Energy Economics 109 (2022) 105967

Contents lists available at ScienceDirect

Energy Economics

journal homepage: www.elsevier.com/locate/eneeco

Do public environmental concerns promote new energy enterprises' development? Evidence from a quasi-natural experiment

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ARTICLE INFO

JEL classifications:
G11
G32
N72

Keywords:
Public environmental concern
New energy enterprises
Market power
$PM_{2.5}$ surge
Extreme event

ABSTRACT

We examine whether the public environmental concerns promote the development of new energy enterprises through a quasi-experiment China's extreme event of 2011 when the PM2.5 Surge incident escalated public environmental concerns. After this incident, the market power of new energy enterprises in severely polluted regions became 108% higher than that in the mildly polluted regions. It implies that public environmental concerns promote the development of new energy enterprises. This observation is limited to non-state-owned companies, companies without political connections, and regions without new energy subsidies. This increased market power of new energy enterprises with increasing public environmental concerns was because of sales increase instead of reduced non-operational costs. Overall, this study answers several interesting questions associated with the increasing public environmental concerns and the rapid development of energy enterprises.

1. Introduction

The rapid economic growth causes energy shortage and environmental pollution worldwide (Lazăr et al., 2019; Wang et al., 2020; Zhao et al., 2021), and the world is focusing on the new energy industries. New energies are the energies being used or currently under study and can be extensively promoted, like solar, geothermal, wind, ocean, biomass, and nuclear fusion energy. The early stages of several studies on new energy enterprises focus on how government subsidies impact their performance, research, and development (R&D), investment, innovation (Luo et al., 2021; Yu et al., 2020; Shao et al., 2021; Li et al., 2021), only to obtain mixed results. Although government subsidies improve the competition among new energy enterprises, they also cause market distortions (He et al., 2021). New energy enterprises should not depend on subsidies to reduce costs to enhance their competitiveness. Instead, they should improve the consumers' awareness of the environmental value of new energy enterprises in alleviating energy shortages and reducing pollution that depends on public environmental concerns. Consumer survey data analysis shows that environmentally concerned consumers lean towards products from eco-friendly enterprises. They will spend more instead of buying similar products from other or non-eco-friendly enterprises (Nesbitt and Sperling, 2001; Wang and Wheeler, 2005; Ensslen et al., 2020; Tong et al., 2020). There are few direct empirical studies for new energy enterprises on how public environmental concerns impact their market competitiveness.

The increased environmental concerns will induce consumers' willingness to purchase new energy enterprises' products (Amador et al., 2013). However, these enterprises will have different pricing strategies depending on the consumer structures, which may not necessarily increase product sales (He et al., 2021). Subsidies and other government policies will also change the market environment and their competition (He et al., 2017). It is necessary to empirically test the real impacts of public environmental concerns on the market competitiveness of new energy enterprises. The direct empirical approach of using public environmental concerns for regression analysis over a company's competitiveness index will face two problems: first, the public environmental concern index from the survey of some groups may not reflect the primary customers' environmental concerns; second, this regression analysis may face internal problems like missing variables and reverse causality. These reasons may also cause the lack of empirical research.

This study uses a difference-in-differences (DID) method to solve the empirical problems. China's extreme event of the $PM_{2.5}$ surge in 2011

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https://doi.org/10.1016/j.eneco.2022.105967
Received 8 August 2021; Received in revised form 19 February 2022; Accepted 14 March 2022
Available online 23 March 2022

provided the key quasi-natural experiment (Gu et al., 2021). Firstly, the significant changes in the public environmental concerns, since the $PM_{2.5}$ surge event, enabled us to conduct quasi-natural experiments. The Chinese government and the public have long focused on economic growth, relatively ignoring environmental pollution. This extreme event made Chinese people focus on smog for the first time. This event, with its extensive media coverage, increased people's concerns about air pollution by smog. Secondly, the extensive Chinese regional differences provided a key method to distinguish between the experimental and control groups to construct a DID model. During the 2011 event, China's Northeast, North, and Central regions were more severely affected by the smog compared to its Southern regions. The empirical results from the DID method show that public environmental concerns significantly improved the market power of new energy enterprises. It was only for those in a competitive market environment, like non-state-owned enterprises, enterprises with no political connection, and enterprises in non-subsidized regions. This paper contributes the following two aspects compared to its existing research. First, it provides more reliable and direct empirical evidence for whether public environmental concerns promote the development of new energy enterprises. The existing studies show that increased environmental concerns of consumers raise the market demands for new energy and other eco-friendly products. It is inconclusive whether this eventually promotes the development of new energy enterprises as they might adjust their pricing strategies and their impacts of government subsidies. This paper's quasi-natural experiment, constructed by China's $PM_{2.5}$ surge event, uses the DID approach that is a thorough causal identification method. It implies that public environmental concerns significantly improve the market power of new energy enterprises and enrich the empirical literature of its impacts on these enterprises.

Secondly, this paper provides new empirical evidence to evaluate the effects of new energy subsidy policies according to the long-term competitiveness of enterprises. Several studies focus on the impact of subsidy policies on new energy enterprises by considering their universality. Subsidies reduce the cost of enterprises and instantly improve their short-term competitiveness. We need to focus if those enterprises that can improve their long-term competitiveness. Existing studies investigated the impacts of subsidy policies on the long-term competition among new energy enterprises (long-term performance, R&D, innovation, etc.). Some impacts do not reflect whether the existing competitive edge is sustainable after canceling the subsidy policy. This paper implies that the enhanced public environmental concerns which promote the market demands for new energy improve their competitiveness, but subsidies limit this improvement. This also provides empirical evidence from a different perspective to evaluate the effects of new energy subsidy policies.

The remaining article organization is as follows. Section 2 reviews the literature and develops our research hypotheses. Section 3 presents our empirical design, Section 4 provides the empirical results, and Section 5 concludes.

2. Literature review and hypothesis development

2.1. Literature review

The existing literature discusses the driving forces of new energy industries development from two perspectives. First, some studies have a relatively macro-perspective of the regional economy and the industry. The main methods include input-output-based and system optimization estimation model, trans-regional panel, vector auto-regression (VAR) structures model, and other econometric models (Lin and Xu, 2018). For example, Garrett-Peltier (2017) analyzes the consumer demand for new energy products in public and private sectors depending on the input-output model and finds that increasing new energy consumption demands will improve employment in this industry. Al-Falahi et al. (2017) use the system optimization method to assess the impacts of economic development and technological stability on new energy industries like solar and wind energy. They find that economic growth increases the demands for new energy, while technological progress expands the production capacity of the new energy industry. Paramati et al. (2017) use a panel cointegration model based on the data from 11 countries. They find a long-term balance between economic growth and the development of new energy. Lin and Xu (2018) use the VAR model based on China's time-series data of more than 60 years, from 1953 to 2015. They find that China's energy consumption structure positively impacts the development of the new energy industry in the short term but has limited impacts in the long term.

