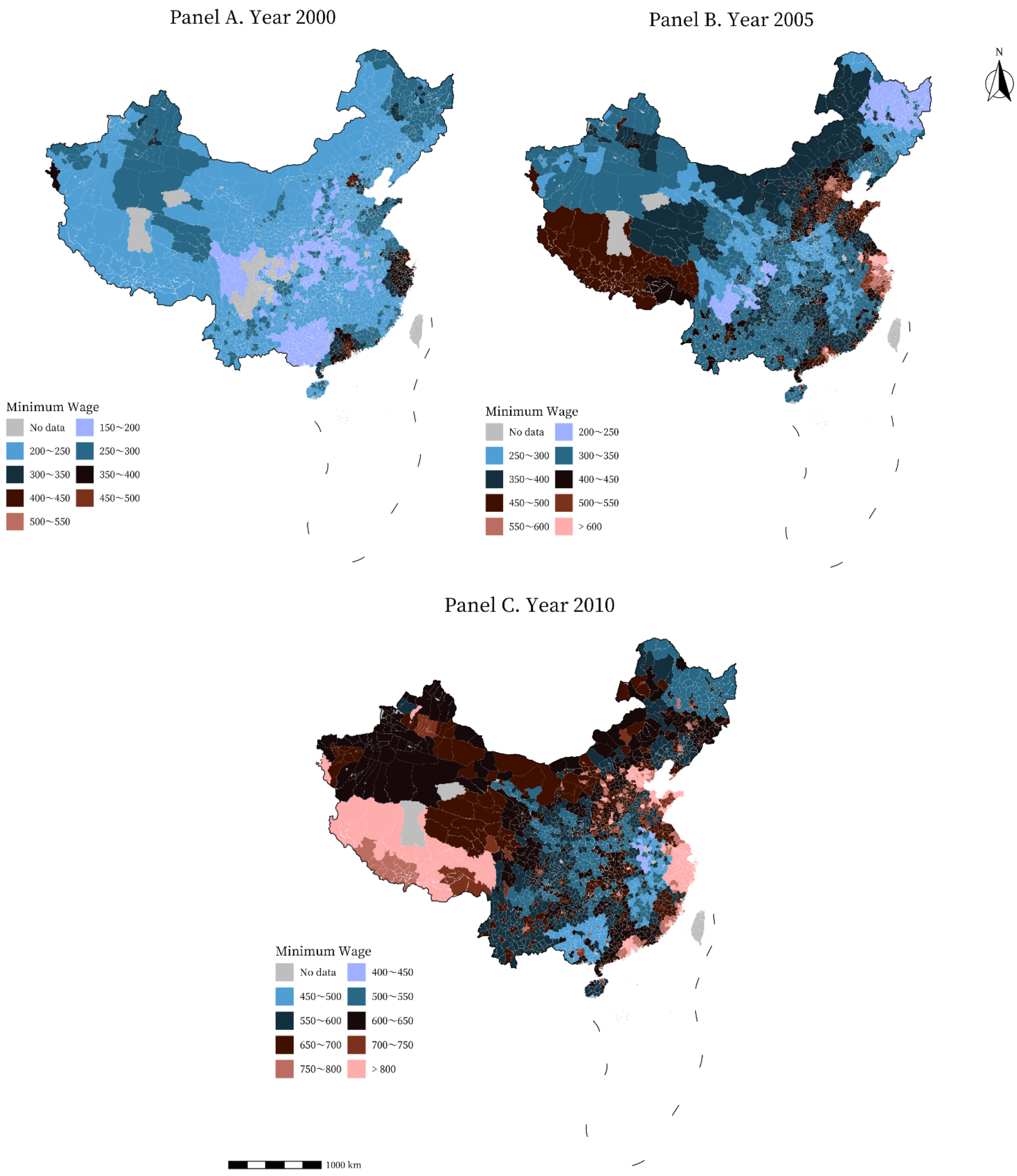

Figure 1. Geographical Distribution of Minimum Wages in China

This figure displays the minimum wages across counties in China. Panel A, B, and C plots the minimum wages in 2000, 2005, and 2010, respectively. Minimum wages at different levels are marked by different colors, with light blue (pink) denoting the lowest (highest) minimum wages.

Table 1. Summary Statistics

This table presents summary statistics at the firm-year level (Panel A) and firm-year-county pair level (Panel B). Panel B, our working sample, focuses on firms within 10 kilometers from the border of neighboring counties. The firm-year-county pair data of the baseline regression sample consists of 935,594 observations from 1998 to 2013. *MinWage* is the natural logarithm of the end-of-year monthly minimum wage in each county in the previous year. *CODEmission* is the natural logarithm of one plus firm's chemical oxygen demand (COD) emission in kilograms. *Wage/Worker* is the natural logarithm of yearly total wage expenditure over the total number of employees. *WaterCapacity* is the wastewater treatment capacity in tons per day over industrial output. *WaterFacility* is the number of wastewater treatment facilities over industrial output times 1000. *SOE* is an indicator that equals one if a firm is registered as state-owned enterprise (110), collectively owned enterprise (120), state-owned joint venture (141), collectively owned joint venture (142), state and collectively owned joint venture (143), or wholly state-owned company (151) and zero otherwise. *Size* is the natural logarithm of total asset. *Profitability* is the firms' operating profit over total asset. *Leverage* is the total liability over total asset. *IndOutput* is the natural logarithm of one plus firms' industrial output. *GDP Per Capita* and *GDP Growth* are the GDP over total population and GDP growth in the city where the firm is located, respectively.

