Pol. J. Environ. Stud. Vol. 34, No. 5 (2025), 5527-5538
DOI: *10.15244/pjoes/191604* ONLINE PUBLICATION DATE: 2024-11-22

Original Research

Can Environmental Regulations Promote Firms' Proenvironmental Behavior? Micro Evidence on Environmental Product Imports

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Received: 23 April 2024
Accepted: 24 July 2024

Abstract

How firms respond to environmental regulations is the key to measuring the effect of these regulations, and firms taking the initiative to assume environmental responsibility and adopt more proenvironmental behaviors in the production decision-making process is crucial for green development. Based on the databases of merged Chinese industrial enterprises, firm pollution discharge, and customs, this paper examines the influence and mechanism of environmental regulation on the proenvironmental behavior of enterprises from the perspective of environmental products. Benchmark analysis revealed that environmental regulations improve the extension and intensive margins of firms' environmental products. That is, environmental regulations effectively promote firms' proenvironmental behavior. The mechanism analysis reveals that the cost effect and technology effect are important factors influencing the impact of environmental regulations on the proenvironmental behavior of firms. Furthermore, the expansion analysis shows that the influence of market incentives and command-and-control environmental regulations on firms' proenvironmental behavior is more significant and that the effect of public voluntary environmental regulation is relatively weak. This paper provides useful policy implications for improving the policy effect of environmental regulations from a microperspective.

Keywords: environmental regulation, proenvironmental behavior, environmental product imports, cost effect, technology effect

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Introduction

With the rapid development of China's economy since the reform and opening up, environmental problems have become increasingly prominent, and this economic growth, characterized by extensive production, has caused severe damage to the ecological environment. Additionally, environmental governance issues have attracted widespread attention. To cope with the difficulties and challenges posed by environmental pollution, the state has elevated environmental protection to the level of national policy, and a series of environmental policies have been issued to achieve the coordinated development of economic growth and environmental protection. However, with the implementation of various environmental policies, it is still difficult for environmental governance issues to escape the dilemma of "policies at the top, countermeasures at the bottom", and it is not uncommon for firms to turn a blind eye to or circumvent the government's environmental regulatory policies to gain maximum economic benefits. Additionally, the impact of environmental regulations on the green development of enterprises has not had the expected effect. As important objects of environmental regulations, firms react to the regulations, which are the key to measuring their effectiveness. If environmental regulations can motivate firms to take the initiative to assume social responsibility to protect the environment, carry out a clean transformation in the production decision-making process, and adopt more proenvironmental behaviors, they will play an important role in the high-quality development of China's environment and economy.

China's environmental regulation policy tools have gradually evolved from the early mode, which relied solely on administrative orders from government departments, to a three-dimensional integrated environmental regulation policy that includes command and control, market incentives, and public voluntary tools. The main feature of command-and-control environmental policy tools is their reliance on the direct management and supervision of government departments. Market incentive environmental policy tools, whose main feature is flexibility, rely mainly on cost benefits to guide the choices of economic stakeholders. Public voluntary environmental policy tools rely mainly on the indirect role of public opinion, and their main feature is indirectness.

In this context, this paper analyzes the impact of environmental policy on the proenvironmental behavior of firms from the point of view of environmental product imports and discusses the heterogeneous effects of different policy tools. Compared with previous studies, this paper's marginal contributions are as follows: From a research perspective, this paper explores the effect of environmental policies on a firm's proenvironmental behavior based on import decision-making and the import scale of environmental products. Additionally, it explores whether environmental policies can drive firms to adopt proenvironmental behaviors spontaneously, which expands the research perspective for environmental policy effect assessment. With respect to the research data, the empirical analysis in this paper is based on matching data from industrial enterprises, firm pollution discharge, and customs databases in China. This paper constructs a large sample dataset containing detailed information on the production, pollution discharge, and import and export of firms. The application of these data improves the representativeness and validity of the research conclusions of this paper. With respect to the research framework, this article verifies the different tools used by enterprises to assess the impact of environmental behavior and provides theoretical guidance for how the government chooses environmental policies to conduct environmental governance, improving the research framework of the impact of environmental regulations on corporate behavior.

The structure of this paper is as follows: The second part is the literature review, in which theoretical hypotheses are proposed. The third part is the research design, including the model specification, indicator construction, and data source. The fourth part presents the empirical analysis, including benchmark, endogeneity, robustness, and heterogeneity analyses. The fifth part provides a discussion of the internal mechanism and expansion analysis. The last section presents the conclusions and policy implications.

