Defining the Optimal Implementation Space of Environmental Regulation in China’s Export Trade

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Abstract: Properly designed environmental regulation policy is an important basis for the high-quality development of trade. Based on the Chinese industry-level panel data in the period 2003 to 2016, and considering the adaptability of environmental regulation and industrial development, our study employs a threshold regression model to reveal the impact of environmental regulation on China’s trade competitiveness. The empirical research of our study finds that the impact of environmental regulation and trade competitiveness of the manufacturing industry presents a U-shaped trend that first increases and then decreases. At present, there is a trend of gradually crossing the inflection point, and only after crossing the inflection point can the full development stage be entered; that is, the implementation intensity of environmental regulation needs to be coordinated with industrial development. Furthermore, the impact of environmental regulation on trade competitiveness has a special threshold. Only when the level of technological development or cost-bearing capacity exceeds a certain threshold can environmental regulation effectively promote trade competitiveness. Our study has profound policy implications. The Chinese government needs to combine the technological development level and cost-bearing capacity of subdivided industries to implement environmental regulation policies by classification, cultivate a good innovation environment, make full use of the innovation-stimulating effect of environmental regulation, establish a more perfect cost-sharing and production transfer exit mechanism, and improve the resource reallocation effect of environmental regulation.

Keywords: environmental regulation; technological development level; cost-bearing capacity; trade competitiveness

1. Introduction

With the leap forward in the development of China’s economic aggregate, the resources and environment are close to the bearing limit, and quality reform under the restriction of environmental policies is an important part of transforming the mode of economic development. In the export market, China’s export commodities still cannot meet the market needs of the target countries to varying degrees. Instead, a large number of extensive production patterns waste resources, and they also bring serious environmental pollution problems. The 2018 global innovation index points out that China’s Gross Domestic Product/energy consumption per unit under the second-level indicator “ecological sustainability” is at a relative disadvantage, ranking 102 in the world, and its carbon dioxide emissions rank first in the world. Meanwhile, according to a forecast, the demand for energy by 2040 is expected to be as much as 30% higher than the current level. In addition, China has encountered trade protectionism initiated by developed countries in recent years. In this context, the report of...
the 19th National Congress of the Communist Party of China put forward the strategic thinking that economic development needs a quality change and power change to promote China’s industry to move towards the middle and high end of the global value chain. In the new round of opening-up, foreign trade needs to gradually turn from “big in and big out” to “excellent in and excellent out”, especially in the context of the current epidemic’s impact on the economic downturn. Whether environmental regulation can become an important handle of enhanced trade competitiveness, whether it can simultaneously transform the mode of economic development and realize high-quality foreign trade, and how to determine the appropriate intensity of environmental regulation for export trade are major practical problems that need to be solved.

Our research focuses on the optimal implementation space of environmental regulation in export trade. The impact of environmental regulation on trade competitiveness is related to the level of technological development and pollution degree, and this impact has certain threshold characteristics. In terms of the level of technological development, when the level of technological development exceeds a certain threshold, environmental regulation helps to promote trade competitiveness, so that the two can develop in full coordination; when the level of technological development is lower than the threshold value, environmental regulation has a significant inhibitory effect on trade competitiveness, enterprises with a lower technological development level cannot bear the cost of environmental regulation, and there is no motivation or ability to carry out technological transformation and innovation. In terms of cost-bearing capacity, the impact of environmental regulation on trade competitiveness has threshold characteristics. When the cost-bearing capacity exceeds a certain threshold value, environmental regulation helps to promote trade competitiveness. Only when the level of technological development or cost-bearing capacity exceeds a certain threshold can environmental regulation effectively promote trade competitiveness.

From the perspective of export competitiveness, we explore the basis and conditions of environmental regulation. The important watershed of environmental regulation implementation lies in the direction and intensity of the impact on technological innovation and resource reallocation. Relevant theories believe that environmental regulation has a positive impact on enterprise innovation and resource reallocation, but it lacks theoretical attention in terms of the “optimal implementation intensity” and “target industry selection” of environmental regulation, which makes it impossible to analyze the implementation effect of environmental regulation in detail. The first obstacle is to define the enforcement intensity of environmental regulation. Aghion et al. (2015) [1] summarily pointed out that “the debate on industrial policy should not focus on the issue of ‘existence’, but should turn to how to design and manage policies to promote development and social welfare”; the second is to determine the target industry for environmental regulation. Environmental regulation needs to take into account both growth and emission reduction, and should fully combine the characteristics of the target industry; especially for industries with adverse comparative advantages that lack self-reliance ability.

The remainder of this paper is structured as follows. Section 2 presents the literature review, Section 3 describes the theoretical analysis and research hypothesis, Section 4 presents the theoretical model and data, Section 5 provides an empirical estimation and result analysis, and Section 6 describes the conclusions.

2. Literature Review

Environmental issues have always been an important factor in the evolution of international trade. In theory, there are basically two views. One is the theory of “pollution havens” and “race to the bottom line”. Based on the theory of “pollution havens” of the free trade doctrine, it is believed that, due to the low regulatory standards of developing countries, the polluted industries in developed countries largely move in and developing countries become “pollution havens”. The developed countries internalize the costs of environmental regulation while developing countries do not internalize the costs of environmental regulation due to the large income gap [2]. In addition, in order to enhance the competitiveness of their products in the international market, developing countries take
the initiative to reduce their environmental regulation standards, which leads to the “race to the bottom line” [3,4]. This phenomenon is essentially related to a country’s factor endowment and technological development [5–7]. The second point includes “compliance cost theory” and “innovation compensation theory”. According to the neoclassical “compliance cost theory”, regulation internalizes the external costs and increases the investment of the enterprise environment to correct the “market failure” from enterprises’ production behavior, thus increasing the enterprise costs with little impact on profit maximization. The reason is that environmental taxes or emissions trading forces enterprise to bear the costs of the negative externalities from their production behavior, while cost constraints restrict the original factor input and production process improvements of enterprises, which limits the further expansion and reproduction of enterprises [8]. “Innovation compensation theory” holds that proper environmental regulation can improve the competitiveness of enterprises and not necessarily bring costs to enterprises, and that environmental pollution is essentially a waste of resources. If reducing pollution promotes the waste of resources into output, strict but reasonable environmental regulation policies can instead promote enterprise innovation and further enhance the enterprise income to partially or completely compensate for the costs of environmental regulation [9,10].