Panel A: Firm-Year Level Summary Statistics

Variable	N	Mean	SD	P25	P50	P75
MinWage	545,639	6.269	0.491	5.940	6.310	6.659
CODEmission	564,546	7.315	3.645	5.771	7.997	9.798
Wage/Worker	479,204	9.536	0.831	8.992	9.488	10.038
WaterCapacity	451,979	0.304	0.854	0.000	0.023	0.167
WaterFacility	451,331	0.599	1.494	0.017	0.144	0.522
SOE	558,930	0.179	0.383	0.000	0.000	0.000
Size	563,817	11.050	1.623	9.888	10.916	12.075
Profitability	527,334	7.931	18.458	-0.038	2.603	9.926
Leverage	563,257	0.600	0.290	0.401	0.603	0.790
IndOutput	564,543	8.261	1.958	7.163	8.243	9.393
GDP Per Capita	559,198	37.899	36.322	12.912	25.214	48.844
GDP Growth	559,066	0.149	0.066	0.104	0.146	0.191

Panel B: Firm-Year-County Pair Summary Statistics

Variable	N	Mean	SD	P25	P50	P75
MinWage	935,594	6.279	0.492	5.914	6.292	6.659
CODEmission	935,594	7.312	3.535	5.861	7.938	9.677
Wage/Worker	848,588	9.616	0.822	9.085	9.569	10.113
WaterCapacity	748,031	0.267	0.793	0.000	0.019	0.136
WaterFacility	747,381	0.532	1.401	0.011	0.118	0.459
SOE	935,591	0.192	0.394	0.000	0.000	0.000
Size	935,594	11.200	1.650	10.014	11.081	12.256
Profitability	935,594	7.179	17.304	-0.112	2.430	9.201
Leverage	935,594	0.600	0.289	0.402	0.602	0.787
IndOutput	935,594	8.362	2.051	7.266	8.367	9.564
GDP Per Capita	935,594	40.326	36.735	14.667	28.443	52.314
GDP Growth	935,594	0.146	0.063	0.105	0.143	0.185

Table 2. Minimum Wages and Firms' Labor Costs

This table presents the OLS regression results of minimum wages on firms' labor costs. Regression samples are at the firm × year × neighboring county pair level. The dependent variable *Wage/Worker* is the natural logarithm of yearly total wage expenditure over total number of employees. The independent variable of interest *MinWage* is the natural logarithm of the end-of-year monthly minimum wage in each county in the previous year. In Columns 1 and 2, 3 and 4, and 5 and 6, samples are restricted to firms located within 5, 10, 15 kilometers from the border of neighboring counties, respectively. In Columns 2, 4, and 6, firm and macro-economic controls are included in the regression. The firm-level controls include the firm's total assets, leverage, profitability, and industrial output. Macro-economic controls include the GDP per capita and GDP growth of the city where the firm is located. See Appendix Table for detailed variable definitions. All specifications include firm, neighboring county pair, industry × year, and province × year fixed effects. Standard errors are clustered at the neighboring county pair level. T-statistics are reported in parentheses. ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

	5 KM		10 KM		15 KM	
	1	2	3	4	5	6
Variables	*Wage/Worker*	*Wage/Worker*	*Wage/Worker*	*Wage/Worker*	*Wage/Worker*	*Wage/Worker*
MinWage	0.100***	0.091***	0.075***	0.059***	0.084***	0.067***
	(3.20)	(3.07)	(3.25)	(2.71)	(4.47)	(3.75)
Size		0.124***		0.129***		0.134***
		(34.77)		(50.46)		(62.78)
Profitability		0.004***		0.004***		0.004***
		(26.21)		(37.88)		(45.16)
Leverage		0.012		0.001		-0.005
		(1.47)		(0.24)		(-1.03)
IndOutput		0.010***		0.011***		0.011***
		(10.97)		(15.88)		(18.95)
GDP Per Capita		0.001***		0.001***		0.001***
		(3.48)		(3.82)		(4.04)
GDP Growth		0.145***		0.133***		0.138***
		(4.26)		(5.26)		(6.46)
Firm FE	YES	YES	YES	YES	YES	YES
County Pair FE	YES	YES	YES	YES	YES	YES
Industry × Year FE	YES	YES	YES	YES	YES	YES
Province × Year FE	YES	YES	YES	YES	YES	YES
Observations	421,594	419,472	852,024	846,711	1,254,999	1,245,536
Adj. R-squared	0.743	0.751	0.751	0.758	0.757	0.764

Table 3. Minimum Wages and Pollutant Emissions

This table presents the OLS regression results of minimum wages on firms' chemical oxygen demand (COD) emissions. Regression samples are at the firm × year × neighboring county pair level. The dependent variable *CODEmission* is the natural logarithm of one plus firms' COD emission in kilograms. The independent variable of interest *MinWage* is the natural logarithm of the end-of-year monthly minimum wage in each county in the previous year. In Columns 1 and 2, 3 and 4, and 5 and 6, samples are restricted to firms located within 5, 10, 15 kilometers from the border of neighboring counties, respectively. In Columns 2, 4, and 6, firm and macro-economic controls are included in the regression. The firm-level controls include the firm's total assets, leverage, profitability, and industrial output. Macro-economic controls include the GDP per capita and GDP growth of the city where the firm is located. See Appendix Table for detailed variable definitions. All specifications include firm, neighboring county pair, industry × year, and province × year fixed effects. Standard errors are clustered at the neighboring county pair level. T-statistics are reported in parentheses. ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