Literature Review and Hypotheses

With the increasing efforts of the government to control environmental pollution, driving the proenvironmental behavior of firms through environmental regulations has attracted increasing attention from scholars [1-3]. The relevant theories of environmental regulation mainly involve the pollution haven hypothesis and the Porter hypothesis [4, 5]. According to the relevant literature on the pollution haven hypothesis, environmental regulations increase the production costs of firms [6, 7]. Some firms migrate to avoid rising environmental costs, whereas other firms engage in more proenvironmental behavior by importing environmental products to respond to local environmental regulations [8, 9]. According to the relevant literature based on the Porter hypothesis, environmental regulations increase the motivation for firms to engage in technological innovation, motivating firms to invest in more research and development (R&D) and innovation and to upgrade production processes [10, 11]. This process may lead to the import of pollution treatment equipment and the introduction of pollution treatment technology, thereby promoting the proenvironmental behavior of firms [12]. On this basis, Hypothesis 1 is proposed.

Hypothesis 1: Environmental regulations can increase firms' imports of environmental products and promote their proenvironmental behavior.

According to the theories above, the cost and technology effects are important channels through which environmental regulation affects the production decisions and behaviors of firms [13, 14]. From the perspective of the cost effect, when the environmental regulation of a region intensifies, the penalty for pollution emissions also intensifies [15]. To avoid high penalties, firms tend to invest more in pollution control, increasing their operating and production costs [16]. Driven by compliance with cost constraints and profit maximization, firms may adjust their production behavior and adopt more proenvironmental behaviors [17]. In addition, from the perspective of the technology effect, environmental regulations can offset the pollution abatement costs caused by environmental regulations through technological innovation and production process improvement [18]. This process may affect firms' proenvironmental behavior to some extent. On this basis, Hypothesis 2 is proposed.

Hypothesis 2: Environmental regulations, through cost and technology effects, influence the proenvironmental behavior of firms.

China's environmental policy tools are characterized by the coexistence of a command-and-control approach, market incentives, and public volunteering [19-21]. According to command-and-control environmental regulations, the government strives to establish mandatory pollution control indicators based on relevant laws, regulations, rules, and standards, forcing firms to add new process equipment, adopt end-of-pipe treatment technologies, and ultimately meet government pollution standards [22, 23]. In China, the costs of command-and-control policy tools are low, and the policies are easy to implement, which can directly reduce pollution emissions and force firms to engage in proenvironmental behavior. Market incentive environmental regulation policy tools influence the choices of firms by influencing costs and benefits, guiding firms to actively reduce pollution emissions, and internalizing external effects [24, 25]. In China, market incentive policy tools increase the flexibility of firms' emission reduction behaviors, allowing different firms to coordinate economic performance and pollution control and encouraging firms to engage in proenvironmental behavior. Public voluntary environmental regulations force the government to strengthen environmental supervision through measures such as public opinion, morality, and reporting and indirectly affect the environmental governance performance and behavior of the entire society [26]. Publicly voluntary environmental policy tools are indirect and may take a long time to produce effects [27]. The role of public voluntary environmental policy tools depends on the subsequent adjustment of relevant laws, regulations, and technical standards, and the relevant mechanism may still not be perfect at this stage in China. Thus, Hypothesis 3 is proposed.

Hypothesis 3: Different types of environmental policy tools have heterogeneous effects; the effects of China's command-and-control and market incentive policy tools on firms' proenvironmental behavior may be significant, whereas the effects of public voluntary policy tools may not be apparent.

Materials and Methods

Model Specification

To study the influence of environmental regulations on firms' proenvironmental behavior, the following econometric model is constructed:

$$IM_{it} = \beta_0 + \beta_1 LNERI_{it} + \lambda X_{it} + v_i + v_t + \varepsilon_{it} \quad (1)$$

where i represents the firm and t represents the years. IM_{it} represents proenvironmental behavior, which is measured by firms' imports of environmental products and involves whether firms import environmental products and the scale of environmental product imports. ERI_{it} represents the intensity of environmental supervision at the firm level. X_{it} represents the control variables, v_i and v_t represent individual and year fixed effects, respectively, and ε_{it} represents the random error term.

