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Environmental Information Disclosure and Export Product Quality: Extension of Product Quality Heterogeneity Model and a DID Analysis on China's Industrial Data

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Abstract: *Firstly, based on the product quality heterogeneity model, this paper analyzes the influence mechanism of environmental information disclosure on the quality of industrial export products. Secondly, using China's industrial data and HS-6 quantile product data in UN Comtrade database from 2005 to 2016, this paper constructs a generalized DID model to investigate the impact of environmental information disclosure on the quality of China's industrial export products. The results show that: environmental information disclosure significantly improves the quality of China's industrial export products. The promotion effect is greater in industries with low financing constraint, strong profitability, high labor intensity and high degree of government control. In addition, environmental information disclosure can improve the quality of export products by stimulating innovation and improving productivity, and reduce the quality of export products by increasing the production costs.*

Keywords: *Environmental Information Disclosure; Export Product Quality; Product Quality Heterogeneity Model; Generalized DID Model*

1. Introduction

Since the reform and opening up, China's economy has maintained rapid and extensive growth, leading to increasingly serious environmental problems. In order to control the deteriorating environmental pollution, the Chinese government has adopted a series of environmental regulation policies. The type of environmental regulation policies has gradually evolved from the command control type in the initial regulation stage to the market type in the promotion and application stage to the information disclosure type in the innovation stage (Fang et al., 2019)[1]. In terms of ecological effects, environmental information disclosure can indeed improve environmental quality (Feng and He, 2020)[2]. However, its economic effect is still unclear. Facing the need of high-quality development of China's industrial industry, the research on the internal relationship between environmental information disclosure and export product quality can provide some references for the export transformation of China's industrial industry.

This paper examines the impact of environmental information disclosure on the quality of China's industrial export products from both theoretical and empirical aspects. There are two types of literature directly related to this study.

The first is the theoretical analysis of the impact of environmental regulation on the quality of export products.

As a representative of the new trade theory, Melitz (2003) relaxed the assumption of enterprise homogeneity in the traditional trade theory to investigate the export decision-making of productivity heterogeneous enterprises in the monopolistic competitive market [3]. Subsequent scholars expanded the enterprise heterogeneity of Melitz model, such as factor endowment heterogeneity (Bernard et al., 2007)[4], product quality heterogeneity (Kugler and Verhoogen, 2011)[5]. There are two main ideas for the construction of product quality heterogeneity model. The first is the externalization of product quality, which is introduced into the utility function (Baldwin and Harrigan, 2011)[6]. The second is the internalization of product quality, which is considered to be the result of producers' pursuit of profit

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maximization (Hallak and Sivadasan, 2013)[7].

The second category is the empirical analysis of the impact of environmental regulation on the quality of export products, mainly involving the following two kinds of literature.

The first is the measurement method of export product quality. It mainly includes unit value method (Hallak, 2006)[8], price index decomposition method (Hallak and Schott, 2011)[9], demand information inference method (Khandelwal et al., 2013)[10], supply and demand information aggregation method (Feenstra and Romalis, 2014)[11]. The second is the econometric analysis of the impact of environmental regulation on the quality of export products. Ning et al. (2021) believe that there is a U-shaped relationship between environmental regulation and export product quality [12].

The existing studies pay more attention to the impact of environmental regulation on the quality of export products, and the analysis of the influence mechanism between them is also biased towards the qualitative analysis of pure words, lacking theoretical derivation.

The contributions of this paper mainly include the following two points: firstly, in terms of theoretical model, this paper takes environmental information disclosure as a new factor of production and introduces it into product quality heterogeneity model to analyze the influence mechanism of environmental information disclosure on the quality of industrial export products. Secondly, from the perspective of research, this paper investigates the impact of environmental information disclosure on the quality of China's export products from the industry level for the first time, and provides a new reference for the formulation of environmental policies and the export transformation of industrial industries.

2. Theoretical Mechanism

2.1 The Cost Effect of Environmental Information Disclosure on Export Product Quality

Whether enterprises refuse to disclose environmental information and pay fines, or accept the disclosure of environmental information and have to improve production pollution, it will lead to an increase in production costs, which will reduce the marginal income brought by enterprises to improve product quality (Fan et al., 2015)[13]. Further, it will reduce the motivation of enterprises to improve the quality of export products, and eventually lead to the decline of the quality of export products.