Theoretically speaking, the net impact of an environmental regulation policy depends on the comparison of the two forces, but in the specific research, many opposite conclusions have been drawn [11]. The possible reason is that, on the one hand, the measurement error and sample selection may affect the robustness of the conclusion, and another important reason is that the heterogeneous effects of environmental regulation are ignored. “Innovation compensation theory” and “compliance cost theory” only focus on the impact of environmental regulation on the behavior and state of enterprises, and assume that the impact of environmental regulation on all enterprises is symmetrical—that is, the impact of environmental regulation on enterprises is the same—without considering the different responses of enterprises to environmental regulation.

Resource-based theory can explain the heterogeneity or asymmetry of environmental regulation to a certain extent. In both neoclassicism and revisionism, the enterprises regulated are homogeneous, while the heterogeneity of enterprises is ignored. Especially for the bearing capacity of environmental regulation cost and the difference in technological innovation investment, the resource-based theory can make up for these deficiencies. According to the resource-based theory, if an enterprise grows up in the framework of structure-behavior-performance, the performance of the enterprise will be subject to the external environment, and the enterprise can obtain a market competitive advantage through the valuable organizational ability, including carrying out environmental strategy-related innovation. The basis of an enterprise is resources, including human capital (skills and knowledge), tangible assets (equipment and raw materials), organization (organizational structure and organizational culture), and technology. The differences in these resources lead to the heterogeneity of enterprises [12]. These scarce and valuable resources have an important impact on the international competitiveness of enterprises.

Enterprise environmental performance capability is the ability of enterprises to carry out production activities with the least impact on resources and the environment under the condition of environmental resource constraints. Enterprises with abundant resources can redesign the production process and technological innovation of environmental resources, and the production process of basic resources can be improved, which requires enterprises to internalize technology into the improved production equipment. The implicit knowledge about environmental capability varies with the characteristics of enterprises. The resource-based theory mainly focuses on the analysis of the differences in enterprises’ basic resources and the implicit knowledge differences, which will affect the survival of enterprises or the competitiveness of the market [13]. Under the background of environmental regulation, the formation of an enterprise’s own unique innovation ability is related to the basic resources owned by the enterprise, which shows that different industries have different abilities to comply with environmental regulations and innovation abilities, and there is heterogeneity. Specifically, the different technological development levels of enterprises directly
determine the cost-bearing capacity of environmental regulation; in particular, the cost of environmental regulation cannot exceed the cost-bearing capacity of high-tech industries. The Environmental Kuznets curve hypothesis also proves this point. When the level of economic development is low, environmental pollution is relatively light; however, with economic growth—in the form of increased per capita income, the degree of environmental deterioration is aggravated; if the economy continues to develop, environmental pollution will be reduced.

The existing research has an important reference value and enlightenment for our study, but there are still some research gaps. First, although the theories of “pollution havens” and “race to the bottom line” in environmental regulation and the export trade provide the theoretical bases for the government’s environmental interference in the trade of developing countries, there are few in-depth studies on the “interference basis” or “interference standard”. Second, the “compliance cost theory” and “innovation compensation theory” have not been concluded, which may be due to the environment being under regulatory constraints; there is a lack of in-depth analysis on the differences in the technological development levels or cost-bearing capacities of subdivided industries and their mechanisms of influence, and so it is difficult to form a complete and unified conclusion. Third, environmental regulation has always been an important factor in the evolution of trade, but there are still few studies on the environmental regulation and high-quality development of trade in developing countries such as China. Our study attempts to expand the research from three aspects. First, according to the technological development level and the cost-bearing capacity of subdivided industries, we explore the optimal implementation space of environmental regulation in the process of enhancing trade competitiveness. Second, we seek to measure trade competitiveness with export technology content indicators that can reflect the innovation output, market orientation, and global level of commercialization, and further explore the impact mechanism of environmental regulation on China’s trade competitiveness. Third, in the context of the new round of opening up, the results reveal the impact of China’s environmental regulation policy in the process of undertaking the transfer of pollution industries to high-quality trade development.

3. Empirical Model and Research Hypothesis

3.1. Environmental Regulation and Export Competitiveness

In the history of the world’s economic development, there are many successful examples of environmental regulation promoting the high-quality development of trade. When Japan implemented the “export-oriented” development model from 1955 to 1970, the traditional polluted industries such as the steel and textile industries in the United States began to move in gradually, which led to extreme environmental pollution events such as the “four public nuisance lawsuits” in Japan. The Japanese government promoted the high-quality development of its export trade and optimized the domestic industrial structure through scientific and appropriate environmental policies. This is of positive significance to China’s new round of high-quality opening up practices. Specifically, environmental regulation plays a very important role in the process of international industrial transfer and domestic industrial export upgrades.

In the process of international industrial transfer, the tightening of environmental regulation will prevent a country from becoming a “heaven of environmental pollution” and improve the quality of foreign direct investment. In the process of undertaking the transfer of international industries, environmental regulation will change the dilemma of the “race to the bottom line” in developing countries. In the process of participating in international trade, with the narrowing of the income gap, developing countries will gradually improve their own environmental regulation standards and the comprehensive costs of production will gradually increase, thus preventing the continuous migration of high-pollution industries to such economies [14] and avoiding the “heaven of environmental pollution”. That is, strict environmental regulation will promote the transition of developing countries to cleaner production processes, help countries upgrade
their environmental management level, enhance green innovation investment, and improve the international competitiveness of products [15,16]. With the increasing concern of the Chinese public with environmental issues, the government has also strengthened the intensity of environmental regulation, increased the production costs of polluting foreign-funded enterprises in China, raised the threshold for foreign direct investment, provided a good development environment for clean foreign-funded enterprises, and improved the quality of foreign direct investment in China [17]. In addition, the level of environmental management has also been greatly improved by the enterprises and the Chinese government.