Second, other studies are motivated by the micro-subjects of enterprises in the new energy industry. Most studies consider the significant impact of the subsidy policies. For example, Wang et al. (2020) conducted a study with 153 listed new energy vehicle enterprises in China from 2009 to 2018. It shows that subsidies deteriorate their financial performance, and their impact on upstream enterprises is heavier than that on midstream and downstream enterprises. Luo et al. (2021) studied 158 listed Chinese new energy power enterprises. It shows that subsidies harm short-term financial performances but improve long-term performances. Technological innovation subsidies have a threshold effect on the short-term financial performances of enterprises. Yu et al. (2020) divided the government subsidies into beforehand and afterward subsidies, found through the studies on Chinese new energy vehicle enterprises in 2013–2017. There is a U-shaped relationship between the beforehand subsidies and the company's financial performance, and a reverse U-shaped relationship between afterward subsidies and their financial performance. Shao et al. (2021) studied 88 new energy vehicle companies listed in China and found that the R&D subsidies significantly increased its investment. Production subsidies have an insignificant impact on the R&D investment of enterprises.

The research findings summarize that the demand factors like economic growth and energy consumption structure and supply factors like technological progress will impact the development of new energy. However, studies based on the micro-perspective of enterprises only focus on the impact of supply factors, especially for the impacts of industrial policies like government subsidies on new energy enterprises' financial performance, R&D, and innovation activities. In summary, the results obtained from the micro-perspective are inconsistent with that from the macro-perspective, and the empirical research based on the demand impact from the micro-perspective needs urgent expansion.

2.2. Hypothesis development

According to the consumer survey analysis, the increased public environmental concerns would raise costumers' willingness to pay for certain products and services from eco-friendly enterprises (Nesbitt and Sperling, 2001; Wang and Wheeler, 2005; Ensslen et al., 2020; Tong et al., 2020). New energy enterprises are eco-friendly enterprises, as new energy leads to less energy consumption and environmental pollution. Thus the demand for products and services of new energy enterprises will increase due to increased public environmental concerns (Amador et al., 2013), leading to an improvement of new energy enterprises' market competitiveness.

However, the increased demand for products and services of new energy enterprises does not necessarily lead to the increase of new energy enterprises' sales revenue, as the enterprises will strategize pricing based on different consumer structures. By analyzing the established theoretical model, He et al. (2021) propose that raising the product prices for consumers with stronger public environmental concerns will offset the effect of demand increasing by public environmental concerns, which will lead to complicated results. It will become even more complicated when there is a subsidy policy.

One potential solution is to make all potential consumers of each new energy enterprise have similarly improved environmental concerns. Thus new energy enterprises will not implement differentiated pricing strategies for their consumers because the improvements of customers' environmental concerns are relatively in general. Then we can investigate the effect of public environmental concerns on new energy enterprises in the case of no pricing strategies change.

China's $PM_{2.5}$ surge event around 2011 just provides such a similar ideal natural experiment (Gu et al., 2021). As the world's second-largest economy, Chinese government and Chinese public have long focused on economic growth, ignoring environmental pollution. After the severe smog pollution boost in 2011, a growing concern of air pollution quickly spread among Chinese people and the Chinese government. Its extensive media coverage has increased China's public environmental concerns (Baiardi and Morana, 2021).

Furthermore, although consumers in the region where the company is located may similarly increase their environmental concern, the increase will majorly differ in different regions, especially for the vast territory of China. During the 2011 event, China's Northeast, North, and Central region were most severely affected by the smog, instead of the Southern regions. This implies that after the $PM_{2.5}$ surge event, the public environmental concerns in areas with severe smog will rise a lot, increasing the market power of new energy enterprises in these areas. Therefore, our first hypothesis proposes H1 as this paper's benchmark hypothesis is as follows:

H1. : After the 2011$PM_{2.5}$ surge event in China, the market power of new energy enterprises in severely polluted regions increased greater than that in the mildly regions.

The substantial increase in public environmental concerns after the event should improve the market power for new energy enterprises participating in market competition, but the effects might still vary across the different business environments. Some Chinese enterprises will enjoy competitive advantages through some non-market characteristics, like state-owned property and political connections. Because of the implicit support from government, SOEs will face a soft budget constraint for losses (Kornai, 1980) and lower financing constraints relative to non-SOEs (Allen et al., 2005). With similar logic, the enterprises with political connections will receive more political resources, like tax incentives, government subsidies, and financing facilities than those without political connections (Liu et al., 2021). Thus, there is lesser pressure from market competition for SOEs and enterprises with political connections. In addition, the new energy industry probably receives special subsidies from the government. Government subsidies give enterprises additional funding and reduce their operational costs, leading to lower pressures for participating market competition.

Sufficiently competitive market environment is an important external factor for promoting new energy enterprises (He et al., 2021). Increased public environmental concerns provide a positive impact on new energy enterprises' production and sales from demand expansion. Nevertheless, it requires that new energy enterprises can completely participate in market competition. As those SOEs, politically connected, and subsidized enterprises have additional non-market competitive advantages, the increased public environmental concern will moderately influence their market power for the insufficiently competitive market environment they face. Thus, our second hypothesis proposed is as follows:

H2a. : After the 2011$PM_{2.5}$ surge event in China, the greater increase of new energy enterprises' market power in severely polluted regions relative to mildly regions are more significant among non-SOEs.

H2b. : After the 2011$PM_{2.5}$ surge event in China, the greater increase of new energy enterprises' market power in severely polluted regions relative to mildly regions are more significant among enterprises with no political connections.

H2c. : After the 2011$PM_{2.5}$ surge event in China, the greater increase of new energy enterprises' market power in severely polluted regions relative to mildly regions are more significant among enterprises in non-subsidized regions.

3. Empirical design

3.1. Data and sample

This paper's research subject is the A-share listed new energy enterprises during 2008–2014, three years before and after the 2011$PM_{2.5}$ surge event. New energy enterprises mainly refer to enterprises engaged in the discovery and application of new energy, like solar energy, geothermal energy, wind energy, ocean energy, biomass energy, nuclear energy. We obtain the public new energy enterprises list from the Chinese new energy network (china-nengyuan.com). We excluded the 2011 samples in our main analysis, because it is difficult to judge the event's impacts on the corporate decisions of 2011 for the rise of public attention to be in the fourth quarter of 2011 (Chen et al., 2018; Gu et al., 2021). We included the 2011 samples in our robustness test. Consistent with prior research, we also excluded the samples with total assets smaller than total liabilities for their extremely high bankruptcy risk, total sales lesser than zero, and missing major variables. In summary, after eliminating the 2011 samples, samples with total assets smaller than total liabilities, samples with total sales lesser than zero, and samples with missing major variables from all A-share listed new energy enterprises during 2008–2014, we finally obtained a total of 956 firm-year observations of 169 new energy firms.