	5 KM		10 KM		15 KM	
	1	2	3	4	5	6
Variables	*CODEmission*	*CODEmission*	*CODEmission*	*CODEmission*	*CODEmission*	*CODEmission*
MinWage	0.415**	0.340*	0.495***	0.463***	0.566***	0.530***
	(2.05)	(1.69)	(3.49)	(3.24)	(4.73)	(4.39)
Size		0.197***		0.191***		0.185***
		(14.33)		(19.82)		(23.43)
Profitability		0.003***		0.003***		0.003***
		(5.47)		(7.85)		(9.23)
Leverage		0.017		0.026		0.025
		(0.50)		(1.09)		(1.32)
IndOutput		0.227***		0.241***		0.253***
		(29.01)		(40.01)		(48.63)
GDP Per Capita		-0.007***		-0.006***		-0.006***
		(-3.54)		(-3.49)		(-3.77)
GDP Growth		0.497**		0.481***		0.486***
		(2.16)		(2.77)		(3.35)
Firm FE	YES	YES	YES	YES	YES	YES
County Pair FE	YES	YES	YES	YES	YES	YES
Industry × Year FE	YES	YES	YES	YES	YES	YES
Province × Year FE	YES	YES	YES	YES	YES	YES
Observations	495,119	462,766	1,004,795	935,594	1,483,431	1,377,089
Adj. R-squared	0.653	0.664	0.665	0.676	0.675	0.687

Table 4. Robustness Checks

This table presents the OLS regression results of robustness checks. Regression samples are at the firm × year × neighboring county pair level. Panel A presents the results for COD pollution intensity. *CODIntensity* is natural logarithm of kilograms of COD emitted over industrial output. In Columns 1, 2, and 3, samples are restricted to firms located within 5, 10, and 15 kilometers from the border of neighboring counties, respectively. All specifications in Panel A include total assets, leverage, profitability, GDP per capita, and GDP growth as controls. Panel B presents the results for alternative pollutants. Samples in all Columns are restricted to firms located within 10 kilometers from the border of neighboring counties. Panel C presents the results from the industry and size matched sample. All specifications in Panels B and C include total assets, leverage, profitability, industrial output, GDP per capita, and GDP growth as controls. See Appendix Table for detailed variable definitions. All specifications include firm, neighboring county pair, industry × year, and province × year fixed effects. Standard errors are clustered at the neighboring county pair level. T-statistics are reported in parentheses. ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

Panel A: Pollution Intensity

	5 KM	10 KM	15 KM
	1	2	3
Variables	*CODIntensity*	*CODIntensity*	*CODIntensity*
MinWage	0.398***	0.299***	0.311***
	(3.85)	(4.29)	(5.52)
Controls	YES	YES	YES
Firm FE	YES	YES	YES
County Pair FE	YES	YES	YES
Industry × Year FE	YES	YES	YES
Province × Year FE	YES	YES	YES
Observations	399,405	808,275	1,190,558
Adj. R-squared	0.779	0.793	0.802

Panel B: Emissions of Other Pollutants

	1	2	3
Variables	*SO_2Emission*	*NH_3-NEmission*	*GasDischarge*
MinWage	0.343***	0.305*	0.280***
	(2.95)	(1.77)	(2.95)
Controls	YES	YES	YES
Firm FE	YES	YES	YES
County Pair FE	YES	YES	YES
Industry × Year FE	YES	YES	YES
Province × Year FE	YES	YES	YES
Observations	935,590	844,669	765,193
Adj. R-squared	0.84	0.692	0.83

(to be continued)

Table 4. Robustness Checks - *continued*

Panel C: Industry and Size Matched Sample

	5 KM	10 KM	15 KM
	1	2	3
Variables	*CODEmission*	*CODEmission*	*CODEmission*
MinWage	0.990**	0.658**	0.486**
	(1.988)	(2.014)	(1.990)
Controls	YES	YES	YES
Firm FE	YES	YES	YES
County Pair FE	YES	YES	YES
Industry × Year FE	YES	YES	YES
Province × Year FE	YES	YES	YES
Observations	143,803	335,309	596,814
Adj. R-squared	0.834	0.832	0.834

Table 5. Minimum Wages, State Ownership, and Pollutant Emissions

This table presents the OLS regression results of minimum wages on firms' industrial emissions across different types of ownership. Regression samples are at the firm × year × neighboring county pair level and restricted to firms within 10 kilometers from the border of neighboring counties. *MinWage* is the natural logarithm of the end-of-year monthly minimum wage in each county in the previous year. *SOE* is an indicator that equals one if a firm is registered as state-owned, and zero otherwise. Panel A focuses on COD emission level and intensity. *CODEmission* is the natural logarithm of one plus firms' COD emission in kilograms. *CODIntensity* is the natural logarithm of kilograms of COD emitted over industrial output. Panel B focuses on emissions of other pollutants including SO_2, NH_3-N, and Gas Discharge. *SO_2Emission* is the natural logarithm of one plus firms' SO_2 emission in kilograms. *NH_3-NEmission* is the natural logarithm of one plus firms' ammonia nitrogen (NH_3-N) emission in kilograms. *GasDischarge* is the natural logarithm of one plus firms' industrial waste gas discharged in 10,000 cubic meters. All specifications include firm and macro-economic controls. In Columns 1-3 of Panel A and Panel B, the firm-level controls include total assets, leverage, profitability, and industrial output. In Columns 4-6 of Panel A, the firm-level controls include total assets, leverage, and profitability. Macro-economic controls include the GDP per capita and GDP growth of the city where the firm is located. In the full sample regressions, the main effects of *SOE* are also controlled. See Appendix Table for detailed variable definitions. All specifications include firm, neighboring county pair, industry × year, and province × year fixed effects. Standard errors are clustered at the neighboring county pair level. T-statistics are reported in parentheses. ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

Panel A: COD Emission and Intensity

	1	2	3	4	5	6
		CODEmission			*CODIntensity*	
Variables	Non-SOE	SOE	Full Sample	Non-SOE	SOE	Full Sample
MinWage	0.601***	-0.248	0.550***	0.339***	0.104	0.333**
	(3.79)	(-0.96)	(3.84)	(4.31)	(0.76)	(4.80)
MinWage × SOE			-0.452***			-0.191***
			(-10.87)			(-7.83)
Controls	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
County Pair FE	YES	YES	YES	YES	YES	YES
Industry × Year FE	YES	YES	YES	YES	YES	YES
Province × Year FE	YES	YES	YES	YES	YES	YES
Observations	754,787	178,802	935,591	657,374	149,009	808,272
Adj. R-squared	0.680	0.721	0.676	0.800	0.793	0.793