Indicator Construction

Proenvironmental behavior of firms IM_{it}. We use the binary margin of firm environmental product imports to measure the proenvironmental behavior of firms. If a firm is more inclined toward environmental products in its import decisions and increases the proportion of environmental products imported, then it is considered that the firm has adopted more environmentally friendly behavior. This paper measures the extensive margin in terms of whether the firm imports environmental products, and it measures the intensive margin in terms of the scale of environmental product imports. This study defines environmental products based on the list of environmental products revised by the Asia–Pacific Economic Cooperation (APEC) in 2012. This list includes 4 categories and 54 kinds of products, and the corresponding six-digit HS codes and classifications are shown in Table 1. Based on the sixth-quantile HS code of the import product information in the Chinese customs database, this study matches the HS code of environmental products and establishes a virtual variable of whether the firm imports environmental products each year in the sample interval, taking a value of 1 for imports and 0 otherwise. The scale of firm environmental product imports is used to measure the intensive margin of firm environmental products; the logarithm is taken.

Environmental regulation intensity ERI_{it}. This paper studies environmental regulation intensity at the firm level; based on firm emission measurements, the removal rate of chemical oxygen demand is used to measure the intensity of environmental regulation.

Table 1. The environmental products defined by the APEC.

Category	Product Code
Environmental monitoring analysis and evaluation equipment	901580, 902610, 902620, 902680, 902690, 902710, 902720, 902730, 902750, 902780, 902790, 903149, 903190, 903180, 903289, 903290, 903300
Renewable energy equipment	840290, 840690, 841182, 841199, 841290,841919, 841990, 850164, 850231850239, 850300, 850490, 854140, 901380, 901390
Environmental protection products	840410, 840420, 840490, 841780, 841790,841939, 841960 841989, 942121, 842129, 842139, 842199, 847420, 847982 847989, 847990, 851410, 851420, 851430, 851490, 854390
Environmentally friendly products	441872

The reasons for this are as follows: Based on the actual pollution emissions of Chinese firms, using COD can somewhat avoid the impact of pollutants emitted by a few industries, especially large state-owned firms [28, 29], on the results. In terms of data availability, the China pollution emission database provides detailed firm COD generation and emission information to maximize the representativeness of the sample size and estimated results compared with other data. Therefore, this paper measures the COD removal rate at the firm level in logarithmic form.

Control variables X_{it}. With respect to research on the proenvironmental behavior of firms [30, 31], the control variables are as follows: The capital intensity variable *CI* is measured as the ratio of fixed assets and employees of the firm. Labor productivity *LP* is measured as the ratio of the output value to the number of employees of the firm. The business lifespan variable *Age* is measured as the difference between the current year and the year the firm was founded plus 1. The scale of the firm *Scale* is measured by the number of employees. The effective tax rate level *TR* is measured by the proportion of the value-added tax payable by the firm to the sales revenue from products. Table 2 presents the descriptive statistics for the major variables.

Data Introduction

This study uses microlevel data from Chinese industrial firms, firm pollution emissions, and customs databases. The Chinese industrial firm database provides complete information about a company's business operations. The Chinese industrial firm database contains statistical information on all state- and nonstate-owned industrial firms larger than a certain size. The statistical items in the Chinese firm pollution emission database are industrial firms, which account for more than 85% of the total emissions in all areas of China. The Chinese customs database contains complete import and export transaction information of firms.

The matching process for the above data is as follows: First, the Chinese industrial firm database is processed with reference to [32], and industrial firm panel data are formed on this basis. Second, a similar method is used to process the firm pollution discharge database to form pollution panel data. Third, based on the unique identification code formed by the firm identity information, the pollution panel data of industrial enterprises are formed by combining the Chinese industrial enterprise and the enterprise pollution emission databases. Finally, based on the method of [33], the customs and industrial firm pollution panel databases are merged to form matching data.

Table 2. Descriptive statistics of the main variables.

Variable	Observations	Mean	Median	Std. Dev.	Min	Max
IM: Import probability	72,778	0.244	0	0.429	0	1
IM: Import scale	72,778	2.663	0	4.885	0	15.89
ERI	58,492	0.369	0.479	0.275	0	0.692
CI	65,613	4.455	4.452	1.238	1.217	7.516
LP	65,613	5.625	5.589	1.076	3.151	8.534
Age	72,736	2.462	2.398	0.659	1.099	3.951
Scale	72,778	5.972	5.908	1.175	3.401	8.988
TR	65,576	0.030	0.024	0.030	-0.022	0.127

Note: Nondummy variables were winsorized at the 1% level on both tails.

The research sample ranges from 2000 to 2010. The samples currently available in China's microfirm database span the years 2000-2013. The data from 2011 to 2013 were not utilized when selecting a sample period for the following reasons: First, there is a significant absence of indicators in the data from 2011 to 2013, and several of the key indicators utilized in this study cannot be calculated. Second, the data quality from 2011 to 2013 was low. To verify the accuracy of the data, the microfirm data were aggregated by industry and compared with the key economic indicators of industrial firms released by China's National Bureau of Statistics. The data from 2000 to 2010 were determined to be consistent with previously released data; however, the data from 2011 to 2013 did not fulfill the criteria. Third, the industrial market structure and environmental rules have not altered considerably; therefore, the study's results will remain consistent.