In the process of domestic industrial exporting, the “green trade barrier” in environmental regulation and the upgrading of consumer demand will force enterprises to improve the export technology content, thus promoting trade competitiveness. First, environmental regulation helps to break through the “green trade barrier.” The precondition for developing countries to undertake the production of developed countries is to meet the stringent environmental protection standard certifications of developed countries, such as International Organization for Standardization (ISO) 14,000. After China’s accession to the World Trade Organization (WTO), the government implemented more stringent market-oriented environmental regulation policies to meet the green requirements of the international market for products, such as pollution control subsidies, excessive emission fees, export tax rebate policies for green products, etc. By adapting to the green trade barriers in the international market, China can continuously improve the levels of cleanliness and technology of its products, further improve the complex properties of products, and achieve the goal of improving the competitiveness of export products. Second, environmental regulation help to “meet the needs of green products” and improve the comparative and first mover advantages of products in international trade. With the continuous upgrading of consumption, the requirements of international and domestic consumers for green environmental protection are also increasing. Therefore, export products need to meet the environmental protection requirements of customers. Furthermore, enterprises need to obtain increasingly more green certifications and improve the performance of its products through technological innovation, process improvement, and other aspects, which will eventually help to improve the export technology content of enterprises [18]. In addition, environmental pollution is essentially a potential inefficiency that results from the resource utilization. Under the constraints of environmental regulation, enterprises will have the pressure of innovation and development, thus forcing them to actively collect relevant market and policy information, generate effective innovative solutions, improve their cognitive level, further reduce the uncertainty of relevant investments, increase the utilization level of environmental resources and their value, promote the development of regulated enterprises, and improve the level of competition in the field of trade (Zhang and Song, 2019) [19].

3.2. Implementation Space of Environmental Regulation in Export Trade Based on the Resource-Based Theory

Theoretically, according to the theories of “compliance cost theory” and “innovation compensation theory”, but according to the resource-based theory, environmental regulation will bring compliance costs or innovation incentive, but the impacts on enterprises are related to the cost-bearing capacity and technology development level of enterprises [19,20]. When the cost-bearing capacity of an enterprise is strong, the enterprise will choose to stay in the original industry and carry out technological innovation and other measures to reduce pollution emissions, in order to reduce the costs of environmental compliance. When the level of technological development is high, an enterprise has the potential to deal with pollution emissions; and under the constraints of environmental regulation, the enterprise will actively update its equipment or processes, improve the level of cleanliness of its export products, and further promote the competitiveness of the export trade. In contrast, when the cost-bearing capacity or technology development level is low and the enterprise cannot bear the regulatory costs, it will be forced to withdraw from the original industry, which will hurt the industry in the long run.

In terms of current policies, China’s current environmental policy is emission reduction-oriented, which is bound to make enterprises balance environmental pollution and enterprise performance.
to some extent. Although an environmental policy based on emission reduction can restrain an enterprise’s pollution emission behavior, it may increase the enterprise’s pollution control costs and generate the negative behavior of reducing the production scale, which will weaken the enterprise’s competitiveness. This also means that under the premise of stable economic growth and the impact of the current coronavirus epidemic, the intensity of the environmental regulation that an industry can bear is limited.

To sum up, the research hypotheses of this study are obtained as follows:

**Hypothesis 1 (H1).** Environmental regulation can exert a positive influence on trade competitiveness by preventing international polluted industry transfer and upgrading domestic industrial exports.

**Hypothesis 2 (H2).** There is an optimal implementation space in the impact of environmental regulation on trade competitiveness, which is related to the cost-bearing capacity and the level of technological development.

4. Theoretical Model and Data

4.1. Theoretical Model

Based on resource-based theory, our study defines the dependent variable as trade competitiveness and the independent variables as those related to environmental regulation. Furthermore, considering that environmental regulation may impose compliance costs on trade competitiveness, it may also create innovation incentives and non-linear influence. Therefore, the quadratic term of environmental regulation is added to the model. In addition, in order to test interactions between environmental regulation and foreign direct investment, export propensity and import penetration, the model is added their multiplicative items to accurately identify the impact path of environmental regulation on trade competitiveness. Thus, the model takes the form:

\[
\ln \text{Tradecomp}_{it} = \alpha + \beta_1 \text{ER} + \beta_2 (\text{ER})^2 + \beta_3 \text{ER} \times \ln \text{FDI} + \beta_4 \text{ER} \times \text{EX} + \beta_5 \text{ER} \times \text{MR} + \beta_6 \text{Z}_{it} + \xi_{it}
\]  

(1)

Here, \(\ln \text{Tradecomp}_{it}\) represents trade competitiveness; \(\text{ER}\) represents environmental regulation, specifically, \(\text{ER}^{\text{Admin}}\) denotes command-and-control environmental regulation; \(\text{ER}^{\text{Market}}\) refers to the market-based environmental regulation; \(\ln \text{FDI}\) represents foreign direct investment; \(\text{EX}\) indicates export tendency; \(\text{MR}\) represents import penetration; \(Z\) represents the control variables, including physical capital (\(\ln \text{Capital}\)), innovation investment (\(\ln \text{Innov}\)), and industry scale (\(\ln \text{Size}\)); \(i\) represents the industry; \(t\) represents time; and \(\xi\) is a random error.

4.2. Variable Description

4.2.1. Dependent Variable

Trade competitiveness (\(\ln \text{Tradecomp}\)) is measured in two ways. ① Export sophistication. Haussmann et al. (2007) [21] proposed the export sophistication index to measure a country’s product trade competitiveness, and it is the per capita GDP weighted by the revealed comparative advantage. The index measures the overall revealed comparative advantage of a certain industry in exporting and considers the implied technology level based on the per capita income, which comprehensively reflects the competitive level of the export products of a certain industry in the international market. In view of this, we employ this method to measure the trade competitiveness of industrial products. The specific calculation method can be found in Haussmann et al. (2007) [21] and Zhang and Song (2019) [18]. ② Revealed comparative advantage (RCA). This is an indicator used to measure the comparative advantage of an industry. It uses the proportion of exports with respect to the total exports. By referring to the standard classification of international trade (SITC Rev. 3) and considering
the continuity of the statistical data, we consolidated the relevant data of the plastic and rubber manufacturing industry and the agricultural and sideline food processing and food manufacturing industry, and deleted the industries with unclear classifications.