All listed new energy enterprises' financial information used in this paper is from *China Stock Market & Accounting Research Database* (CSMAR). The Smog $PM_{2.5}$ data comes from the National Aeronautics and Space Administration (NASA) satellites and the ground observation posts published by the Atmospheric Composition Analysis Group of Dalhousie University in the United States (Van Donkelaar et al., 2015, 2019). We used the *Guidelines for the Industry Classification of Listed Companies* published by the China Securities Regulatory Commission (CSRC) in 2001 for the classification of industries. We classify manufacturing industries into two-digit categories and other industries into one-digit categories. To minimize the effect of outliers, all continuous variables are winsorized at the 1st and 99th percentiles.

3.2. Models and variables

We used the 2011$PM_{2.5}$ surge event as a quasi-natural experiment and built the following DID model to test out the first hypothesis:

$$MP_{it} = \beta_0 + \beta_1 Treat_i \times Post_t + \beta_2 Treat_i + \beta_3 Post_t + \sum \beta_l Controls_{it}^l + \mu_i + \nu_t + \varepsilon_{it} \quad (1)$$

where the explanatory variable MP_{it} refers to the market power of company i in year t. Following with the classic literature in the field of industrial organization (Lindenberg and Ross, 1981; Domowitz et al., 1986), we measured market power using the Lerner Index, i.e., $MP = LI = (Price\text{-}Marginal\ cost)/price$. Its actual definition is $LI = (Operating\ revenue\text{-}Operating\ cost)/operating\ revenue$ *considering* practical issues like data availability. To facilitate the horizontal comparison between the listed companies in different industries, we get the final measurement index of the product market power of the listed companies after industrial adjustment (Datta et al., 2013). We use the Lerner index value of the listed company minus the average value of the Lerner index weighted by the sales revenue of all the industries' listed companies:

$$MP_{i,j,t} = LI_{i,j,t} - \sum_{i=1}^{J} \omega_{i,j,t} \times LI_{i,j,t} \quad (2)$$

where $LI_{i,j,t}$ is the Lerner index value of company i in the industry j at year t, and $\omega_{i,j,t}$ is the proportion of the company's sales revenue to the industry's total sales revenue.

The primary explanatory variable is $Treat_i \times Post_t$. For the treated companies, the indicator variable $Treat_i$ takes the value one if the $PM_{2.5}$ of the province where the company is located is above the national median level in the event year (2011). For the control group, the value of the indicator variable $Treat_i$ takes zero. $Post_t$ is the dummy variable indicating whether the event has happened, and it takes the value one for the sample period after the event, and zero otherwise. As the treatment is defined at the provincial level, we cluster standard errors clustered by province. Our interest coefficient in model (1) is β_1. Based on H1's analysis, we expect it to be positive and significant.

We control for mainly two types of firm characteristics that may affect a firm's market power. Firstly, the company's basic financial characteristics, including the *Size* (natural logarithm of total assets), *Leverage* (total debt nominated by total assets), *ROA* (net profit nominated by total assets), *Tang* (fixed assets nominated by total assets), and *Growth* (the change rate of sales revenue). Secondly, corporate governance variables, including the *Dual* (takes the value one if the chairman and CEO are the same person, otherwise zero), *SOE* (one for SOEs, otherwise zero), and *Top1Hold* (the number of shares held by the largest shareholder nominated by company's total shares). In addition, we also include the year fixed effects to control for the intertemporal market shock and the firm fixed effects to control for time-invariant differences across firms.

Our second hypothesis is to examine whether the promoting effects of public environmental concerns on new energy enterprises' market power is more pronounced in a sufficiently competitive market environment (non-SOEs, companies with no political connections, and regions without new energy subsidies). To be an SOE or not depends on the nature of the company's controller. Our definition of political connection follows Deng et al. (2018): it takes the value of one for companies with political connections if the company's chairman or general manager is or have been a government official, deputy to the National People's Congress, or a Chinese People's Political Consultative Conference (CPPCC) member, otherwise, it takes the value of zero indicating companies with no political connection.

We define the new energy subsidy based on the "Ten Cities and One Thousand New Energy Vehicles" program launched by China in January 2009. This policy aims to increase the share of new energy vehicles in the auto market to 10% by 2012 through a three-year plan of financial subsidies. The program was implemented in three batches across 25 cities in total, including Beijing, Shanghai, Chongqing, Changchun, etc. Since the new energy vehicle is integral to the new energy field, this subsidy policy covers the majority of new energy enterprises through extensive upstream and downstream connections. Thus, we define subsidized new energy enterprises if their registered address is among the 25 cities under the "Ten Cities and One Thousand New Energy Vehicles" program. According to the theoretical analysis of the second hypothesis, the coefficient β_1 of the model (1) would be more significantly positive in non-SOEs, companies with no political connection, and companies in non-subsidized regions, relative to the SOEs, enterprises with political connections, and those in subsidized regions. All variable definitions are presented in Table 1.

3.3. Descriptive statistics

Table 2 shows the descriptive statistical results of this paper's main variables. The average value of the new energy enterprises' market power is 0.279, and its median is 0.015. The explanatory variable *Treat's* average value is 0.5377, greater than 0.5, indicating that more new energy enterprises' locations are in severely smoggy regions. The average value of *Post* is 0.5136, greater than 0.5, indicating that the new energy enterprises increased since the $PM_{2.5}$ surge event. The descriptive statistics of the explanatory variables (at least partially) suggest that the increasing public environmental concerns associated with smog promotes the new energy enterprises' development. In addition, the *Leverage* of new energy enterprises is relatively high, with an average of 54%. On average, new energy enterprises have acceptable profitability

Table 1
Variable definitions.