The matching data from the Chinese industrial firm database, firm pollution emission database, and customs database are the micro database with the largest sample scale and the most authoritative source for investigating Chinese industrial enterprises' energy and environmental issues. Furthermore, industrial firms are the primary emitters of air pollution and greenhouse gases in China. As a result, the selection of study samples in this work ensures that the research is both comprehensive and effective.

Results and Discussion

Benchmark Analysis

The benchmark return results are shown in Table 3. Columns (1) and (2) in Table 3 examine the impact of environmental regulations on firms' proenvironmental behavior based on import decisions regarding environmental products. The results suggest that environmental regulations increase the probability of environmental product imports. That is, environmental regulations promote the proenvironmental behavior of firms from the extensive margin. Columns (3) and (4) of Table 3 are based on the environmental product import scale analysis of the effects of environmental regulations on firms' proenvironmental behavior. The results suggest that environmental regulations increase the scale of firm environmental product imports. That is, environmental regulations promote the proenvironmental behavior of firms from the intensive margin. The possible economic explanations are as follows: With the strengthening of environmental supervision, firms have changed from

Table 3. Impact of environmental regulations on firms' pro-environmental behaviors.

	Extensive margin of environmental product imports		The intensive margin of environmental product imports	
	(1)	(2)	(3)	(4)
ERI	0.0232***	0.0220**	0.2493***	0.2419***
	(0.0084)	(0.0089)	(0.0877)	(0.0924)
CI		0.0191***		0.2465***
		(0.0039)		(0.0404)
LP		0.0296***		0.3447***
		(0.0043)		(0.0448)
Age		-0.0180***		-0.2351***
		(0.0064)		(0.0660)
Scale		0.0420***		0.5404***
		(0.0049)		(0.0508)
TR		-0.2242***		-2.3391***
		(0.0793)		(0.8218)
Constant	0.3005***	-0.1438***	3.1707***	-2.3720***
	(0.0062)	(0.0466)	(0.0648)	(0.4828)
Time fixed effect	YES	YES	YES	YES
Individual fixed effect	YES	YES	YES	YES
Observations	58,492	52,798	58,492	52,798

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. The numbers in parentheses indicate standard errors.

the traditional production mode to the clean production mode and increased their efforts regarding clean production. Therefore, on the one hand, the production process will be improved by expanding the margin, and the import decision will be more inclined toward environmental products. On the other hand, from the perspective of the intensive margin, environmental regulations affect the production process of firms, and firms achieve the green transformation of production by importing more environmental products.

The influence of the control variables on the proenvironmental behavior of firms is further analyzed. The results show that as enterprise capital intensity, labor productivity, and firm scale increase, firms may have greater capital, technology, and scale advantages and be more motivated to "promote cleanliness" in their production behavior. Thus, they are more inclined to change to proenvironmental behavior and increase the type and scale of the environmental products that they import. With the increase in the effective tax rate of firms and the increase in the tax burden, firms will have no additional funds to carry out green transformation, and the probability and scale of firm environmental product imports will be reduced, inhibiting the proenvironmental behavior of firms. In addition, the probability and scale of environmental product imports decrease as firms age, as mature firms have a stable market share and less incentive to improve cleaner production methods.

Endogeneity Analysis

This study solves the endogeneity problem by constructing environmental regulation at the prefecture level through environmental regulation at the firm level, satisfying the requirements of both correlations with the explanatory variables and exogeneity with the explained variables. The proportion of the output value of firms in the total output value of prefecture-level cities is the weight, and environmental regulations in prefecture-level cities are obtained by the weighted average. Columns (1) and (2) of Table 4 present the results of two-stage least squares (2SLS) estimation of the instrumental variables. The results also indicate that environmental regulations improve the probability and scale of environmental product imports and promote the proenvironmental behavior of firms. When other control variables are added, as shown in columns (3) and (4), the results are still consistent with the benchmark results, which explains why the conclusions remain valid when the endogeneity problem is controlled. The results of both the Lagrange multiplier (LM) statistics and the Sargan statistics reported in Table 4 significantly decrease the original hypothesis of insufficient instrumental variables and overidentification of the instrumental variables. The results of the F statistics are also significantly above the critical value level of 10%, indicating that the choice of instrumental variables is reasonable.