Table 5. Minimum Wages, State Ownership, and Pollutant Emissions – *continued*

Panel B: Emissions of Other Pollutants

	1	2	3	4	5	6	7	8	9
	SO_2Emission			*NH_3-NEmission*			*GasDischarge*		
Variables	Non-SOE	SOE	Full Sample	Non-SOE	SOE	Full Sample	Non-SOE	SOE	Full Sample
MinWage	0.468***	-0.313	0.454***	0.402**	-0.038	0.351**	0.395***	-0.196	0.405***
	(3.53)	(-1.57)	(3.91)	(2.09)	(-0.16)	(2.02)	(3.19)	(-1.27)	(3.88)
MinWage × SOE			-0.586***			-0.316***			-0.566***
			(-13.39)			(-6.55)			(-15.30)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
County Pair FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry × Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Province × Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	754,783	178,802	935,587	716,693	126,309	844,666	592,527	170,667	765,193
Adj. R-squared	0.844	0.853	0.840	0.691	0.746	0.692	0.826	0.871	0.830

Table 6. Minimum Wages, State Ownership, and Abatement Efforts

This table presents the OLS regression results of minimum wages on firms' abatement efforts across different types of ownership. Regression samples are at the firm × year × neighboring county pair level and restricted to firms within 10 kilometers from the border of neighboring counties. *MinWage* is the natural logarithm of the end-of-year monthly minimum wage in each county in the previous year. *SOE* is an indicator that equals one if a firm is registered as state-owned, and zero otherwise. Columns 1, 2, and 3 focus on the number of wastewater treatment capacities, and Columns 4, 5, and 6 focus on the wastewater treatment facilities. *WaterCapacity* is the wastewater treatment capacity in tons per day over industrial output. *WaterFacility* is the number of wastewater treatment facilities over industrial output. Firm controls (*Size*, *Leverage*, and *Profitability*) and macro-economic controls (*GDP Per Capita* and *GDP Growth*) are included in regressions in all Columns. In Columns 1 and 4, and 2 and 5, samples are restricted to non-SOE and SOE firms, respectively. In Columns 3 and 6, the main effect of SOE is also controlled. See Appendix Table for detailed variable definitions. All specifications include firm, neighboring county pair, industry × year, and province × year fixed effects. Standard errors are clustered at the neighboring county pair level. T-statistics are reported in parentheses. ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

	1	2	3	4	5	6
	WaterCapacity			*WaterFacility*		
Variables	Non-SOE	SOE	Full Sample	Non-SOE	SOE	Full Sample
MinWage	-0.069**	-0.042	-0.045*	-0.191**	-0.145	-0.144*
	(-2.29)	(-0.83)	(-1.77)	(-2.11)	(-0.69)	(-1.77)
MinWage × SOE			0.021**			0.057**
			(2.50)			(2.07)
Controls	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
County Pair FE	YES	YES	YES	YES	YES	YES
Industry × Year FE	YES	YES	YES	YES	YES	YES
Province × Year FE	YES	YES	YES	YES	YES	YES
Observations	586,584	157,518	746,047	585,929	157,504	745,384
Adj. R-squared	0.655	0.649	0.641	0.457	0.576	0.486

Table 7. Minimum Wages, Pollution Charges and Industrial Pollution

This table presents the COD and SO_2 pollution fee changes across different provinces in China and the OLS regression results of minimum wages on firm's COD and SO_2 emissions across different levels of pollution fees. There are no pollution fees before 2003. Since July 1st 2003, the COD emissions were charged 0.7/kg, while the pollution fees of SO_2 emissions were increased to 0.63/kg in three years (i.e., the SO_2 emissions fees were 0.21/kg on July 1st 2003, 0.42/kg on July 1st 2004, and 0.63/kg on July 1st 2005, respectively). This policy applies to all businesses operating in Mainland China. Panel A and Panel B present the pollution fee adjustment dates and changes in per kilogram pollution charges for COD and SO_2 across different provinces from 2003 to 2013. Regression results are reported in Panel C. Regression samples are at the firm × year × neighboring county pair level and restricted to firms within 10 kilometers from the border of neighboring counties. *MinWage* is the natural logarithm of the end-of-year monthly minimum wage in each county in the previous year. *CODEmission* is the natural logarithm of one plus firm's COD emission in kilograms. *SO_2Emission* is the natural logarithm of one plus firm's sulfur dioxide (SO_2) emission in kilograms. *CODCharges* and *SO_2Charges* are the per kilograms pollution fees for COD and SO_2 at the end of the year, respectively. Firm controls (*Size*, *Leverage*, *Profitability*, and *IndOutput*) and macro-economic controls (*GDP Per Capita* and *GDP Growth*) are included in regressions in all Columns. See Appendix Table for detailed variable definitions. All specifications include firm, neighboring county pair, industry × year, and province × year fixed effects. The main effect of *CODCharges* and *SO_2Charges* are absorbed by the province × year fixed effects. Standard errors are clustered at the neighboring county pair level. T-statistics are reported in parentheses. ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

Panel A: COD Discharge Fees

Province	Adjustment Date	Before Adjustment	After Adjustment
Guangdong	2010.04.01	0.7/kg	1.4/kg
Hebei	2008.07.01	0.7/kg	1.1/kg
	2009.07.01	1.1/kg	1.4/kg
Jiangsu	2007.07.01	0.7/kg	0.9/kg
Liaoning	2010.08.01	0.7/kg	1.4/kg
Shandong	2008.07.01	0.7/kg	0.9/kg
Shanghai	2008.06.01	0.7/kg	1/kg
Xinjiang	2012.08.01	0.7/kg	1.4/kg
Yunnan	2009.09.01	0.7/kg	1.4/kg