Variable	Definition
Cost MP	Operating costs by the average operating costs of other companies in the same industry
CR4	The sum of the top four proportions of a firm's sales related to total sales of all firms in the same industry
Dual	Takes the value one if the chairman and CEO are the same person, otherwise zero
ER	Takes the value one if the company located in the province with weak environmental regulation (less than the national median) just before the 2011$PM_{2.5}$ surge event, otherwise zero
Growth	The change rate of sales revenue
HHI	The sum of the squared proportion of a firm's sales related to total sales of all firms in the same industry
Investment	Cash paid for the purchase and construction of fixed assets, intangible assets, and other long-term assets nominated by total assets
Inventory Investment	Inventory nominated by total assets
Leverage	Total debt divided by total assets
LNAGE	Natural logarithm of company's age
LNRM	Natural logarithm of the number of mentions of the company in research reports
LNRM1	Natural logarithm of the number of mentions of the company in non-negative research reports
LNRM2	Natural logarithm of the number of mentions of the company in non-negative research reports minus the number of mentions of the company in negative research reports
MP	Lerner index with industrial adjustment, whereas manufacturing industries classify in two-digit categories, and other industries classify in one-digit categories
MP1	Lerner index without industrial adjustment
MP2	Lerner index with industrial adjustment, whereas manufacturing industries classify in three-digit categories, and other industries classify in two-digit categories
MP3	Lerner index with industrial adjustment, whereas manufacturing industries classify in four-digit categories, and other industries classify in three-digit categories
NE_Province	The number of provincial new energy companies
PEC_Staggered	Takes the value one for the firm-year observations of companies having suffered in severe pollution (the provincial PM2.5 above the national median level in the year) ever since the 2011PM2.5 surge event, otherwise zero
Post	Takes the value one for the sample period after the 2011$PM_{2.5}$ surge event, otherwise zero
Post2009	Takes the value one for the sample period since 2009, otherwise zero
Post2010	Takes the value one for the sample period since 2010, otherwise zero
R&D Investment	R&D expenditures nominated by total assets
ROA	Net profit nominated by total assets
Sales MP	Sales revenue by the average sales revenue of other companies in the same industry
Size	Natural logarithm of total assets
SOE	Takes the value one for SOEs, otherwise zero
Tang	Fixed assets nominated by total assets
Top1Hold	The number of shares held by the largest shareholder divided by the company's total shares
Treat	Takes the value one if the PM2.5 of the province where company located is above the national median level in the event year (2011), otherwise zero
Treat_City1	Takes the value one if the urban PM2.5 level at the company's location was higher than the national median in 2011, otherwise zero
Treat_City2	Takes the value one if both the provincial and urban PM2.5 level at the company's location was higher than the national median in 2011, otherwise zero
Treat_Regularity	Takes the value one if the company located in the region implemented the Announcement on the Implementation of Special Emission Limits of Air Pollutants, otherwise zero
Treat_Subsidiaries	Takes the value one if most of a company's subsidiaries located in the severely polluted province, otherwise zero
Treat_Subsidy	Takes the value one if the company located in the region implemented the "Ten Cities and One Thousand New Energy Vehicles" program, otherwise zero

Table 2
Summary statistics.

Variable	Mean	Median	1st Quantile	3rd Quantile	SD
MP	0.0279	0.0150	−0.0402	0.0870	0.1174
Treat	0.5377	1.0000	0.0000	1.0000	0.4988
Post	0.5136	1.0000	0.0000	1.0000	0.5001
Size	22.349	22.155	21.431	23.062	1.2970
Leverage	0.5402	0.5541	0.4212	0.6722	0.1887
ROA	0.0397	0.0336	0.0116	0.0638	0.0566
Tang	0.3052	0.2525	0.1547	0.4408	0.1946
Growth	0.0977	0.0966	−0.0400	0.2303	0.2839
Dual	0.1778	0.0000	0.0000	0.0000	0.3826
SOE	0.3117	0.0000	0.0000	1.0000	0.4634
Top1Hold	0.3519	0.3368	0.2303	0.4728	0.1565

and growth performance with an approximate annual average *ROA* of 4% and an approximate annual *Growth* rate of 10%.

4. Empirical results

4.1. Baseline regression

Table 3 shows the first hypothesis's test results based on model (1). Column (1) only includes firm fixed effects, Column (2) includes all firm-level control variables and firm fixed effects, and Column (3) includes all firm-level control variables, firm fixed effects, and year fixed effects. The coefficients of the key explanatory variable *Treat* × *Post* in columns (1) to (3) are positive and significant at or below 5%. The economic magnitude is also sizeable: taking column (3), for example, the market power of enterprises in severely polluted regions increased by an average of 108% compared to those in mildly polluted regions after the $PM_{2.5}$ surge event. In summary, the baseline regression results of Table 3 indicate that public environmental concerns significantly improve the new energy enterprises' market power and promote their development, supporting the H1.

Passing the test for parallel trends is a prerequisite for the effectiveness of DID model. Taking the 2011 event occurrence as the baseline, we define 2009 and 2010 as the *Year* (−2) and *Year* (−1), respectively, 2012, 2013, and 2014 after the event, as the *Year* (+1), *Year* (+2), and *Year* (+3). We construct the dummy variables corresponding to the above years and use them to replace the original *Post*, interacting with variable *Treat*. This helps to break down the analysis of the specific year's impact compared instead of the original model (1) only comparing the event's pre and post overall impacts.

Table 4 shows the parallel trends test results. The coefficients of interaction terms *Treat* × *Year* (−1) and *Treat* × *Year* (−2) are statistically insignificant. It indicates that the market power between the experimental group (severely polluted regions) and the control group (mildly polluted regions) before the event has insignificant differences, which is a crucial requirement for using DID model.

Although the coefficient of interaction terms *Treat* × *Year* (+1) is insignificant, the coefficients of interaction terms *Treat* × *Year* (+2) and *Treat* × *Year* (+3) are both positive and significant at or below the 5% level. Moreover, the coefficient of *Treat* × *Year* (+3) is larger and significant at a lower level than the coefficient of *Treat* × *Year* (+2). Overall, these results suggest that it takes a few years for the market power of the experimental group's sample enterprises (severely polluted regions) to become significantly higher than that of the control group (mildly polluted regions), indicating that there is a causal effect of public environmental concerns promoting the new energy enterprises' development.

Table 3
Baseline regression.

	(1)	(2)	(3)
	MP	MP	MP
Treat × Post	0.0302**	0.0304***	0.0297***
	(0.0119)	(0.0107)	(0.0107)
Post	−0.0326***	−0.0153*	
	(0.0083)	(0.0087)	
Size		−0.0127*	−0.0071
		(0.0065)	(0.0082)
Leverage		−0.0389	−0.0385
		(0.0574)	(0.0563)
ROA		0.542***	0.565***
		(0.0838)	(0.0863)
Tang		0.0568	0.0586
		(0.0501)	(0.0495)
Growth		−0.0077	−0.0094
		(0.0106)	(0.0118)
Dual		0.0030	0.0028
		(0.0122)	(0.0124)
SOE		0.0117	0.0079
		(0.0098)	(0.0098)
Top1Hold		0.105**	0.0961*
		(0.0483)	(0.0509)
Year FEs	No	No	Yes
Firm FEs	Yes	Yes	Yes
Adj. R^2	0.038	0.222	0.231
Observations	956	956	956

This table presents the baseline regression results of the impact of public environmental concerns on new energy enterprises' market power. Dependent variable *MP* is defined as industrial adjusted Lerner index. The independent variable of special interest is *Treat* × *Post*. *Treat* takes the value one if the company is located in severely polluted provinces, otherwise zero. *Post* takes the value one for the sample period after the 2011PM2.5 surge event, otherwise zero. All variable definitions are provided in Table 1. Robust standard errors clustered by province are reported in parentheses. ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

4.2. Placebo tests

We conduct two placebo tests with fictitious event time and fictitious treatment groups to ensure the impacts just come from the $PM_{2.5}$ surge event. First, we conduct a placebo test by changing the policy's implementation time to ensure that regression results do not follow spurious regression based on the fictitious event time. We use a sample period just before the $PM_{2.5}$ surge event happened (2008–2010), and assume fictitious events happened in 2009 and 2010, respectively. Table 5 columns (1) and (2) show the placebo test results based on the fictitious events.

Table 4
Test for parallel trends.