4.2.2. Independent Variables

Environmental regulation (ER). There are usually two methods to measure environmental regulation variable: direct and indirect. Direct measurement methods include pollution emissions and removal rate [22], pollution control costs and investment, or the number of environmental protection policies. Indirect measurement methods include energy efficiency [23], per capital income level or other relevant alternative indicators [24]. With the diversification of the forms of environmental pollution emissions, only measuring environmental regulation from one aspect cannot fully reflect the reality. According to the research purpose of this study and based on the existing research [19,25], we employ the improved entropy method to build a comprehensive measurement system for the environmental regulation intensity. The target layer is set as the environmental regulation intensity, and the indicator layer includes multiple items, consisting of wastewater, waste gas, and solid waste in Table 1. Due to the availability of the data and the measurement effect of other variables selected in this study, the ratio of the SO$_2$ treatment facility operating costs to the industrial output value and the ratio of the wastewater treatment facility operating costs to the industrial output value are selected to represent market-oriented environmental regulation. The SO$_2$ emissions per unit of output value, smoke (dust) emissions per unit of output value, wastewater emissions per unit of output value, and solid waste comprehensive utilization rate of waste materials represent command-and-control environmental regulation.

| First Level Index | Second Level Index | Third Level Index | Calculation Method                                      |
|-------------------|--------------------|-------------------|--------------------------------------------------------|
| Intensity of environmental regulation | SO$_2$ emissions per unit of output value | Ratio of SO$_2$ emissions to industrial output value |
|                   | Smoke and dust emissions per unit of output value | Ratio of smoke and dust emissions to industrial output value |
|                   | Wastewater discharge per unit of output value | Ratio of wastewater discharge to industrial output value |
|                   | Comprehensive utilization rate of solid waste | Ratio of solid emissions to solid utilization |
| Market-based environmental regulation | SO$_2$ facility operating costs per unit of output value | Ratio of SO$_2$ facility operating costs to industrial output value |
|                   | Operating costs of wastewater facilities per unit of output value | Ratio of wastewater facility operating costs to industrial output value |

Note: Under the classification of market-based environmental regulations, the “emission tax” and “emission fee”—namely, “facility operation cost”—are generally considered to be the same in the literature. This paper adopts this general approach.

The scientificity of adopting this method lies in the following. First, the selected indicators cover all forms of industrial pollutants, including wastewater, waste gas, and solid waste (smoke and powder), and more comprehensively depict the changes in pollution discharge in the subdivisional industries. Second, the comprehensive indicators are selected to be measured, avoiding the overlap of “pollution treatment investment” and “innovation investment” in this study in order to produce multiple commonalities. In addition, the former literature used the measurement method of “the ratio of the operating cost of waste gas (water) treatment facilities to the emission”, and the two variables may have internal relations and influence each other. Compared with the measurement method of cost
input, the measurement method of output eliminates the measurement deviation caused by external factors such as subsidies and taxes, which is more scientific.

Furthermore, the main reason for selecting “industrial output value” as the reference object is that it can reveal the change in the environmental pollution and treatment level more subtly by subdividing the production scale or cost-bearing capacity of the industry. As the emissions per unit of output value are smaller and the operating costs of pollution facilities per unit of output value are higher, the intensity of environmental regulation will be higher. Using the improved entropy method, we can objectively determine the weight of each index, more scientifically reflect the overall situation of industrial environmental regulation, avoid the disadvantages of the previous subjective evaluation weight, and ensure the scientificity of the environmental regulation evaluation index.

Before the measurement, first the type of indicators should be consistent—that is, some indicators are negative while others are positive. There are both maxima and minima indicators among the indicators. The minima indicators are also called positive indicators, and the minima indicators are called negative indicators. Before the comprehensive evaluation, it is necessary to make the negative indicators positive for them to have the same trend change as the positive indicators. According to the research content, the positive measures of negative indicators are converted using the method of Lin and Du (2016) [26] through the transformation
\[ x^* = \frac{1}{x}, \]
where \( x \) and \( x^* \) are indicators before and after the positive change, respectively.

Then, the specific calculation method is as follows.

First, the indicators of environmental regulation measures are treated without quantification to reduce the extreme values and the dimensional differences between the variables:
\[ x^*_{kf} = \frac{x_{kf} - \bar{x}_f}{s_f}. \] (2)

Here, \( k \) represents the industry; \( f \) represents the regulatory indicators; \( x^*_{kf} \) and \( x_{kf} \) represent the assigned value after standardization and the original value, respectively; and \( \bar{x}_f \) and \( s_f \) represent the mean value and standard deviation, respectively.

Second, calculate the proportion \( p_{kf} \) of index \( x^*_{kf} \), the entropy \( e_f \) of index \( f \), and the difference coefficient of index \( g_f \), where \( 0 \leq g_f \leq 1 \).
\[ p_{kf} = x^*_{kf} \sum_{k=1}^{m} x^*_{kf}, \quad e_f = -\frac{1}{\ln m} \sum_{k=1}^{m} p_{kf} \ln p_{kf}, \quad g_f = 1 - e_f. \] (3)

If \( g_f \) is larger, it reflects that the index \( x_f \) is more important in the comprehensive \( x > 0 \) Evaluation. Then, calculate the weight \( a_f \) of index \( x_f \):
\[ a_f = g_f \sum_{f=1}^{n} g_f. \] (4)

Finally, according to the standardized \( x^*_{kf} \) value and weight \( a_f \) of each sub index, the intensity index of the environmental regulation of industry \( k \) in year \( t \) is obtained:
\[ ER_{kf} = \sum_{f=1}^{n} a_f p_{kf}. \] (5)

Relevant data are from the China Environmental Statistics Yearbook, the China Environmental Yearbook, and the China Industrial Statistics Yearbook. Due to the lack of relevant data in 2003 and 2004 in the China Environmental Statistical Yearbook, the relevant data in the China Environmental Yearbook is adopted. From 2003 to 2007, “industrial dust” and “industrial smoke” were summed up and expressed by “industrial smoke dust”. Since 2008, the Ministry of Environmental Protection no longer distinguishes between “industrial dust” and “industrial smoke”. Furthermore, since
2013, the China Industrial Statistical Yearbook has replaced the “total industrial output value” with the “industrial sales output value”. Since the sales rate index basically shows “97%” or above, the “industrial sales output value” is approximately replaced by the “total industrial output value”. Because of the statistical caliber of the data, we finally obtained the manufacturing data of 26 industries and the panel spans over a period of 14 years (2003–2016). Since the China Environmental Statistical Yearbook has no longer reported the relevant data of pollution emissions by industry since 2017, we selected the sample period from 2003 to 2016.

4.2.3. Control Variables

1. Physical Capital \((\ln\text{Capital})\). On the basis of the Heckscher–Ohlin theory, Helpman (1987) [27] provides an explanation of export competitiveness from the perspective of material capital; countries will use a comparative advantage to study how to effectively use their rich elements for commodity production, and high-quality commodities need a higher capital intensity. This is expressed in terms of the annual average balance of the net value of fixed assets.