Panel B: SO_2 Discharge Fees

Province	Adjustment Date	Before Adjustment	After Adjustment
Anhui	2008.01.01	0.63/kg	0.84/kg
	2009.01.01	0.84/kg	1.05/kg
	2010.01.01	1.05/kg	1.26/kg
Guangdong	2010.04.01	0.63/kg	1.26/kg
Guangxi	2009.01.01	0.63/kg	0.95/kg
	2010.01.01	0.95/kg	1.26/kg
Hebei	2008.07.01	0.63/kg	1/kg
	2009.07.01	1/kg	1.26/kg
Heilongjiang	2012.08.01	0.63/kg	0.95/kg
	2013.08.01	0.95/kg	1.26/kg
Inner Mongolia	2008.07.10	0.63/kg	0.95/kg
	2009.01.01	0.95/kg	1.26/kg
Jiangsu	2007.07.01	0.63/kg	1.26/kg
Liaoning	2010.08.01	0.63/kg	1.26/kg
Shandong	2008.07.01	0.63/kg	1.26/kg
Shanghai	2009.01.01	0.63/kg	1.26/kg
Shanxi	2008.04.01	0.63/kg	1.26/kg
Tianjin	2010.12.20	0.63/kg	1.26/kg
Xinjiang	2012.08.01	0.63/kg	1.26/kg
Yunnan	2009.01.01	0.63/kg	0.95/kg
	2010.01.01	0.95/kg	1.26/kg

(To be continued)

Table 7. Minimum Wages, Pollution Charges and Industrial Pollution - *continued*

Panel C: Pollution Discharge Fees

	1	2
Variables	*CODEmission*	*SO_2Emission*
MinWage	0.804***	0.644***
	(4.14)	(4.51)
MinWage × CODCharges	-0.597**	
	(-2.50)	
MinWage × SO_2Charges		-0.605***
		(-3.08)
Controls	YES	YES
Firm FE	YES	YES
County Pair FE	YES	YES
Industry × Year FE	YES	YES
Province × Year FE	YES	YES
Observations	935,594	935,590
Adj. R-squared	0.676	0.840

Table 8. Minimum Wages and Pollutant Emissions: Cross-Section

This table presents the OLS regression results of minimum wages on firms' chemical oxygen demand (COD) emissions across different types of firms. Regression samples are at the firm × year × neighboring county pair level and restricted to firms within 10 kilometers from the border of neighboring counties. *MinWage* is the natural logarithm of the end-of-year monthly minimum wage in each county in the previous year. Panel A presents the results on a firm's wage distance to minimum wage which equals a firms' total wage expenditure divided by number of employees minus the local minimum wages. In each year, firms are sorted by their industry wide wage distance to minimum wages. *Distance* is an indicator which equals one if the firm is in the high distance to minimum wage industry in this year. Column 1 focuses on low distance to minimum wage firms (i.e., below median industry's distance to minimum wages) and Column 2 focuses on high distance to minimum wage firms (i.e., above median industry's distance to minimum wages). Panel B focuses on a firm's labor intensity which equals a firm's total wage expenditure over total assets. In each year, firms are sorted by their industry wide labor intensity. *LaborIntensity* is an indicator that equals one if the firm is in the high labor intensity industry in this year. Column 1 focuses on low labor intensity firms (i.e., below median industry's labor intensity) and Column 2 focuses on high labor intensity firms (i.e., above median industry's labor intensity). Panel C focuses on product market power which is measured by the industry's Lerner Index. For each firm, the Lerner Index is computed by dividing the difference between operating income and operating expense by operating income. In each year, firms are sorted by their industry wide Lerner Index. PMC is an indicator that equals one if the firm is in the high product market power industry in this year. Column 1 focuses on firms with low product market power (i.e., below median industry's Lerner Index) and Column 2 focuses on firms with high product market power (i.e., above median industry's Lerner Index). Panel D focuses on financial constraints which is proxied by firm size. *Small Firm* is an indicator that equals one if firm size above the sample median and zero otherwise. Column 1 focuses on larger firms (i.e., less financially constrained and *Small Firm* = 0), and Column 2 focuses on smaller firms (i.e., more financially constrained and *Small Firm* = 1). Firm controls (*Size*, *Leverage*, *Profitability*, and *IndOutput*) and macro-economic controls (*GDP Per Capita* and *GDP Growth*) are included in regressions in all Columns. Panel E presents the findings regarding the differential responses of publicly listed firms and private firms to minimum wage increases. Column 1 focuses on private firms (i.e., non-listed firms) and Column 2 focuses on listed firms. *Listed* is an indicator that equals one if the plant is a subsidiary of a listed firm. The main effect of *Distance*, *LaborIntensity*, *PMC*, *AverageWage* in the full sample regressions in Panel A, B, and C are absorbed by the industry × year fixed effects. The main effects of *Small Firm* and *Listed* are controlled in Columns 3 of Panel D and E. See Appendix Table for detailed variable definitions. All specifications include firm, neighboring county pair, industry × year, and province × year fixed effects. Standard errors are clustered at the neighboring county pair level. T-statistics are reported in parentheses. ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

Panel A: Distance to Minimum Wages

	1	2	3
	Low Distance	High Distance	Full Sample
Variables	*CODEmission*	*CODEmission*	*CODEmission*
MinWage	0.529***	0.375**	0.515***
	(3.00)	(2.06)	(3.54)
MinWage × Distance			-0.138**
			(-2.54)
Controls	YES	YES	YES
Firm FE	YES	YES	YES
County Pair FE	YES	YES	YES
Industry × Year FE	YES	YES	YES
Industry × Year FE	YES	YES	YES
Observations	530,529	397,205	935,594
Adj. R-squared	0.724	0.681	0.676

(*To be continued*)