	(1)	
	Coefficients	Standard errors
	MP	
Treat × Year (−2)	0.0173	(0.0108)
Treat × Year (−1)	0.0076	(0.0130)
Treat × Year (+1)	0.0252	(0.0152)
Treat × Year (+2)	0.0411**	(0.0169)
Treat × Year (+3)	0.0487***	(0.0177)
Controls	Yes	
Year FEs	Yes	
Firm FEs	Yes	
Adj. R^2	0.237	
Observations	956	

This table presents the result of the parallel trends test. Dependent variable *MP* is defined as industrial adjusted Lerner index. Independent variables are *Treat* × *Year* (−2), *Treat* × *Year* (−1), *Treat* × *Year* (+1), *Treat* × *Year* (+2), *Treat* × *Year* (+3). *Treat* takes the value one if the company is located in severely polluted provinces, otherwise zero. The variables *Year* (−2), *Year* (−1), *Year* (+1), *Year* (+2), *Year* (+3), indicate the year relative to the 2011PM2.5 surge event. *Post* takes the value one for the sample period after the 2011PM2.5 surge event, otherwise zero. All variable definitions are provided in Table 1. Robust standard errors clustered by province are reported in parentheses. ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Table 5
Placebo test.

	(1)	(2)	(3)	(4)
	Fictitious event time		Fictitious treatment group	
	MP	MP	MP	MP
Treat × Post2009	0.0129 (0.0113)			
Treat × Post2010		−0.0021 (0.0103)		
Treat_Subsidy × Post			0.0090 (0.0130)	
Treat_Regularity × Post				0.0168 (0.0137)
Controls	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Adj. R^2	0.234	0.229	0.216	0.218
Observations	465	465	956	956

This table presents the results of the placebo test with fictitious event time and fictitious treatment group. Dependent variable *MP* is defined as industrial adjusted Lerner index. Independent variables in columns (1) to (4) are *Treat* × *Post2009*, *Treat* × *Post2010*, *Treat_Subsidy* × *Post*, *Treat_Regularity* × *Post*, respectively. *Treat* takes the value one if the company is located in severely polluted provinces, otherwise zero. *Treat_Subsidy* (*Treat_Regularity*) takes the value one if the company is located in subsidized cities (provinces with emission limit requirements *according to Announcement on the Implementation of Special Emission Limits of Air Pollutants* issued in 2013), otherwise zero. *Post* takes the value one for the sample period after the 2011PM2.5 surge event, otherwise zero. *Post2009* (*Post2010*) takes the value one for the sample period since 2009 (2010), otherwise zero. All variable definitions are provided in Table 1. Robust standard errors clustered by province are reported in parentheses. ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

The coefficients of *Treat* × *Post*2009 and *Treat* × *Post*2010 are no longer significant compared to the basic regression results. When we assume the event occurrence as 2009 and 2010, the trend of the market power changes of enterprises in the experimental group (severely polluted regions) and the control group (mildly polluted regions) have insignificant differences, thus ensuring a valid DID model.

Second, we construct a placebo test based on the fictitious treatment group, since other policies implemented simultaneously may also cause deferent reactions for the treatment group and the control group. Using two relevant policies (*Subsidy Policy*[1] and *Regularity Policy*[2]) with regional differences during the sample period, we construct the fictitious treatment group affected by the policy, and the control group not affected. Table 5 columns (3) and (4) show the placebo test results based on the fictitious treatment group. The coefficients of the fictitious experimental group are insignificant, further ensuring a valid DID model.

4.3. Sensitivity tests

We further test the sensitivity of our baseline regression results over alternative samples, different definitions of key variables, and different control variables. In contrast to the sample period with three years before and after the $PM_{2.5}$ surge event, we collected samples two years and four years before and after the event to reestimate the model (1), respectively. Table 6 columns (1) and (2) show the results, where the coefficient of *Treat* × *Post* is still significantly positive. We deleted the 2011 samples in the baseline regression for the impacts on them might be uncertain. We added them back and treated them as samples affected by the event. Column (3) in Table 6 presents the results depending on the samples, including 2011 ones. The coefficient of *Treat* × *Post* remains significantly positive.

New energy enterprises listed during the sample period may lead to interference, like listed companies in severely polluted regions after the 2011$PM_{2.5}$ surge event. Thus we eliminate all new energy enterprises listed during the sample period and reestimate the model (1). Column (4) in Table 6 presents the results. The coefficient of *Treat* × *Post* is still significantly positive.

Companies in severely polluted industries would attract more public attention after the $PM_{2.5}$ surge event because of its industry characteristics. We use the sample of new energy enterprises with no severely polluted industries and reestimate the model (1). Column (5) in Table 6 presents the results. The coefficient of *Treat* × *Post* is still significantly positive.

There is a probable systematic difference between new energy enterprises located in severely polluted regions and mildly polluted regions. Thus we conduct a PSM-DID method. We match the new energy enterprises located in severely polluted regions with those located in mildly polluted regions based on a vector of firm's characteristics, including *MP*, *Size*, *Leverage*, *ROA*, *Tang*, *Growth*, *Dual*, *SOE*, and *Top1Hold*. Then we reestimate the model (1) with the matched sample. Column (6) in Table 6 presents the results. The coefficient of *Treat* × *Post* remains significantly positive.

We defined the treatment group and the control group based on the provincial $PM_{2.5}$ level of the company's location in the benchmark regression. However, there may still be some differences in the $PM_{2.5}$ levels even within the same province. Thus we redefine the *Treat* indicator at the city level for more precise identification. We conduct two city-level *Treat* indicators: *Treat_City*1 takes the value one if the urban $PM_{2.5}$ level at the company's location was higher than the national median in 2011, otherwise, zero; *Treat_City*2 takes the value one if both the provincial and urban $PM_{2.5}$ level at the company's location was higher than the national median in 2011, otherwise zero. Table 7 columns (1) and (2) show the results. The coefficients of *Treat_City*1 × *Post* and *Treat_City*2 × *Post* are still significantly positive.

Listed companies may have a lot of subsidiaries across different regions. The definition of the treatment group and the control group based on registered province may not reflect the pressure of public environmental concerns that companies faced. Thus we redefine *Treat* indicator based on the locations of the company's subsidiaries. We conduct the *Treat_Subsidiaries* indicator, and define it take the value one if most of a company's subsidiaries located in severely polluted province (provincial $PM_{2.5}$ level higher than the national median in 2011), otherwise zero. Column (3) in Table 7 shows the test results. The coefficient of *Treat_Subsidiaries* × *Post* remains significantly positive.

Public environmental concerns in mildly polluted regions may also increase a lot in a few years after the 2011$PM_{2.5}$ surge event, especially for those who become severely polluted later. Thus we conduct a staggered DID model. We define a *PEC_Staggered* indicator, which takes the value one for the firm-year observations of companies having suffered in severe pollution (the provincial $PM_{2.5}$ above the national median level in the year) ever since the 2011$PM_{2.5}$ surge event, otherwise zero. Taking the period 2012 for example, if the $PM_{2.5}$ of provincial above the national median level in 2011 and 2012, *PEC_Staggered* indicator takes the value one, otherwise zero. Then we reestimate model (1) using the *PEC_Staggered* indicator. Column (4) shows the results. The coefficient of *PEC_Staggered* remains significantly positive.