2.2 The Innovation Compensation Effect of Environmental Information Disclosure on Export Product Quality

Innovation compensation effect refers to that after the implementation of environmental information disclosure policy, enterprises turn to carry out innovation activities to compensate for the cost effect. In turn, appropriate environmental information disclosure policy will promote enterprises to carry out green technology innovation, improve production efficiency and gain more benefits, so that enterprises will have more resources to improve the quality of export products.

2.3 A Simple Theoretical Model

This paper assumes that the enterprises in the industry are continuous, each enterprise produces only one heterogeneous product, and the market is a monopolistic competitive market.

2.3.1 Demand

It is assumed that the utility of representative consumers is a function of product quality (λ_i) and quantity (q_i), which is usually expressed in the form of CES:

$$U = [\sum_i (\lambda_i q_i)^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}} \quad (1)$$

Where $\sigma>1$ indicates the substitution elasticity between product categories. The comprehensive price index corresponding to this utility function is:

$$P = \sum_i p_i^{1-\sigma} \lambda_i^{\sigma-1} \quad (2)$$

Where p_i represents the price of the product. In addition, the total expenditure of consumers is:

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$$D = \sum_i p_i^{1-\sigma} q_i^{\sigma-1} \quad (3)$$

Therefore, the utility maximization problem faced by consumers is:

$$\max[\sum_i (\lambda_i q_i)^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}} s.t. \sum_i p_i^{1-\sigma} q_i^{\sigma-1} \le Y \quad (4)$$

Where Y represents the total income of consumers. It is assumed that all the income of consumers is used for consumer expenditure. The demand of consumers can be obtained:

$$q_i = p_i^{-\sigma} \lambda_i^{\sigma-1} \frac{D}{P} \quad (5)$$

2.3.2 Supply

It is assumed that the export cost consists of production cost and trade cost, and it is further assumed that labor is no longer the only factor of production. This paper also regards environmental information disclosure as a factor of production. It is assumed that the labor required to produce q_i units of product is L_i and the environmental information disclosure is E_i. The market prices of the two factors are w_i and e_i respectively. The production cost of q_i units of product can be expressed as:

$$c_i = f_0 + \frac{\lambda_i^{\theta}}{\psi_i}(w_i L_i + e_i E_i) \quad (6)$$

Where f_0 is the fixed cost, ψ_i is productivity, $\theta>0$ indicates the elasticity of production cost to the quality of export products. As for trade cost, it is assumed that it consists of fixed export cost (f_e) and transportation cost ($\tau_i q_i$). Where $0<\tau_i<1$ indicates the iceberg transportation cost coefficient. Therefore, the total cost of q_i units of product exported abroad can be expressed as:

$$C_i = f_0 + \frac{\lambda_i^{\theta}}{\psi_i}(w_i L_i + e_i E_i) + f_e + \tau_i q_i \quad (7)$$

The profit is:

$$\Pi_i = (p_i - \tau_i) p_i^{-\sigma} \lambda_i^{\sigma-1} \frac{D}{P} - f_0 - \frac{\lambda_i^{\theta}}{\psi_i}(w_i L_i + e_i E_i) - f_e \quad (8)$$

Under the condition of profit maximization, the price of export products meets:

$$\frac{\partial \Pi_i}{\partial p_i} = p_i^{-\sigma} \lambda_i^{\sigma-1} \frac{D}{P} - \sigma(p_i - \tau_i) \lambda_i^{\sigma-1} \frac{D}{P} p_i^{-\sigma-1} = 0 \quad (9)$$

The price can be obtained as $p_i = \frac{\sigma}{\sigma-1}\tau_i$. After substituting formula (8), the profit can be obtained:

$$\Pi_i = \sigma^{-\sigma}(\sigma-1)^{\sigma-1} \tau_i^{1-\sigma} \lambda_i^{\sigma-1} \frac{D}{P} - f_0 - \frac{\lambda_i^{\theta}}{\psi_i}(w_i L_i + e_i E_i) - f_e \quad (10)$$