Table 8. Minimum Wages and Pollutant Emissions: Cross-Section - *continued*

Panel B: Labor Intensity

	1	2	3
	Low Labor Intensity	High Labor Intensity	Full Sample
Variables	*CODEmission*	*CODEmission*	*CODEmission*
MinWage	0.041	0.821***	0.397***
	(0.28)	(3.61)	(2.82)
MinWage × LaborIntensity			0.151**
			(2.54)
Controls	YES	YES	YES
Firm FE	YES	YES	YES
County Pair FE	YES	YES	YES
Industry × Year FE	YES	YES	YES
Province × Year FE	YES	YES	YES
Observations	521,532	402,593	935,594
Adj. R-squared	0.689	0.707	0.676

Panel C: Product Market Power

	1	2	3
	Low PMC	High PMC	Full Sample
Variables	*CODEmission*	*CODEmission*	*CODEmission*
MinWage	0.639***	0.193	0.585***
	(3.14)	(1.21)	(3.96)
MinWage × PMC			-0.287***
			(-5.20)
Controls	YES	YES	YES
Firm FE	YES	YES	YES
County Pair FE	YES	YES	YES
Industry × Year FE	YES	YES	YES
Province × Year FE	YES	YES	YES
Observations	512,841	417,440	935,594
Adj. R-squared	0.703	0.680	0.676

Panel D: Financial Constraints

	1	2	3
	Less Financial Constraint	More Financial Constraint	Full Sample
Variables	*CODEmission*	*CODEmission*	*CODEmission*
MinWage	0.283*	0.569***	0.147
	(1.88)	(2.81)	(1.03)
MinWage × Small Firm			0.557***
			(17.77)
Controls	YES	YES	YES
Firm FE	YES	YES	YES
County Pair FE	YES	YES	YES
Industry × Year FE	YES	YES	YES
Province × Year FE	YES	YES	YES
Observations	471,491	459,787	935,594
Adj. R-squared	0.681	0.692	0.677

(*To be continued*)

Table 8. Minimum Wages and Pollutant Emissions: Cross-Section - *continued*

Panel E: Listed vs. Non-Listed

Variables	1 Non-Listed *CODEmission*	2 Listed *CODEmission*	3 Full Sample *CODEmission*
MinWage	0.505***	-0.015	0.485***
	(3.39)	(-0.05)	(3.39)
MinWage × *Listed*			-0.338***
			(-6.15)
Controls	YES	YES	YES
Firm FE	YES	YES	YES
County Pair FE	YES	YES	YES
Industry × Year FE	YES	YES	YES
Industry × Year FE	YES	YES	YES
Observations	867,158	68,053	935,594
Adj. R-squared	0.677	0.657	0.676

Table 9. Minimum Wages, Aggregate Pollutant Emissions, and Performance

This table presents the regression results of minimum wages on counties' aggregate COD emission and average industrial firms' profitability. Regression samples are at the county × year × neighboring county pair level. *MinWage* is the natural logarithm of the end-of-year monthly minimum wage in each county in the previous year. *CODEmission* is the natural logarithm of one plus total COD emission across all firms in each county. *Profitability* is the average firm-level profitability across all firms in each county. *SOERatio* is percentage of firms that are registered as SOE in each county. The main effect of *SOERatio* is controlled in all Columns. In Columns 2 and 4, *GDP Per Capita*, *GDP Growth*, and *AvgIndOutput* are further controlled in the regression. *GDP Per Capita* and *GDP Growth* are the GDP over total population and GDP growth in the city where the county is located, respectively. *AvgIndOutput* is the natural logarithm of total industry output across all industrial firms in each county. All specifications include county, neighboring county pair, and province × year fixed effects. Standard errors are clustered at the neighboring county pair level. T-statistics are reported in parentheses. ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

	1	2	3	4
Variables	*CODEmission*	*CODEmission*	*Profitability*	*Profitability*
MinWage	0.622***	0.405***	-2.557***	-1.371*
	(4.58)	(3.37)	(-3.32)	(-1.80)
MinWage × SOERatio	-0.535***	-0.565***	-1.446***	-1.685***
	(-4.87)	(-5.47)	(-3.06)	(-3.33)
Controls	NO	YES	NO	YES
County FE	YES	YES	YES	YES
County Pair FE	YES	YES	YES	YES
Province × Year FE	YES	YES	YES	YES
Observations	212,416	205,118	198,795	191,588
Adj. R-squared	0.543	0.609	0.461	0.470