We define the market power of new energy enterprises as an industrial adjusted Lerner index, indicating that the industry classification method may have a greater impact. Thus, we implement other industry classification methods to construct the indicators of market power for robustness testing. In particular, we conduct three indicators: *MP1* (Lerner index without industrial adjustment), *MP2* (Lerner index with industrial adjustment, whereas manufacturing industries classify in

[1] The aforementioned "Ten Cities and One Thousand New Energy Vehicles" program.

[2] The *Announcement on the Implementation of Special Emission Limits of Air Pollutants* issued by the Ministry of Ecology and Environment in 2013, which proposed the emission limit requirements for 19 provinces and municipalities including Beijing and Shanghai.

Table 6
Robustness tests over alternative samples.

	(1)	(2)	(3)	(4)	(5)	(6)
	2 years before and after 2011	4 years before and after 2011	Including 2011	No newly listed enterprises	No severely polluted industries	PSM sample
	MP	MP	MP	MP	MP	MP
Treat × Post	0.0216**	0.0314***	0.0286***	0.0310**	0.0273**	0.0215**
	(0.0088)	(0.0109)	(0.0096)	(0.0143)	(0.0124)	(0.0099)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.261	0.222	0.272	0.205	0.229	0.251
Observations	644	1248	1115	743	830	767

This table presents the results of the robustness test over alternative samples. Dependent variable *MP* is defined as industrial adjusted Lerner index. The independent variable of special interest is *Treat* × *Post*. *Treat* takes the value one if the company is located in severely polluted provinces, otherwise zero. *Post* takes the value one for the sample period after the 2011PM2.5 surge event, otherwise zero. All variable definitions are provided in Table 1. Robust standard errors clustered by province are reported in parentheses. ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Table 7
Robustness tests with alternatively defined indicators of treatment.

	(1)	(2)	(3)	(4)
	MP	MP	MP	MP
Treat_City1 × Post	0.0277**			
	(0.0136)			
Treat_City2 × Post		0.0329***		
		(0.0114)		
Treat_Subsidiaries × Post			0.0242**	
			(0.0116)	
PEC_Staggered				0.0282**
				(0.0112)
Controls	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Adj. R^2	0.227	0.235	0.228	0.230
Observations	956	956	924	956

This table presents the results of the robustness test with alternatively defined indicators of treatment. Dependent variable *MP* is defined as industrial adjusted Lerner index. Independent variables in columns (1) to (4) are *Treat_City1* × *Post*, *Treat_City2* × *Post*, *Treat_Subsidiaries* × *Post*, and *PEC_Staggered*, respectively. *Treat_City1* (*Treat_City2*) takes the value one if the company is located in severely polluted cities, otherwise zero. *Treat_Subsidiaries* takes the value one if most of the company's subsidiaries are located in severely polluted provinces, otherwise zero. *Post* takes the value one for the sample period after the 2011PM2.5 surge event, otherwise zero. *PEC_Staggered* takes the value one for the observations of companies having suffered from severe pollution ever since the 2011PM2.5 surge event, otherwise zero. All variable definitions are provided in Table 1. Robust standard errors clustered by province are reported in parentheses. ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Table 8
Robustness tests with alternatively defined indicators of MP.

	(1)	(2)	(3)
	MP1	MP2	MP3
Treat × Post	0.0175**	0.0248**	0.0242**
	(0.0084)	(0.0111)	(0.0114)
Controls	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes
Adj. R^2	0.281	0.221	0.223
Observations	956	956	956

This table presents the results of the robustness test with alternatively defined indicators of MP. Dependent variables in columns (1) to (3) are *MP*1, *MP*2, and *MP*3, respectively. *MP*1 is defined as the Lerner index without industrial adjustment. *MP2* is defined as Lerner index with industrial adjustment, whereas manufacturing industries classify in three-digit categories, and other industries classify in two-digit categories. *MP*3 is defined as Lerner index with industrial adjustment, whereas manufacturing industries classify in four-digit categories, and other industries classify in three-digit categories. The independent variable of special interest is *Treat* × *Post*. *Treat* takes the value one if the company is located in severely polluted provinces, otherwise zero. *Post* takes the value one for the sample period after the 2011PM2.5 surge event, otherwise zero. All variable definitions are provided in Table 1. Robust standard errors clustered by province are reported in parentheses. ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

three-digit categories, and other industries classify in two-digit categories), and *MP3* (Lerner index with industrial adjustment, whereas manufacturing industries classify in four-digit categories, and other industries classify in three-digit categories). Table 8 shows the robustness test results of the market power indicators constructed with these different definitions above. The coefficient of *Treat* × *Post* is still significantly positive.

The development of new energy enterprises may lead to an improvement of the local environment, which will interfere with the baseline regression results. Thus, we add control variables to model (1) to eliminate the interference. The first is the new energy company's age (*LNAGE*), as longer operations lead to a greater positive impact on the local environment. The second is the number of provincial new energy companies (*NE_Province*), as more new energy companies accumulate more positive impact on the local environment. Table 9 columns (1) to (3) show the robustness test results with additional control variables *LNAGE*, *NE_Province*, and both together, respectively. The coefficient of *Treat* × *Post* is still significantly positive.

The market power of new energy companies might be related to industry concentration. Thus we add variables of industry concentration to model (1) to control for the potential impacts from industry concentration. Consistent with prior research on industrial organization, we construct two proxies for industry concentration, *HHI* (the sum of the squared proportion of firm's sales related to total sales of all firms in the same industry) and *CR4* (the sum of top four proportions of firm's sales related to total sales of all firms in the same industry). Table 9 columns (4) to (5) show the robustness test results with additional control variables *HHI* and *CR4*, respectively. The coefficient of *Treat* × *Post* remains significantly positive.

Although using firm fixed effects can control for time-invariant differences across firms, it will underestimate the spillover effect across firms. Thus, instead of a firm fixed-effect model, we also use other fixed-effect models for robustness testing. Table 10 columns (1) to (4) present the results based on industry fixed effects, province fixed effects, both together, and industry × province fixed effects, respectively. The coefficient of *Treat* × *Post* remains significantly positive.

In summary, Tables 6 to 10 provide the robustness test results over alternative samples, different definitions of key variables, and different control variables. The remaining significantly positive coefficient of *Treat* × *Post* indicates a convincing correlation between the increasing public environmental concerns and the emerging energy enterprises.

Table 9
Robustness tests with alternative control variables.