Robustness Analysis

The impact of environmental regulations on firms' proenvironmental behavior may significantly differ according to firm age. Therefore, new entrants and outgoing firms may interfere with the benchmark results. In columns (1) and (2) of Table 5, firms that have existed continuously for more than three years within the sample period are selected as sample data

Table 4. Endogeneity analysis.

	(1)	(2)	(3)	(4)
	Extensive	Intensive	Extensive	Intensive
ERI	0.1244**	1.3413**	0.1200**	1.3482**
	(0.0503)	(0.5231)	(0.0515)	(0.5343)
Control variables	NO	NO	YES	YES
Time fixed effect	YES	YES	YES	YES
Individual fixed effect	YES	YES	YES	YES
Observations	50,098	50,098	44,715	44,715
Adj R^2	0.004	0.004	0.008	0.009
Sargon	0.000	0.000	0.000	0.000
CD-Wald F	1077.90	1077.90	1015.88	1015.88
	[8.96]	[8.96]	[8.96]	[8.96]
LM	1047.82	1047.82	985.82	985.82
	(0.00)	(0.00)	(0.00)	(0.00)

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. The numbers in parentheses indicate standard errors.

Table 5. Robustness analysis.

	Deleting short-lived businesses		Overriding missing values		Controlling for the region and industry	
	(1) Extensive	(2) Intensive	(3) Extensive	(4) Intensive	(5) Extensive	(6) Intensive
ERI	0.0248**	0.2736***	0.0181**	0.1910**	0.0216**	0.2371**
	(0.0101)	(0.1040)	(0.0075)	(0.0778)	(0.0089)	(0.0925)
Constant	-0.1504***	-2.5817***	-0.1436***	-2.4088***	-0.0804	0.1156
	(0.0542)	(0.5600)	(0.0402)	(0.4150)	(0.3444)	(3.5692)
Control variables	YES	YES	YES	YES	YES	YES
Time fixed effect	YES	YES	YES	YES	YES	YES
Individual fixed effect	YES	YES	YES	YES	YES	YES
Control for the city	NO	NO	NO	NO	YES	YES
Control for the industry	NO	NO	NO	NO	YES	YES
Observations	32,833	32,833	65,532	65,532	52,798	52,798

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. The numbers in parentheses indicate standard errors.

for robustness analysis. In addition, missing COD values in the sample were further processed. In columns (3) and (4) of Table 5, the missing values of the COD removal rate are replaced by 0. Finally, the region and industry factors in columns (5) and (6) of Table 5 are controlled for robustness.

The results show that the coefficients of the environmental regulation variables in Table 5 are all significantly positive after excluding the sample of new business entrants and those that have exited, replacing missing COD values, and controlling for industry and region factors. The results indicate that environmental regulations can increase the probability and scale of environmental product imports; namely, environmental regulations promote the proenvironmental behavior of firms from the aspects of extensive and intensive margins, confirming the robustness of the benchmark conclusion.

Heterogeneity Analysis

As a large developing country with a vast territory and a large population, China's unbalanced regional economic development is a fundamental national condition. To investigate how geographic characteristics affect the relationship between environmental regulations and firm environmental product imports, columns (1)-(4) of Table 6 investigate the influence of environmental regulations on the proenvironmental behaviors of firms in different regions. Based on existing research [34, 35], China's eastern provinces give full play to the advantages of being located by the sea and the policy advantages of attracting investment, and their rapid economic growth is considered developed, whereas China's central and western provinces are regarded as underdeveloped regions[1]. The results verify that environmental regulations significantly increase the probability and scale of environmental product imports in developed regions. For undeveloped regions, environmental regulations have no significant influence on the probability and scale of environmental product imports. One possible explanation is that developed regions have entered the primary stage of intensive economic growth, which not only emphasizes pollution control but also introduces a series of policies to encourage the development of the environmental protection industry, making the design and application of environmental regulation tools more reasonable and scientific.