Internet Appendix for

Minimum Wages, State Ownership, and Corporate Environmental Policies

Tao Chen, Xi Xiong, and Kunru Zou

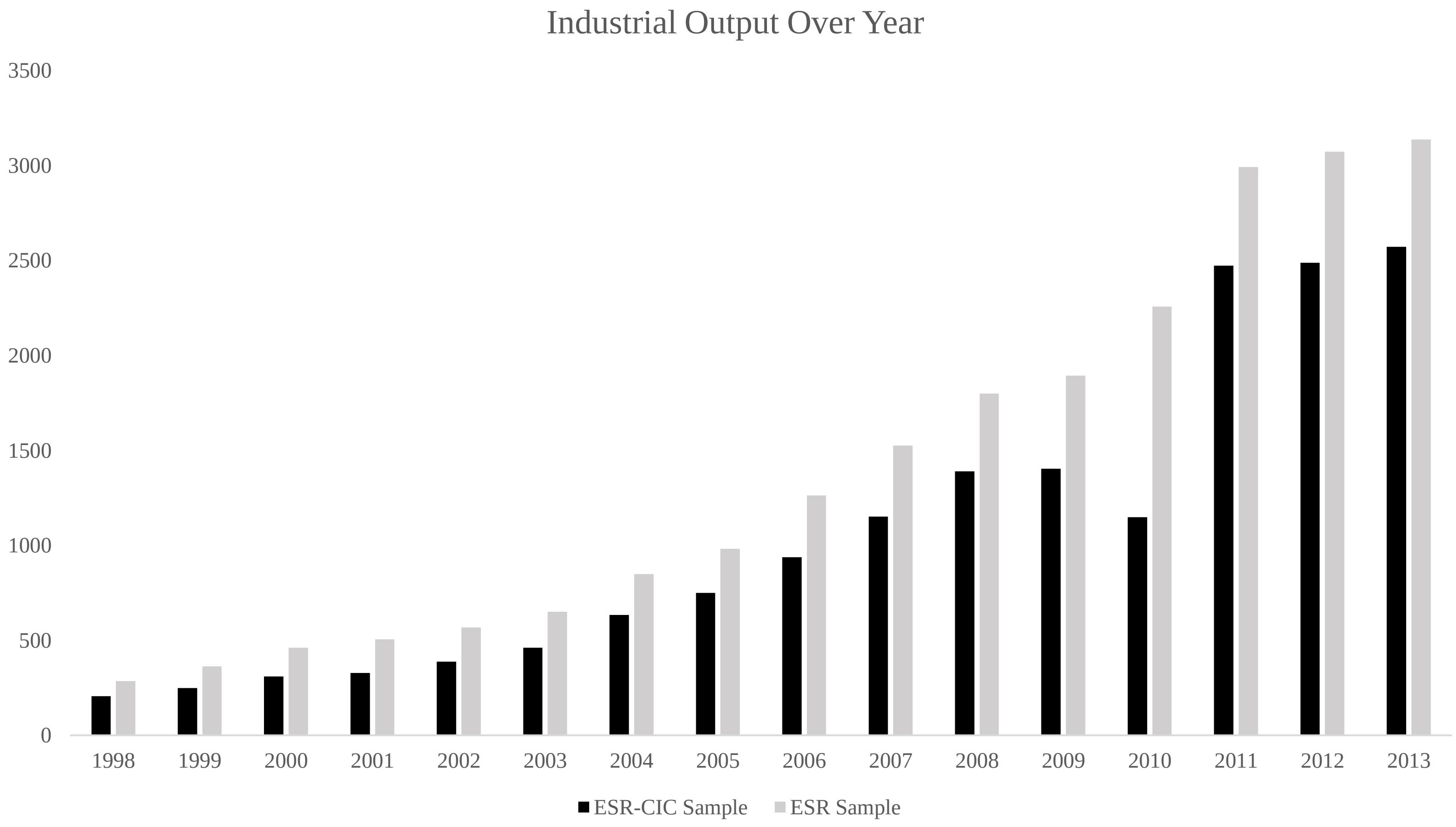

Figure A1. Industrial output over year. This figure plots the total industrial output of firms in the ESR-CIC matched sample and the ESR sample from 1998 to 2013. The grey bar denotes the total industrial output (in 10 billion RMB) for all firms covered in the ESR sample, while the black bar denotes the total industrial output (in 10 billion RMB) for all firms mutually covered by ESR and CIC database.

Table A1. Split Sample Summary Statistics (High vs. Low Minimum Wages)

This table presents summary statistics at the two subsamples (i.e., firms facing high vs. low minimum wages. We split the sample based on the working sample at the firm-year-county pair level by the yearly median minimum wages. In our working sample, we focus on firms within 10 kilometers from the border of neighboring counties. *MinWage* is the natural logarithm of the end-of-year monthly minimum wage in each county in the previous year. *CODEmission* is the natural logarithm of one plus firm's chemical oxygen demand (COD) emission in kilograms. *Wage/Worker* is the natural logarithm of yearly total wage expenditure over the total number of employees. *WaterCapacity* is the wastewater treatment capacity in tons per day over industrial output. *WaterFacility* is the number of wastewater treatment facilities over industrial output times 1000. *Size* is the natural logarithm of total asset.

	Low Minimum Wages			High Minimum Wages		
Variable	N	Mean	SD	N	Mean	SD
MinWage	484,933	6.090	0.475	450,661	6.482	0.423
CODEmission	484,933	7.140	3.825	450,661	7.497	3.183
Wage/Worker	438,541	9.441	0.814	410,047	9.803	0.788
WaterCapacity	381,865	0.314	0.891	366,166	0.218	0.673
WaterFacility	381,466	0.614	1.547	365,915	0.447	1.224
Size	484,933	11.077	1.632	450,661	11.331	1.659

Table A2. Monthly Average Minimum Wages and Pollutant Emissions

This table presents the OLS regression results of average monthly minimum wages on firms' chemical oxygen demand (COD) emissions. Regression samples are at the firm × year × neighboring county pair level. The dependent variable *CODEmission* is the natural logarithm of one plus firms' COD emission in kilograms. The independent variable of interest *MinAvgWage* is the natural logarithm of the average monthly minimum wage in each county in the previous year. In Columns 1, 2, and 3, samples are restricted to firms located within 5, 10, 15 kilometers from the border of neighboring counties, respectively. The firm-level controls include the firm's total assets, leverage, profitability, and industrial output. Macro-economic controls include the GDP per capita and GDP growth of the city where the firm is located. See Appendix Table for detailed variable definitions. All specifications include firm, neighboring county pair, industry × year, and province × year fixed effects. Standard errors are clustered at the neighboring county pair level. T-statistics are reported in parentheses. ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

	5 KM	10 KM	15 KM
	1	2	3
Variables	*CODEmission*	*CODEmission*	*CODEmission*
MinAvgWage	0.754***	0.724***	0.786***
	(3.34)	(4.60)	(5.93)
Controls	YES	YES	YES
Firm FE	YES	YES	YES
County Pair FE	YES	YES	YES
Industry × Year FE	YES	YES	YES
Province × Year FE	YES	YES	YES
Observations	482,626	971,169	1,425,605
Adj. R-squared	0.657	0.67	0.681