2. Innovation investment \((\ln\text{Innov})\). All kinds of investment in innovation—such as the capital stock of technological development, the capital stock of technological transformation, the capital stock of foreign technology introduction, and the capital stock of digestion and absorption—are collectively referred to as innovation investment. Therefore, the factor analysis method is used for the comprehensive calculation of the factor scores, and the maximum variance orthogonal rotation method is used to obtain the coefficient scores of each sub index. Then, the weight of each index is obtained as follows: 

\[
\lambda_i = \frac{\sum_{t=1}^{m} \theta_{it}}{\sum_{i=1}^{n} \sum_{t=1}^{m} \theta_{it}}
\]

The weighted calculation of the innovation input index is 

\[
\text{Innov} = \sum_{i}^{m} \lambda_i k_i = \sum_{i}^{m} \lambda_i k_i.
\]

3. Foreign direct investment \((\ln\text{FDI})\). The EK model believes that foreign direct investment is the most important channel of technology diffusion. Through personnel flow and vertical specialization, it promotes the imitation of production processes and products, produces technology spillover, and can provide a good example for domestic enterprises. It uses the sum of the capital in Hong Kong, Macao, and Taiwan and foreign capital, and employs the fixed asset investment price index as the price deflator.

4. Export tendency \((\text{EX})\). The “export self-selection effect” holds the following: First, in the fierce international market competition, enterprises can continuously improve their productivity through survival of the fittest. Second, as they export to the international market, they are closer to advanced technology, higher quality standards, and more high-end product information, and more likely to promote productivity improvement through their own learning; thus, export tendency has a positive impact on the competitiveness of export trade [28]. This is measured by the ratio of the industrial export value to the industrial output value.

5. Penetration of imported goods \((\text{MR})\). Imports corresponding to exports can promote the technical content of a domestic finished product by importing intermediate products with a high productivity and improving the input quality of the intermediate factors [29]. This is measured by the ratio of the total import value of the industry to the total output value of the industry. The original data of imports and exports are from UN Comtrade and are sorted by using the Chinese industry classification.

5. Empirical Estimation and Result Analysis

Before the empirical analysis, we tested the data’s stationarity and multicollinearity. The Levin–Lin–Chu, Im–Pesaran–Shin, and Augmented Dickey–Fuller unit root tests were carried out and showed that all the variables were stationary series. In addition, the variance inflation factor is tested, and the average VIF is 2.64, which reflects that there is no collinearity between the variables. Table 2 is the descriptive statistics of the main variables.
### Table 2. Descriptive statistics of the main variables.

| Variable      | N  | Mean | St. Dev. | Min  | Max  |
|---------------|----|------|----------|------|------|
| Tradecomp (ln)| 364| 2.704| 0.456    | 2.842| 2.909|
| ERAdmin       | 364| 0.305| 0.343    | 0.085| 1.073|
| ERMarket      | 364| 0.413| 0.765    | 0.032| 1.909|
| FDI(ln)       | 364| 6.258| 1.518    | 0.616| 8.969|
| Technical     | 364| 0.038| 0.029    | 0.005| 0.233|
| Capital(ln)   | 364| 21.809| 18.658  | 2.124| 115.266|
| EX            | 364| 0.167| 0.165    | 0.003| 0.669|
| MR            | 364| 0.026| 0.031    | 0.001| 0.153|
| Innovation (ln)| 364| 14.781| 1.175   | 11.959| 17.128|
| Cost          | 364| 112.780| 26.269  | 65.795| 301.022|
| Size (ln)     | 364| 9.481| 1.099    | 6.579| 11.470|

5.1. Overall Impact of Environmental Regulation on Export Competitiveness

Models (1), (2), and (3) are command-and-control environmental regulation, and models (4), (5), and (6) are market-based environmental regulation in Table 3. The regression coefficients of command-and-control environmental regulation and market-based environmental regulation are both that the primary term is negative and the secondary term is positive, reflecting the U-shaped curve of environmental regulation for trade competitiveness, which is consistent with the conclusions drawn by relevant scholars [30,31]. According to the calculation, at present, the intensity of environmental regulation is still on the left side of the U-shaped curve. There is a coordination problem between resources, with the environment and economic development on the left side of the U-shaped curve. However, when the environmental regulation crosses the turning point of trade competitiveness, the retroaction of environmental regulation will appear. The development of industry also follows the U-shaped characteristics of environmental regulation. Enterprises gradually internalize the costs of environmental regulation and then explore a high-quality development path. For example, Japan has gradually transformed its original labor-intensive and capital-intensive export structure into a technology-intensive export structure dominated by the integrated circuit and semiconductor industry, which has become a model in the history of world development for promoting the successful transformation and upgrading of the domestic industrial structure by improving export competitiveness through an appropriate environmental policy design.
5.2. An Examination of the Mechanism of the Impact of Environmental Regulation on the Competitiveness of Export Trade

In terms of the action mechanism, models (2) and (5) show that the combined impact of environmental regulation and export tendency is also significant for the improvement of trade competitiveness. The possible reason is that, under an environment of fierce global competition, export enterprises still need to upgrade the demand and constantly break through green trade barriers, which will continue to promote the transition of developing countries to cleaner production processes and help such countries upgrade their environmental management level and increase investment in green innovation. Enterprises also need to obtain increasingly more green certifications. Breaking through these “green barriers” requires industrial adjustments, a specialized division of labor, and strengthening the export competitiveness of products in developing countries [32]. In addition, previous export-oriented strategies ignored the resource and environmental problems caused by the extensive mode of production, and this had led to the loss of an important path for enterprises to rely on domestic demand to participate in international competition. Export orientation by foreign demand led to a high deviation between export products and the local demand [15,33], which caused a special phenomenon to appear—namely, that the quality of export goods is much higher than that of domestic consumer goods.

The combination of environmental regulation and the penetration of imported goods has a significant impact on the improvement of trade competitiveness. This is also consistent with the conclusion of Qian et al. (2017) [29]—that is, Chinese enterprises can obtain reverse technology spillovers by importing intermediate products or finished products with a high technology content.
The joint effect of environmental regulation and foreign direct investment on trade competitiveness is more significant. The possible reason lies in the fact that in recent years, China has attracted high-tech and green FDI and better promoted the spillover of technology and management experience, and the notion that local governments ignore the environmental requirements of foreign direct investment in the pursuit of economic growth has also been changed. Therefore, in international trade, environmental regulation improves a country’s trade competitiveness by preventing the transfer of polluted industries and breaking through green trade barriers, thus preliminarily verifying Hypothesis 1.