The environmental regulations faced by firms vary according to the nature of the industry in which they are engaged, which inevitably results in differences in firms' environmental investment behavior and leads to differences in their proenvironmental behavior. Therefore, this paper takes the average industrial pollution control proportion as an evaluation index and divides industries into pollution-intensive and cleaner-production industries. Columns (5)-(8) of Table 6 show the results, which suggest that strengthening environmental regulations has a stronger incentive effect on the proenvironmental behavior of pollution-

[1] The eastern provinces of China include Jiangsu, Fujian, Guangdong, Jilin, Shandong, Anhui, Hainan, Liaoning, Hebei, Tianjin, Shanghai, Zhejiang, Beijing, Heilongjiang, Hong Kong, Macao and Taiwan. The central and western provinces include Henan, Hubei, Hunan, Jiangxi, Guizhou, Shanxi, Ningxia, Guangxi, Gansu, Sichuan, Chongqing, Yunnan, Inner Shaanxi, Tibet, Mongolia, Qinghai, and Xinjiang.

intensive firms. One possible explanation is that pollution-intensive industries face more stringent environmental controls and industry regulations and, thus, assume more environmental responsibility than cleaner-production industries. It is likely that such firms will receive more environmental protection funds for the purchase of environmental protection facilities, environmental protection technology, system improvement, and pollution emission management to promote the proenvironmental behavior of firms.

The distinctive feature of Chinese firms is the coexistence of various ownership types, which are significantly different in terms of business background and environment. Columns (1)-(4) of Table 7 report the influence of environmental regulations on the proenvironmental behavior of firms under different ownership types. The results suggest that environmental regulations significantly increase the probability and scale of the environmental product imports of nonstate-owned firms but have no significant effect on the probability and scale of the environmental product imports of state-owned firms. The possible economic explanations are as follows: State-owned enterprises' operating performance and job security in the promotion and examination of local officials play important roles. Ownership bias often leads to discrimination and the incomplete implementation of regulations. Therefore, when state-owned firms are faced with environmental regulations, they cannot motivate firms to adjust their import strategy or promote their proenvironmental behavior.

In addition, different degrees of market competition also cause different production behaviors in enterprises. In the face of the impact of environmental regulations, firms in industries with different levels of market competition also adopt different countermeasures. The industries are divided into high-competition and low-competition industries according to their median market concentration, which is measured by the Herfindahl–Hirschman index (HHI). As shown in columns (1)-(2) of Table 7, in industries with high market concentration, environmental regulations do not significantly increase the probability and scale of environmental protection of product imports. In industries with low market competition, environmental regulations significantly increase the probability and scale of environmental protection of product imports. Due to the high market concentration of industry enterprises, they are monopolistic and lack competition. Thus, when faced with the impact of environmental regulations, they have no incentive to engage in clean production and are not motivated to engage in proenvironmental behaviors.

Further Analysis

Discussion of the Internal Mechanism

A major finding of this study is that the impact of environmental regulations stimulates the proenvironmental behavior of firms. Why, then, does the impact of environmental regulations make firms import more environmentally friendly products?

To verify Hypothesis 2, the cost effect is measured by introducing the investment in emission reduction equipment and the production cost of firms, and the technology effect is measured by the total number of patents and green patent applications of firms to investigate the possible transmission path through which environmental regulation affects firms' proenvironmental behavior.

Tables 8 columns (1) and (2) show the cost effect mechanism. The results suggest that the estimated coefficients of the influence of environmental regulations on reducing emissions, equipment investment, and the production cost of firms are significantly positive. With the strengthening of environmental regulations, firms'

Table 6. Heterogeneity analysis I: Locational characteristics and industry characteristics.

	Developed regions		Underdeveloped regions		Pollution-intensive industries		Cleaner-production industries	
	(1) Extensive	(2) Intensive	(3) Extensive	(4) Intensive	(5) Extensive	(6) Intensive	(7) Extensive	(8) Intensive
ERI	0.0202**	0.2161**	0.0271	0.3340	0.0273**	0.3265***	0.0120	0.1152
	(0.0097)	(0.0996)	(0.0230)	(0.2468)	(0.0115)	(0.1185)	(0.0145)	(0.1510)
Constant	-0.1900***	-2.8692***	-0.0053	-0.8658	-0.1724***	-1.9887***	-0.0873	-2.6748***
	(0.0524)	(0.5392)	(0.1039)	(1.1149)	(0.0605)	(0.6236)	(0.0755)	(0.7876)
Time fixed effect	YES	YES	YES	YES	YES	YES	YES	YES
Individual fixed effect	YES	YES	YES	YES	YES	YES	YES	YES
Observations	43784	43784	9014	9014	31149	31149	21649	21649

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. The numbers in parentheses indicate standard errors.

Table 7. Heterogeneity analysis II: Ownership and market characteristics.