2.3.3 Equilibrium

In the monopolistic competitive market, the condition of long-term equilibrium is that there is no excess profit, that is $\Pi_i=0$. By combining this formula with formula (10), the critical outlet mass of product (λ_i^*) can be obtained. Since this paper focuses on the quality of export products at the industry level, the distribution function of the quality of export products in the industry is defined as:

$$G(\lambda_i) = 1 - \lambda_i^{-\gamma} \quad (11)$$

Where $\gamma>\sigma+1$. The corresponding probability density function is:

$$g(\lambda_i) = \gamma \phi^{-\gamma-1} \quad (12)$$

Accordingly, the probability density function is:

$$\mu(\lambda_i) = \frac{g(\lambda_i)}{1 - G(\lambda_i^*)} = \frac{\gamma}{\lambda_i}(\frac{\lambda_i^*}{\lambda_i})^{\gamma} \quad (13)$$

Based on this, the average export product quality of the industry can be obtained:

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$$\overline{\lambda_h} = [\int_{\lambda_i^*}^{\infty} \lambda_i^{\sigma-1} \mu(\lambda_i) d\lambda]^{\frac{1}{\sigma-1}} = (\frac{\gamma}{1+\gamma-\sigma})^{\frac{1}{\sigma-1}} \lambda_i^* \quad (14)$$

According to equation (14), the impact of environmental information disclosure on the quality of industrial export products depends on the impact of environmental information disclosure on the λ_i^*, and the direction of influence shall be consistent.

The derivative of the critical export quality of the product to the environmental information disclosure element can be obtained:

$$\frac{\partial \lambda_i^*}{\partial E_i} = \frac{\lambda_i^{*\theta} e_i P}{\sigma^{-\sigma}(\sigma-1)^{\sigma} \tau_i^{1-\sigma} \lambda_i^{*\sigma-2} D\psi_i - \theta \lambda_i^{*\theta-1} P(w_i L_i + e_i E_i)} \quad (15)$$

The sign of $\partial \lambda_i^* / \partial E_i$ cannot be simply determined as positive or negative, depending on the relative size of the two items in the denominator.

From the above analysis, it can be seen that the cost effect of environmental information disclosure will increase production costs, and the innovation compensation effect will improve productivity. Therefore, the factor price of environmental information disclosure (e_i) and product productivity (ψ_i) can reflect the cost effect and innovation compensation effect to a certain extent. The greater the cost effect, the greater the second term of the denominator of equation (15), and $\partial \lambda_i^* / \partial E_i$ tends to be negative. The greater the innovation compensation effect, the greater the first term of the denominator of equation (15), and $\partial \lambda_i^* / \partial E_i$ tends to be positive.

Therefore, the following two propositions can be obtained.

Proposition 1: when the cost effect is large enough, environmental information disclosure will reduce the quality of industrial export products by increasing production costs.

Proposition 2: when the innovation compensation effect is large enough, environmental information disclosure will improve the quality of industrial export products by stimulating innovation and improving productivity.

3. Empirical Design

3.1 Model Setting and Variable Description

Taking the environmental information disclosure policy implemented in China in 2008 as a quasi-natural experiment, this paper constructs the following generalized DID model to identify the impact of environmental information disclosure policy on the quality of China's industrial export products:

$$Quality_{ht} = \alpha_0 + \alpha_1 EID_h \times Post_t + \alpha_2 X_{ht} + \mu_h + \eta_t + \varepsilon_{ht} \quad (16)$$

Where h indicates the industry and t indicates the year. $Quality_{ht}$ represents the quality of industrial export products. EID_h represents the virtual variable of industry grouping. $Post_t$ represents the virtual variable of policy implementation. X_{ht} represents the control variable, μ_h represents the fixed effect of the industry, η_t is the fixed effect of the year, ε_{ht} denotes random disturbance term.

3.1.1 Explained Variable

This paper uses the constant substitution elasticity model in the demand information inference method to calculate the quality of China's export products at the industry level.