In addition, the results show that market-based environmental regulation has less of an impact on trade competitiveness than command-and-control environmental regulation, which is consistent with the conclusions drawn by Wang and Liu (2016) [34]. One possible reason is that the implementation of China’s emission fee system has some problems, such as a low emission fee quota, a low collection rate, and the nonstandard use of fees. In contrast, because command-and-control environmental regulation is implemented in accordance with mandatory technical standards and emission restrictions, it can be transformed into practical constraints on enterprises in a short time, thus forcing enterprises to carry out technology and process innovation and other activities. In terms of the control variables, investment in technological innovation (lnInov) plays an important role in trade competitiveness, reflecting that material capital, as an important source of a traditional comparative advantage of the export trade and as a representative of other factors, plays an important role in export competitiveness.

### 5.3. Robustness Test

1. Revealed comparative advantage (RCA). To improve the robustness of the test, the RCA is employed to measure the competitiveness of the export trade in order to test the robustness. The impacts of command-and-control environmental regulation and market-oriented environmental regulation on export competitiveness both showed a “U-shaped” relationship in Table 4. The estimated results show that the regression coefficient is significant at the 1% level, and the results are consistent with those above. In terms of the control variables, the impacts on the competitiveness of the export trade are similar to the above results, indicating that the estimation results are robust.

| Dependent Variable | RCA          |
|-------------------|--------------|
| $ER_{Admin}$      | $-0.015^{*}$ |
|                   | ($-1.82$)    |
| $ER_{Admin} \times ER_{Admin}$ | $0.003^{*}$ |
|                   | (1.70)       |
| $ER_{Market}$     | $-0.001^{*}$ |
|                   | ($-1.91$)    |
| $ER_{Market} \times ER_{Market}$ | $0.000^{**}$ |
|                   | (2.05)       |

2. Eliminate the interference of overcapacity industries. Most of the low-end inefficient capacity has the characteristics of high-energy consumption and high pollution, and there are different degrees of structural overcapacity. Therefore, while the polluted industries are under the pressure of environmental constraints, they may also be under the pressure of
capacity reduction. To eliminate the interference of a capacity removal policy, according to “the guidance on resolving the serious contradiction of overcapacity” issued by the State Council in 2013, the identified overcapacity industries—such as steel, plate glass, cement, electrolytic aluminum, the corresponding “ferrous technology smelting and rolling processing industry”, the “nonmetallic mineral manufacturing industry”, the “nonferrous metal smelting and rolling processing industry”, and the “transportation equipment industry”—were eliminated and the model was regressed again. According to Table 5, the environmental regulation coefficient is consistent with the main test results, and the research conclusion of this study has not changed.

| Dependent Variable | (1)   | (2)   | (4)   | (5)   |
|--------------------|-------|-------|-------|-------|
| ER<sub>Admin</sub> | -0.013 * | -0.021 * |       |       |
|                   | (-1.82) | (-1.79) |       |       |
| ER<sub>Admin</sub> × ER<sub>Admin</sub> | 0.002 * |       |       |       |
|                   | (1.72)  |       |       |       |
| ER<sub>Market</sub> |       | 0.000 ** | -0.000 ** |       |
|                   |       | (1.72) | (~2.16) |       |
| ER<sub>Market</sub> × ER<sub>Market</sub> |       |       | 0.000 ** |       |
|                   |       |       | (2.42)  |       |
| Year Effect       | Control | Control | Control | Control |
| Industry Effect    | Control | Control | Control | Control |
| Adj-R<sup>2</sup>  | 0.423   | 0.423   | 0.424   | 0.424   |
| Obs                | 308     | 308     | 308     | 308     |

5.4. Definition of the Implementation Space of the Optimal Environmental Regulation of the Export Trade

The above analysis shows that the impact of environmental regulation on China’s trade competitiveness follows a U-shaped curve. Clarifying the main factors influencing the nonlinear relationship is the basis of making flexible, dynamic, and targeted environmental regulation policies, which is also a further exploration of the relationship between environmental regulation and trade competitiveness. Due to the differences in the degree of pollution and resource ownership level in different industries, there are differences in the strategies that respond to environmental regulation [35]. Specifically, in terms of technological development, the level of technological development will affect the degree of cleanliness of an enterprise’s production. Through innovation, it can “compensate” for the costs of environmental regulation. In terms of pollution, the level of production pollution determines the costs of environmental regulations borne by enterprises. When pollution is high, it will crowd out enterprise innovation investment and the inputs of other resources, and environmental regulation will bring a higher “cost” to enterprises.

Whether environmental regulation “compliance cost effect” or “innovation compensation effect” is related to the cost-bearing capacity and technological development level of enterprises is discussed by Tang et al. (2017) [16]. Just as in recent years, all countries are implementing different forms of industrial policies and interventions, but the cases of “failure more than success” make scholars begin to transform “whether it should be implemented or not” into “how to implement”. In addition, properly designed industrial policies (environmental regulation policies) can become an important basis for the high-quality development of trade. Furthermore, the process of realizing the appropriate design needs to identify the implementation basis and conditions of environmental regulation and reveal the threshold variables and characteristics that affect trade competitiveness, which plays a crucial role in the positive effects of environmental regulation.
The industrial heterogeneity of the impact of environmental regulation on trade competitiveness needs to be addressed—that is, whether the “compliance cost effect” or “innovation compensation effect” of environmental regulation are closely related to the influencing factors of the transformation from “follow cost” to “innovation compensation”. With the help of threshold analysis, our study tries to find the threshold factors that hinder this transformation and further clarify the group differences of the impact of environmental regulation on trade competitiveness. According to Hansen’s method, the panel threshold regression method is used to analyze the threshold characteristics of environmental regulation on trade competitiveness. The single threshold panel model is set as follows:

\[ y_{it} = a_i + \beta'_1 Z_{it} \times I(q_{it} \leq \lambda) + \beta'_2 Z_{it} \times I(q_{it} > \lambda) + \gamma' X_{it} + \xi_{it}, \]

where \( q_{it} \) is the threshold variable, \( \lambda \) is the threshold parameter, and \( I(\cdot) \) is the index parameter. For Equation (6), the fixed effect method is used to measure the mean value, thereby eliminating the fixed effect value \( a_i \); further, the sum of the residual squared \( S_1(\lambda) \) is obtained. Then, the estimated value of the threshold is as follows:

\[ \hat{\lambda} = \arg\min[S_1(\lambda)]. \] (7)

After the threshold value \( \hat{\lambda} \) is determined, the values of parameters \( \beta_1, \beta_2, \) and \( \gamma \) can be estimated. Then, we test whether there is a threshold effect in the model as follows:

\[ H_0 : \beta_1 = \beta_2, \quad H_1 : \beta_1 \neq \beta_2. \] (8)

If \( H_0 \) holds, there is no threshold effect; otherwise, there is a threshold effect.