	State-owned firms		Non-state-owned firms		High concentration		Low concentration	
	(1) Extensive	(2) Intensive	(3) Extensive	(4) Intensive	(5) Extensive	(6) Intensive	(7) Extensive	(8) Intensive
ERI	-0.0001	-0.1152	0.0230**	0.2618***	0.0121	0.1152	0.0253**	0.3139**
	(0.0239)	(0.2535)	(0.0098)	(0.1008)	(0.0136)	(0.1438)	(0.0123)	(0.1256)
Constant	-0.0797	-2.4871**	-0.1702***	-2.4016***	-0.1982***	-3.6145***	-0. 0486	-0.7959
	(0.1172)	(1.2459)	(0.0523)	(0.5379)	(0.0715)	(0.7545)	(0.0642)	(0.6537)
Time fixed effect	YES	YES	YES	YES	YES	YES	YES	YES
Individual fixed effect	YES	YES	YES	YES	YES	YES	YES	YES
Observations	10936	10936	41862	41862	25687	25687	27111	27111

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. The numbers in parentheses indicate standard errors.

investment in emission reduction equipment and their production costs increase, which will lead to more imports of environmentally friendly products, help firms realize cleaner production processes, and promote their proenvironmental behaviors.

Tables 8 columns (3) and (4) show the technology effect mechanism. Column (3) shows that environmental regulations do not affect the total number of patent applications. Dummy variables of green patent applications are introduced to further examine the effects of environmental regulation on firms' green innovation. Column (4) reports that the estimated coefficient of the impact of environmental regulations on whether firms apply for green patents is significantly negative, suggesting that when faced with environmental regulations, firms reduce their investment in green innovation and import environmental products to achieve pollution reduction.

Discussion of Policy Tools

To verify Hypothesis 3, we discuss the heterogeneous effects of different types of environmental regulation tools used to encourage firms' proenvironmental behavior. First, the influence of command-and-control environmental regulations on firms' proenvironmental behavior is investigated. Existing studies measure command-and-control environmental regulation using indicators such as the three simultaneous investment amounts and the accumulative effect of local environmental laws and regulations in each region. This paper uses the input of environmental protection personnel to represent the strength of command-and-control environmental regulations. Greater law enforcement input in a region indicates stricter standards of command-and-control tools in the region. As shown in columns (1) and (2) of Table 9, command-and-control environmental regulations significantly increased the probability and scale of

Table 8. Internal mechanism analysis.

	Cost Effect		Technology Effect	
	(1) Reduction equipment	(2) Production cost	(3) Patent	(4) Green patent
ERI	0.6816***	0.0223*	0.1302	-0.2165**
	(0.1505)	(0.0133)	(0.2195)	(0.0887)
Constant	-0.7278	8.8171***	-3.2240***	-7.4660***
	(0.7810)	(0.0432)	(1.1469)	(0.2460)
Time fixed effect	YES	YES	YES	YES
Individual fixed effect	YES	YES	YES	YES
Observations	50,169	41,728	52,798	52,798

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. The numbers in parentheses indicate standard errors.

the import of environmental products. Owing to command-and-control environmental regulations, environmental protection issues are at the forefront. To meet pollution reduction standards, firms take the initiative to update their pollution reduction equipment and choose alternative raw materials to effectively reduce the production and emission of pollutants, forcing firms to adopt proenvironmental behaviors and accelerate the green transformation of their production mode.

Second, we examine the impact of market incentive environmental regulation on firms' proenvironmental behavior. At the national level, the most common market-based regulation tool is the pollutant discharge charging system. Other systems are not widely used in China. Therefore, this paper uses the logarithm of the ratio of pollution charges to pollution emissions to measure market-motivated environmental regulations. Columns (3) and (4) of Table 9 shows that market incentive environmental regulations significantly increase the probability and scale of firm environmental product imports, promoting the proenvironmental behavior of firms and accelerating the green transformation of firms' production mode.

Finally, as people's demands for ecological quality increase, consumers will pressure government environmental protection departments through letters, visits, phone calls, suggestions to the National People's Congress, and proposals to the CPPCC. Therefore, this paper uses the proportion of environmental petitions in the regional population of each province to measure public voluntary environmental regulations. Columns (5) and (6) of Table 9 show that public voluntary environmental regulations do not improve the probability of firm environmental product imports, nor do they increase the scale of environmental product imports. Thus, public voluntary environmental regulations do not effectively influence firms' proenvironmental behaviors regarding concrete implementation.