Table A3. Minimum Wages and Firms' Production

This table presents the OLS regression results of minimum wages on firms' industrial output. Regression samples are at the firm × year × neighboring county pair level. The dependent variable *IndOutput* is the natural logarithm of one plus firms' industrial output. In Columns 1, 2, and 3, samples are restricted to firms located within 5, 10, 15 kilometers from the border of neighboring counties, respectively. The firm-level controls include the firm's total assets, leverage, and profitability. Macro-economic controls include the GDP per capita and GDP growth of the city where the firm is located. All specifications include firm, neighboring county pair, industry × year, and province × year fixed effects. Standard errors are clustered at the neighboring county pair level. T-statistics are reported in parentheses. ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

	5 KM	10 KM	15 KM
	1	2	3
Variables	*IndOutput*	*IndOutput*	*IndOutput*
MinWage	0.025	0.018	0.002
	(0.35)	(0.36)	(0.04)
Controls	YES	YES	YES
County Pair FE	YES	YES	YES
Industry × Year FE	YES	YES	YES
Province × Year FE	YES	YES	YES
Observations	462,766	935,594	1,377,089
Adj. R-squared	0.700	0.712	0.722

Table A4. Minimum Wages and Pollutant Emissions (2000-2021)

This table presents the OLS regression results of minimum wages on city-level pollutant emissions. Regression samples are at the neighboring city pair × year level. We identify city pairs when their borders touch. The dependent variable *SO_2Emission* (*NO_XEmission*) is the natural logarithm of cities' SO_2 (NO_x) emission in tons. The independent variable of interest *MinWage* is the natural logarithm of the end-of-year monthly minimum wage in each city in the previous year. In columns 1-4, macroeconomic controls are included at the city-level in the regressions. Macroeconomic controls include the GDP per capita and GDP growth at the city-level. Columns 1 and 3 include city pair and province × year fixed effects. Columns 2 and 4 include city, year, and city pair fixed effects. Standard errors are clustered at the neighboring city pair level. T-statistics are reported in parentheses. ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

	1	2	3	4
Variables	*SO_2Emission*	*SO_2Emission*	*NO_xEmission*	*NO_xEmission*
MinWage	0.673***	0.129**	1.582***	0.287*
	(0.138)	(0.063)	(0.332)	(0.152)
GDP	0.211***	0.202***	0.181*	0.194***
	(0.055)	(0.041)	(0.107)	(0.067)
GDPGrowth	0.098***	0.069***	0.280***	0.393***
	(0.026)	(0.021)	(0.104)	(0.125)
City FE	NO	YES	NO	YES
Year FE	NO	YES	NO	YES
City Pair FE	YES	YES	YES	YES
Province Year FE	YES	NO	YES	NO
Observations	27,162	27,175	6,245	6,245
Adj. R-squared	0.887	0.846	0.904	0.883

Table A5. Minimum Wages, State-Ownership, and SO_2 Emission Intensity

This table presents the OLS regression results of minimum wages on firms' SO_2 emission intensity. Regression samples are at the firm × year × neighboring county pair level. *MinWage* is the natural logarithm of the end-of-year monthly minimum wage in each county in the previous year. *SOE* is an indicator that equals one if a firm is registered as state-owned, and zero otherwise. The dependent variable *SO_2Intensity* is the natural logarithm of firms' SO_2 emitted over industrial output. All specifications include firm and macro-economic controls. The firm-level controls include the firm's total assets, leverage, and profitability. Macro-economic controls include the GDP per capita and GDP growth of the city where the firm is located. In the full sample regressions, the main effects of *SOE* are also controlled. All specifications include firm, neighboring county pair, industry × year, and province × year fixed effects. Standard errors are clustered at the neighboring county pair level. T-statistics are reported in parentheses. ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

	1	2	3
		SO_2Intensity	
Variables	Non-SOE	SOE	Full Sample
MinWage	0.147**	-0.054	0.156***
	(2.13)	(-0.48)	(2.60)
MinWage × *SOE*			-0.132***
			(-4.89)
Controls	YES	YES	YES
Firm FE	YES	YES	YES
County Pair FE	YES	YES	YES
Industry × Year FE	YES	YES	YES
Province × Year FE	YES	YES	YES
Observations	507,769	133,110	642,667
Adj. R-squared	0.833	0.826	0.826

Table A6. Minimum Wages and Firms' Market Share Over Time

This table presents the OLS regression results of minimum wages on firms' market share over time. Regression samples are at the firm × year × neighboring county pair level. The dependent variable $Market\ Share_t$ is the ratio of a firm's revenue for the current year to the total revenues of firms in this industry for the same year. $Market\ Share_{t+1}$ and $Market\ Share_{t+2}$ are the firm's market share in the subsequent year and the year after that, respectively. The independent variable of interest *MinWage* is the natural logarithm of the end-of-year monthly minimum wage in each county in the previous year. In Columns 1-3, samples are restricted to firms located within 10 kilometers from the border of neighboring counties. The firm-level controls include the firm's total assets, leverage, profitability, and industrial output. Macro-economic controls include the GDP per capita and GDP growth of the city where the firm is located. All specifications include firm, neighboring county pair, industry × year, and province × year fixed effects. Standard errors are clustered at the neighboring county pair level. T-statistics are reported in parentheses. ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

	1	2	3
Variables	$Market\ Share_t$	$Market\ Share_{t+1}$	$Market\ Share_{t+2}$
MinWage	-0.316***	-0.283***	-0.262***
	(-4.33)	(-3.79)	(-3.65)
Controls	YES	YES	YES
County Pair FE	YES	YES	YES
Industry Year FE	YES	YES	YES
Province Year FE	YES	YES	YES
Observations	935,590	775,637	633,838
Adj. R-squared	0.864	0.829	0.823