If \( H_1 \) holds, the sum of the squares of the residuals is \( S_0 \); if there is a threshold effect, the sum of the squares of the residuals is \( S_1(\hat{\lambda}) \) and \( F = \frac{S_0 - S_1(\hat{\lambda})}{2}. \) Then, bootstrapping is used for the simulation, and the asymptotic distribution of the F-statistic is obtained. Then, we calculate the value of the likelihood ratio test. If the value is significant, it can be concluded that there is at least one threshold value.

If there are two or more thresholds, Equation (8) can be extended to a threshold panel model with multiple thresholds, and the two thresholds can be divided into three area threshold models:

\[ y_{it} = a_i + \beta'_1 Z_{it} \times I(q_{it} \leq \lambda_1) + \beta'_2 Z_{it} \times I(q_{it} \leq \lambda_2) + \beta'_3 Z_{it} \times I(q_{it} > \lambda_2) + \gamma' X_{it} + \xi_{it}, \] (9)

where \( \lambda_1 \) and \( \lambda_2 \) are the threshold parameters, and \( \lambda_1 < \lambda_2. \) If the single threshold model rejects \( F1, \) it is necessary to test the significance of the second threshold. If it is significant, there are at least two or more thresholds. Through repeated threshold existence tests, the number of thresholds is finally determined.

In this study, the technology development level (Technical) and cost-bearing capacity (Cost) are used as the threshold variables, and the threshold panel models are as follows:

\[ \ln\text{Tradecompp}_{it} = a_i + \beta_1 \text{ER}_{it} \times I(\text{Technical}_{it} \leq \lambda) + \beta_2 \text{ER}_{it} \times I(\text{Technical}_{it} > \lambda) + \gamma X_{it} + \xi_{it}, \] (10)

where \( \text{Technical}_{it} \) is the threshold variable.

\[ \ln\text{Tradecompp}_{it} = a_i + \beta_1 \text{ER}_{it} \times I(\text{Cost}_{it} \leq \lambda) + \beta_2 \text{ER}_{it} \times I(\text{Cost}_{it} > \lambda) + \gamma X_{it} + \xi_{it}, \] (11)

where \( \text{Cost}_{it} \) is the threshold variable.

Technology development level (Technical). As the carrier of skills and knowledge, human capital can not only reflect the level of technological input, but can also reflect the level of technological transformation. Therefore, it can effectively represent the level of technological development of enterprises, and we can use the share of scientific and technological activities among employees to measure it.
Cost-bearing capacity (Cost). How to change the “compliance cost effect” of environmental regulation into “innovation compensation effect” is related to the cost-bearing capacity. Only with a certain cost-bearing capacity can enterprises avoid exiting the industry and further turn to “innovation compensation” [19]. Referring to the practice of Yu (2017) [31], China’s producer’s product index is adopted to express this measure. China’s producer product index includes three parts: production costs, profits, and taxes. At the moment of tax reduction and fee reduction, the index can better reflect the actual costs of industrial products entering the circulation field. It is more comprehensive and accurate than the “main business cost” and can better reflect the cost-bearing capacity of an enterprise.

The existence of the threshold effect and threshold quantity is tested, and the threshold variables of the “technology development level” and “cost bearing capacity” are finally obtained. After the calculation, the threshold value of the technological development level is 0.033, and the threshold value of the cost-bearing capacity is 101.204. Specifically, the threshold of technological development is 0.033, and the boundary of the cost-bearing capacity is 101.204. On both sides of these two critical values, there are differences in the impact or direction of environmental regulation on the export competitiveness. After several threshold existence tests, there are two thresholds found.

Taking the technological development level as the threshold variable:

Table 6 shows the threshold effect of environmental regulation on trade competitiveness. In Table 7, models (1) and (2) are the estimated results with the same technology development level as the threshold variable, and models (3) and (4) are the estimated results with same the cost-bearing capacity as the threshold variable. Model (1) controls the physical capital, scale, and other factors. From model (1) and model (2), it can be seen that when the technological development level is less than or equal to 0.033—that is, the proportion of scientific and technological personnel among employees is less than or equal to 3.34%—the impact of environmental regulation on trade competitiveness is significantly negative. When the proportion of scientific and technological personnel among employees is greater than 3.34%, the impact of environmental regulation on trade competitiveness is significantly positive. It can be seen that the impact of environmental regulation on trade competitiveness has a threshold effect. Only when the level of technological development exceeds a certain threshold value can environmental regulation effectively promote trade competitiveness and the two can enter a fully coordinated stage of development. When the level of technological development is lower than the threshold value, environmental regulation has a significant inhibitory effect on trade competitiveness. Enterprises with low technological development levels cannot bear the costs of environmental regulation, as they have no power or ability to carry out technological transformation and innovation activities. Only by improving the technological development level of low-tech enterprises, increasing the proportion of scientific and technological personnel, and helping low-tech enterprises to cross the “threshold” can fully coordinated development be achieved.

| Table 6. Existence test of the threshold effect. |
|-------------------------------------------------|
| **Threshold Variable:** | **Technological Development Level** | **Cost-Bearing Capacity** |
|------------------------------------------------|
| Single threshold test | F1 15.42 | 14.03 |
| P 0.093 | 0.036 |
| 10%, 5%, 1% Critical value | 14.823, 24.365, 50.9284 | 25.626, 36.167, 57.059 |
| Double threshold test | F2 10.24 | 5.33 |
| P 0.2167 | 0.6933 |
| 10%, 5%, 1% Critical value | 15.386, 20.211, 28.115 | 21.560, 26.695, 39.286 |
Table 7. Estimation results of the threshold panel model.