	(1)	(2)	(3)	(4)	(5)
	MP	MP	MP	MP	MP
Treat × Post	0.0306**	0.0295**	0.0302**	0.0285**	0.0315***
	(0.0111)	(0.0113)	(0.0115)	(0.0110)	(0.0108)
LNAGE	−0.0484		−0.0498		
	(0.0432)		(0.0462)		
NE_Province		0.0009	0.0018		
		(0.0066)	(0.0071)		
HHI				0.170	
				(0.174)	
CR4					−5.972**
					(2.668)
Controls	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.233	0.231	0.233	0.233	0.246
Observations	956	956	956	956	956

This table presents the results of the robustness test with alternative control variables. Dependent variable *MP* is defined as industrial adjusted Lerner index. The independent variable of special interest is *Treat* × *Post*. *Treat* takes the value one if the company is located in severely polluted provinces, otherwise zero. *Post* takes the value one for the sample period after the 2011PM2.5 surge event, otherwise zero. All variable definitions are provided in Table 1. Robust standard errors clustered by province are reported in parentheses. ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Table 10
Robustness tests with alternative fixed effects.

	(1)	(2)	(3)	(4)
	MP	MP	MP	MP
Treat × Post	0.0301**	0.0267**	0.0282**	0.0286**
	(0.0110)	(0.0128)	(0.0122)	(0.0115)
Controls	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Industry FEs	Yes	No	Yes	No
Province FEs	No	Yes	Yes	No
Industry × Province FEs	No	No	No	Yes
Adj. R^2	0.445	0.314	0.553	0.703
Observations	956	956	956	956

This table presents the results of the robustness test with alternative fixed effects. Dependent variable *MP* is defined as industrial adjusted Lerner index. The independent variable of special interest is *Treat* × *Post*. *Treat* takes the value one if the company is located in severely polluted provinces, otherwise zero. *Post* takes the value one for the sample period after the 2011PM2.5 surge event, otherwise zero. All variable definitions are provided in Table 1. Robust standard errors clustered by province are reported in parentheses. ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

4.4. Test of hypothesis 2 (i.e., H2)

Table 11 shows the results for hypotheses 2a–2c. Columns (1) and (2) show the regression results of the non-SOEs and SOEs. Columns (3) and (4) show the regression results of the samples with no political connections and with political connections, respectively. Columns (5) and (6) show the regression results of the non-subsidized and subsidized regional samples. The coefficients of *Treat* × *Post* are significantly positive at or below the 5% level in the subsamples of non-SOEs (column (1)), not politically connected enterprises (column (3)), and non-subsidized regional enterprises (column (5)), indicating a promoting effect of public environmental concerns on new energy enterprises. By comparison, SOEs (column (2)), politically connected enterprises (column (4)), and subsidized regional enterprises (column (6)) have insignificant coefficients of *Treat* × *Post*, suggesting there is no promoting effect of public environmental concerns on new energy enterprises in these samples. The empirical results are according to the theoretical expectation of hypothesis 2a–2c, implying that the promoting effects of public environmental concerns on the new energy enterprises' development rely on a highly competitive market environment.

4.5. Potential mechanisms

We consider two potential mechanisms through which public environmental concerns promote the new energy enterprises' development. First, we check whether the new energy enterprises in severely polluted areas attracted more public attention after the $PM_{2.5}$ surge event. Reading research reports published by analysts is a crucial way for the public to learn about listed companies. Thus, we use the natural logarithm of the number of mentions of the company in research reports (*LNRM*) to measure the company's public attention, and expect public environmental concerns have positive impacts on the public attention of new energy enterprises. Column (1) in Table 12 shows the results. The coefficient of *Treat* × *Post* is significantly positive at the 5% level, indicating that new energy enterprises in severely polluted areas attracted more public attention after the $PM_{2.5}$ surge event.

It is important to note that not all of the research reports are positive reports, and analyses may also publish negative ones. Negative reports will lead to negative impacts on mentioned companies, although with public attention increasing. In order to eliminate the non-consistent effects with negative reports, we redefine the company's public attention in two ways: the natural logarithm of the number of mentions of listed companies in non-negative research reports (*LNRM1*) and the natural logarithm of the number of mentions of the company in non-negative research reports minus the number of mentions of the company in negative research reports (*LNRM2*), where negative reports are identified based on their title.[3] Table 12 columns (2) and (3) show the results. The coefficient of *Treat* × *Post* is also significantly positive at the 5% level, suggesting that new energy enterprises in severely polluted areas attracted more positive public attention after the $PM_{2.5}$ surge event.

Second, we check whether it is increased demand for goods and services instead of cost reduction cause new energy enterprises' market power increase by public environmental concerns. We break down the market power source into two categories, labeled as sales market power and cost market power (i.e., higher sales pricing and lower operating costs). Sales market power is defined as sales revenue by the average sales revenue of other companies in the same industry (*SMP*), and cost market power is defined as operating costs by the average operating costs of other companies in the same industry (*CMP*). A larger value of *SMP* indicates greater sales market power, while a larger value of *SMP* indicates less cost market power. Table 12 columns (4) and (5) show the results of the impact of public environmental concerns on sales market power and cost market power, respectively. The coefficient of *Treat* × *Post* is significantly positive at the 5% level in column (4), and is not statistically significant in column (5), indicating that improving market power of new energy enterprises by public environmental concerns is mainly due to increased demand for goods and services, rather than operation cost reduction.

4.6. Further analysis

Prior studies show that environmental regulation has a great impact on new energy enterprises, like carbon regulation promoting new energy vehicles consumption (Zhu et al., 2019), subsidies and tariffs expanding the production of domestic new-energy cars (Yang et al., 2019). To ensure the promoting effect is from the increased public environmental concerns, not due to the environmental regulation, we retrain our sample to the 19 provinces which proposed the emission limit requirements by the *Announcement on the Implementation of Special*

[3] On average, only less than 2.5% of the research reports where new energy companies are mentioned showed negative sentiment.

Table 11
Testing the hypothesis 2 (i.e., H2).

	(1)	(2)	(3)	(4)	(5)	(6)
	Non-SOEs	SOEs	Enterprises with no PC	Enterprises with PC	Non-subsidy regions	Subsidy regions
	MP	MP	MP	MP	MP	MP
Treat × Post	0.0247**	−0.0010	0.0367***	0.0067	0.0475**	0.0031
	(0.0113)	(0.0091)	(0.0129)	(0.0168)	(0.0172)	(0.0171)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.192	0.200	0.303	0.243	0.308	0.174
Observations	658	298	679	277	527	429

This table presents the results of the H2 test according to subsamples. Dependent variable *MP* is defined as industrial adjusted Lerner index. The independent variable of special interest is *Treat* × *Post*. *Treat* takes the value one if the company is located in severely polluted provinces, otherwise zero. *Post* takes the value one for the sample period after the 2011PM2.5 surge event, otherwise zero. All variable definitions are provided in Table 1. Robust standard errors clustered by province are reported in parentheses. ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Table 12
Potential mechanisms.