Conclusions

Under resource and environmental constraints, driving firms to adopt proenvironmental behaviors by implementing reasonable environmental regulations is an important practical research topic. By matching samples from Chinese industrial firms, firm pollution discharge, and customs databases, the purpose of this study is to explore the influences of environmental regulation on the proenvironmental behavior of enterprises and the mechanism of this impact from the micro perspective of environmental product imports. The primary conclusions are as follows: First, environmental regulations promote the proenvironmental behavior of firms from the intensive and extensive margins of environmental product imports. Second, the influence of environmental regulations on firms' proenvironmental behavior is heterogeneous in terms of firms' location, industry, ownership, and product characteristics. Specifically, environmental regulations have greater incentive effects on the environmental behavior of enterprises in developed regions, pollution-intensive enterprises, nonstate-owned enterprises, and enterprises with low market concentration. Third, cost and technology effects are important mechanisms through which environmental regulations affect firms' proenvironmental behavior. Finally, command-and-control and market incentive environmental policies significantly promote firms' proenvironmental behaviors, whereas the impact of public voluntary environmental policies is relatively weak.

Future research should address some of this study's limitations. This research disregards the dynamic influence of firms entering and exiting the market and instead focuses on the static impact of environmental regulations on existing firms' proenvironmental behavior. Future research on the influence of environmental regulations on proenvironmental behavior should account for the dynamic changes that occur as firms join and exit the market. Owing to the

Table 9. Impact of heterogeneous environmental regulations.

	Command-and-control		Market incentive		Public voluntary	
	(1) Extensive	(2) Intensive	(3) Extensive	(4) Intensive	(5) Extensive	(6) Intensive
ERI	0.0665**	0.7356***	0.3294***	2.4925**	-0.0020	0.0073
	(0.0268)	(0.2769)	(0.1231)	(1.2693)	(0.0044)	(0.0456)
Constant	-0.1460***	-2.4386***	-0.1494***	-2.4476***	-0.1395***	-2.3995***
	(0.0404)	(0.4164)	(0.0403)	(0.4159)	(0.0406)	(0.4186)
Time fixed effect	YES	YES	YES	YES	YES	YES
Individual fixed effect	YES	YES	YES	YES	YES	YES
Observation	65,532	65,532	65,532	65,532	65,532	65,532

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. The numbers in parentheses indicate standard errors.

limitations of the current study's sample data, more research is necessary. Due to a lack of critical indicators and insufficient quality in the follow-up period, the sample period is limited to the period 2000–2010. The database only includes state-owned and nonstate-owned firms larger than the prescribed size, excluding sample data from China's middle and small firms. Future research might update the sample period and collect appropriate medium and small firm samples in China via on-the-spot inspections and questionnaire surveys to broaden the current study. Furthermore, given that China's environmental regulatory policy change has evident Chinese features, the results' application to other nations, particularly industrialized countries, needs additional verification. Including international corporations in the sample and performing horizontal comparisons would enable making broad generalizations.

The policy implications are as follows: First, the environmental regulation system should be gradually developed and improved to encourage firms to adopt proenvironmental behavior. At present, China has made great achievements in industrial development, but the extensive mode of production has not changed overall. Therefore, government departments must formulate reasonable environmental regulations based on the actual situation to drive firms to voluntarily adopt proenvironmental behaviors and force the green transformation of firms' production mode. Second, the implementation of environmental regulations should fully consider the differences among firms. For undeveloped areas, the intensity of environmental regulation must be improved, but the local economic situation should also be fully considered. Environmental protection and economic growth must be carried out simultaneously. For pollution-intensive industries, special treatment and key inspections have been carried out, administrative orders have been adopted to limit pollution emissions by firms, and penalties for illegal emissions have increased, forcing firms to adopt a cleaner production mode. For state-owned firms and firms with a high degree of monopoly, local governments should gradually reduce their protection of these firms and build an environment of fair competition. Third, government departments should provide firms with certain policy support to guide them and drive their proenvironmental behaviors through innovation under the constraints of environmental regulations. High import difficulty and cost make it unsustainable to rely solely on imported environmental products to achieve the green transformation of firm production. Therefore, while strengthening environmental regulations, government departments can appropriately provide firms with R&D subsidies, innovation tax credits, and other preferential support policies to encourage them to improve their innovation ability to better adapt to and apply environmental products in the production process, forming a new trade path of imports for innovation. Finally, the government should increase public awareness of environmental pollution regulations, improve the mechanism of disclosing environmental information, and gradually increase the public's right to participate in environmental supervision. By establishing an interactive mechanism and forming a supervision network that combines professional law enforcement and public supervision, the public can effectively supervise the emission behaviors of firms more conveniently to truly influence the production decisions of firms and promote the green transformation of their production mode.

Acknowledgments

This research is sponsored by the National Natural Science Foundation of China (72274112) and the Taishan Scholars Project Funding (tsqn202211237, tsqn202306273).

Conflict of Interest

The authors declare they have no conflicts of interest.

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