| Dependent Variable | Threshold Variable: Technical Development Level | Threshold Variable: Cost-Bearing Capacity |
|--------------------|-----------------------------------------------|------------------------------------------|
| ER × 1 (Technical ≤ 0.0334) | \(-0.724^{***}\) \((-3.96)\) \(-0.002^{**}\) \((-2.16)\) | \(-0.002^{**}\) \((-2.07)\) \(-0.153^{***}\) \((-3.80)\) |
| ER × 1 (Technical ≥ 0.0334) | \(0.506^{**}\) \((2.33)\) \(0.129^{***}\) \((4.03)\) | \(0.015^{**}\) \((2.13)\) \(0.106^{**}\) \((2.49)\) |
| lnFDI | 0.050 \((0.98)\) | InFDI | 0.046 \((0.90)\) |
| lnCapital | 0.005^{***} \((2.91)\) | lnCapital | 0.004^{***} \((2.63)\) |
| MR | 0.190^{**} \((2.41)\) | MR | 0.063^{**} \((2.04)\) |
| EX | \(-0.901^{***}\) \((-4.65)\) | EX | \(-0.911^{***}\) \((-4.69)\) |
| lnSize | 0.031 \((0.71)\) | lnSize | 0.033 \((0.75)\) |
| lnInnov | 0.071^{***} \((2.64)\) | lnInnov | 0.085^{***} \((3.20)\) |
| Year Effect | Control | Control | Year Effect | Control | Control |
| Industry Effect | Control | Control | Industry Effect | Control | Control |
| Adj-R² | 0.048 | 0.357 | Adj-R² | 0.002 | 0.355 |
| Obs | 364 | 364 | Obs | 364 | 364 |

In addition, it also reflects that there is an “optimal implementation space” for environmental regulation policies, which especially needs to be combined with the technological development level of different sub sectors to determine the appropriate intensity of environmental regulation on the macro level. For example, when there is an economic downturn, there needs to be caution regarding implementing a higher environmental regulation intensity—that is, the “implementation opportunity” needs to be determined. When the enterprise has a certain level of technological development, the implementation intensity of environmental regulation needs to be matched accordingly—that is, there is an optimal implementation space characterized by the level of industrial technology development. Therefore, it is necessary to consider the technology development level of the industry segment in order to construct a highly applicable and systematic framework for environmental policy optimization. Thus, Hypothesis 2 is preliminarily verified.

Taking the cost-bearing capacity as the threshold variable:

From model (3) and model (4) in Table 7, it can be seen that when the cost-bearing capacity is less than or equal to 101.204—that is, China’s producer product index is less than or equal to 101.204—the impact of environmental regulation on trade competitiveness is significantly negative; when China’s producer product index is greater than 101.204, the impact of environmental regulation on trade competitiveness is significantly positive.

It can be seen that the impact of environmental regulation on trade competitiveness has threshold characteristics. Only when the cost-bearing capacity exceeds a certain threshold value can environmental regulation effectively promote trade competitiveness, and the two can enter a fully coordinated stage of development. Meanwhile, when the cost-bearing capacity is lower than the threshold value, environmental regulation has a significant inhibitory effect on trade competitiveness. Enterprises with low cost-bearing capacities cannot bear the costs of environmental regulation, and they have no power or ability to carry out technological transformation and innovation. The conclusions are consistent with those of Deng and Zhang (2015) [20]. Furthermore, they also reflect that environmental regulation has a certain “function of compulsory fine washing” impact...
on industry. For enterprises unable to bear the costs of environmental regulation, especially for industries with a high energy consumption and high pollution, they will withdraw or transfer production in the form of “marketization” to promote the effective adjustment of the industry structure. In addition, we also need to combine the bearing capacity of an advanced production capacity to avoid damaging the development of industry.

6. Conclusions

Based on the theoretical and mechanism analysis, this study concludes that environmental regulation has a positive impact on the promotion of trade competitiveness, but this impact has threshold characteristics which are analyzed from the perspectives of the technology development degree and the cost-bearing capacity. It also discusses the optimal implementation space of environmental regulation in the process of enhancing trade competitiveness, which provides a new perspective for the implementation basis and conditions of environmental regulation. The results show the following.

(1) In terms of the overall effect, the impact of environmental regulation on trade competitiveness presents a “U-shaped” relationship. At present, the intensity of environmental regulation is still on the left side of the U-shaped curve, and the positive impact of command-and-control environmental regulation on trade competitiveness is greater than that of market-oriented environmental regulation.

(2) In terms of the mechanism, environmental regulation promotes the competitiveness of international trade by preventing the migration of polluted industries and breaking through green trade barriers.

(3) In terms of the implementation space of environmental regulation, there is a threshold effect on the impact of environmental regulation on trade competitiveness. Only when the level of technological development or cost-bearing capacity exceeds a certain threshold can environmental regulation effectively promote trade competitiveness.

This study has profound policy implications.

The first is that an inclusive trade policy based on environmental regulation needs to be established. From the perspective of foreign countries, it is necessary to improve the entry threshold of foreign environmental protection, accelerate the transformation of the mode of attracting investment from “quantity” to “quality”, and establish appropriate import and export green trade standards. From the domestic perspective, it is necessary to coordinate and integrate environmental regulation policies and trade policies to effectively stimulate domestic enterprises to carry out green technology innovation, production process innovation, labor skills training, and other activities, as well as promote the coordinated development of the ecological environment and economic trade.

The second is that the “optimal implementation space” of environmental regulation needs to be determined and a framework with a high applicability and systematic environmental policy optimization needs to be formed. It is necessary to establish dynamic environmental regulation standards based on the technological development level and cost-bearing capacity, accurately implement “functional environmental regulation policies”, accurately make up for the market failures of environmental pollution in different industries, strengthen the promotion of a market-oriented environmental regulation system, constantly improve environmental regulation tools based on the market regulation mechanism, stimulate the adverse impact of environmental regulation, and further stimulate the drive for industrial innovation and structural adjustment impact.

The third is that the technological innovation environment needs to be optimized, and the cost-sharing mechanism needs to be constructed. It is necessary to improve the innovation-driven environment; increase investment in technology research and development; increase the proportion of people engaged in scientific and technological activities; and improve the efficiency and reduce costs through measures such as labor skills training, tax reductions, and fee reductions. In addition, it is necessary to establish a reasonable benefit compensation and cost sharing mechanism to form a government, enterprise, and public incentive compatibility mechanism; help enterprises with low cost-bearing abilities to overcome the “pain period” and successfully cross the “threshold” of environmental regulation costs; and expand the positive impact of environmental regulation on trade
competitiveness. For enterprises with a high energy consumption and high pollution, it is necessary to establish a mechanism to withdraw from production and transfer assistance and make full use of the resource reallocation effect of environmental regulation.

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