	(1)	(2)	(3)	(4)	(5)
	Public attention			Decomposing market power	
	LNRM	LNRM1	LNRM2	Sales MP	Cost MP
Treat × Post	0.208**	0.241**	0.259**	0.0435**	0.0357
	(0.0971)	(0.106)	(0.106)	(0.0204)	(0.0212)
Controls	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.588	0.581	0.568	0.652	0.630
Observations	956	956	954	956	956

This table presents the results of the potential mechanism test. Dependent variables in columns (1) to (3) are *LNRM*, *LNRM*2, and *LNRM*3, respectively, indicating public attention to new energy enterprises. Dependent variables in columns (4) and (5) are *Sales MP* and *Cost MP*, indicating the market power of increased demand for goods and services and operation cost reduction. The independent variable of special interest is *Treat* × *Post*. *Treat* takes the value one if the company is located in a severely polluted province, otherwise zero. *Post* takes the value one for the sample period after the 2011PM2.5 surge event, otherwise zero. All variable definitions are provided in Table 1. Robust standard errors clustered by province are reported in parentheses. ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Emission Limits of Air Pollutants issued in 2013, and drop the 2014 samples. Column (1) in Table 13 shows the results. The coefficient of *Treat* × *Post* is still significantly positive.

Gu et al. (2021) indicate that there may be a complementary effect of public environmental concerns and environmental regulation on severely polluted companies increasing green investment. Thus we conduct a triple-DID method following Gu et al. (2021) to investigate the moderate effect of environmental regulation on the positive relationship between public environmental concerns and the market power of new energy enterprises. *ER* Takes the value one if the company located in the province with weak environmental regulation (less than the national median) just before the 2011$PM_{2.5}$ surge event, otherwise zero. Column (2) shows the results. The coefficient of *Treat* × *Post* × *ER* is still significantly positive, indicating that there is a complementary effect between public environmental concerns and environmental regulation on promoting new energy enterprises' development.

Besides increasing public environmental concerns, air pollution would lead to great damage to human capital (Zhang et al., 2017; Liao et al., 2021). Thus, we split the sample into labor-intensive industries and capital-intensive industries, and compare the impacts of public environmental concerns on the market power of new energy enterprises between the two subsamples. We define labor-intensive industries and capital-intensive industries in two steps. First, we calculate the number of employees divided by the scale of fixed assets of each company annually, and record it as *L/K*. Second, we define labor-intensive industries for the industries with greater industrial mean *L/K* than the median of industrial mean *L/K* of all industries just before the 2011$PM_{2.5}$ surge event, otherwise capital-intensive industries. Columns (3)–(4) show the results. The coefficient of *Treat* × *Post* is significantly positive in capital-intensive industries, and is statistically insignificant in labor-intensive industries. The results suggest that the promoting effect of public environmental concerns on new energy enterprises may be offset by the damage on human capital caused by air pollution.

Table 13
The impact of environmental regulation and industry characteristics.

	(1)	(2)	(3)	(4)
	Regulated regions	Environmental regulation	Labor-intensive industry	Capital-intensive industry
	MP	*MP*	*MP*	*MP*
Treat × Post	0.0248*	0.0085	0.0030	0.0346**
	(0.0121)	(0.0149)	(0.0097)	(0.0142)
Treat × Post × ER		0.0387*		
		(0.0212)		
Controls	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Adj. R^2	0.238	0.240	0.237	0.373
Observations	634	956	482	474

This table presents the results of the additional investigation on the impact of environmental regulation and industry characteristics. Dependent variable *MP* is defined as industrial adjusted Lerner index. The independent variable of special interest is *Treat* × *Post* (or *Treat* × *Post* × *ER* when existing). *Treat* takes the value one if the company is located in a severely polluted province, otherwise zero. *Post* takes the value one for the sample period after the 2011PM2.5 surge event, otherwise zero. *ER* takes the value one if the company is located in a province with weak environmental regulation, otherwise zero. All variable definitions are provided in Table 1. Robust standard errors clustered by province are reported in parentheses. ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Eventually, it is probable for new energy enterprises to take action in facing the opportunity of increased public environmental concerns, like more investment and R&D. Thus we investigate whether new energy enterprises promote investment and R&D with the increased public environmental concerns. Columns (1)–(3) in Table 14 show the results of the impact of public environmental concerns on investment (Cash paid for the purchase and construction of fixed assets, intangible assets, and other long-term assets nominated by total assets), R&D investment (R&D expenditures nominated by total assets) and inventory investment (inventory nominated by total assets), respectively. The coefficient of *Treat* × *Post* is significantly positive across all three columns, which

Table 14
Firm's strategy reacted to increased PEC.

	(1)	(1)	(2)
	Investment	R&D Investment	Inventory Investment
Treat × Post	0.0126*	0.0073*	0.0053*
	(0.0066)	(0.0041)	(0.0029)
Controls	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes
Adj. R^2	0.204	0.307	0.074
Observations	956	956	956

This table presents the results of the additional investigation on the firm's strategy that reacted to increased public environmental concern. Dependent variables in columns (1) to (3) are *Investment*, *R&D Investment*, and *Inventory Investment*, respectively. The independent variable of special interest is *Treat* × *Post*. *Treat* takes the value one if the company is located in a severely polluted province, otherwise zero. *Post* takes the value one for the sample period after the 2011PM2.5 surge event, otherwise zero. All variable definitions are provided in Table 1. Robust standard errors clustered by province are reported in parentheses. ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

indicates that new energy enterprises promote investment and R&D reacted to the increased public environmental concerns.

5. Concluding remarks

This paper examines the impact of public environmental concerns on the development of new energy enterprises. Based on the Chinese 2011$PM_{2.5}$ surge event as a quasi-natural experiment, we conduct a DID model and found that the market power of new energy enterprises increased greater in severely polluted regions than those in mildly polluted regions after the event. The heterogeneity test shows that the positive impact of public environmental concerns on the development of new energy enterprises is more pronounced in non-SOEs, enterprises with no political connection, and regions with no new energy subsidy. Then we find public environmental concerns promote the new energy enterprises' development through increasing positive reports on new energy enterprises of analyses and improving the demand for new energy enterprises' goods and services, rather than operation cost reduction. Overall, our empirical results suggest a positive impact of public environmental concerns on the development of new energy enterprises.

Unlike prior studies mainly focusing on the role of subsidy, this paper provides a new perspective on promoting new energy enterprises through public environmental concerns. As public environmental concerns can boost consumer support for new energy enterprises' products, the government should prioritize the positive role of public environmental concerns and enhance public environmental concerns by strengthening environmental awareness, supporting new energy enterprises to become socially responsible, encouraging banks to provide more green loans on new energy enterprises and other methods. Meanwhile, the government should improve the impartiality of the new energy industry's participation in market competition and reduce or cancel their special policy subsidies since a sufficiently competitive market environment contributes to efficiency improvement of the new energy industry in the long run.

Acknowledgements

This work is supported by Soft Science Research Project of Shanghai Science and Technology Innovation Action Plan Grant No. 22692193300, and National Natural Science Foundation of China under Grant No. 72121002.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.eneco.2022.105967.

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