3.1.2 Core Explanatory Variable

According to the “Enterprise Environmental Information Disclosure Index Report” released by the Environmental Economics Research Center of Fudan University, industries with more serious pollution emissions are more affected by environmental information disclosure policies. Therefore, the heavy pollution industries specified in the “Environmental Information Disclosure Guidelines for Listed Companies” issued by the Ministry of Environmental Protection are taken as the treatment group (EID=1) and other industries as the control group (EID=0). In addition, the environmental information disclosure policy was officially implemented in 2008. Therefore, in 2008 and after, post=1, before 2008, post=0.

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3.1.3 Control Variable

Referring to the existing literature, this paper selects the following control variables.

(1) Financing constraint (Financing). It is measured by the ratio of interest expenditure to total profit. (2) Profitability (Profit). It is measured by cost profit margin. (3) The degree of market competition (lnNum). It is measured by the number of industrial enterprises above designated size in the industry. (4) Industry size (lnSize). It is measured by total assets. (5) The degree of loss (Deficit). It is measured by the ratio of the amount of loss to the total profit.

3.2 Sample Selection and Data Sources

The original data for measuring the quality of export products come from the UN Comtrade database. The data of control variables come from "China Industrial Statistical Yearbook". Since the "China Industrial Statistical Yearbook" of 2017 and 2018 have not been published, this paper selects the data from 2005 to 2016 for regression analysis.

Referring to the comparison table between HS coded products and China's industry summarized by Zhou (2006) to match the products with the industry, this paper matches the products with the industries [14]. After matching, 28 industrial industries are retained, including 16 heavily polluting industries, as shown in Table 1.

Table 1: Retained industries

Code	Name	Code	Name
06*	Coal mining and selection industry	26*	Chemical raw materials and chemical products
10*	Non-metallic mining and selection industry	27*	Pharmaceutical manufacturing
14	Food processing and manufacturing	28*	Chemical fiber manufacturing
15*	Beverage industry	29*	Rubber and plastic products
16	Tobacco processing industry	30*	Non-metallic mineral products industry
17*	Textile industry	31*	Ferrous metal smelting and pressing industry
18*	Garment and other fiber products	32*	Nonferrous metal smelting and pressing industry
19*	Leather, fur, eiderdown and its products	33*	Metal products industry
20	Wood processing and wood, bamboo, rattan, palm, grass products	34	General machinery manufacturing
21	Furniture manufacturing	35	Special equipment manufacturing
22*	Paper and paper products industry	37	Transportation equipment manufacturing
23	Reproduction of printing and recording media	38	Electrical machinery and equipment manufacturing
24	Culture and education sports goods manufacturing industry	39	Electronic and communication equipment manufacturing
25*	Petroleum processing and coking industry	40	Instruments and cultural office industry

Note: * indicates heavy polluting industry.

The descriptive statistics of the main variables are shown in Table 2.

Table 2: Descriptive statistics

Variable	Mean	Std. Dev.	Minimum	Maximum
Quality	0.5575	0.1066	0.3033	0.9391
Financing	0.1937	0.3646	-0.5878	5.5747
Profit	0.0769	0.0530	-0.0430	0.4150
lnNum	8.9553	1.0763	4.8520	10.5891
lnSize	9.2838	1.0364	6.5257	11.2779
Deficit	0.1343	0.6212	-3.1498	9.3467

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4. Analysis of Empirical Results

4.1 Benchmark Regression Results

The benchmark regression results are shown in Table 3. Column (1) only considers the industry fixed effect, column (2) considers both the industry fixed effect and the year fixed effect, and columns (3) - (5) gradually add other control variables on the basis of column (2). The regression results in five cases show that environmental information disclosure significantly improves the quality of China's industrial export products. For example, in column (5), the regression coefficient of EID×Post is 0.0781, which is significant at the significance level of 1%. This shows that the innovation compensation effect of environmental information disclosure occupies a dominant position, which promotes the quality of China's industrial export products.

In terms of control variables, taking column (5) as an example, the regression coefficients of Profit and lnNum are significantly positive at the significance level of 1% and 5% respectively, indicating that profitability and market competition are conducive to the improvement of the quality of China's industrial export products. The regression coefficient of lnSize is significantly negative at the significance level of 5%, indicating that industry size has a restraining effect on the quality of China's industrial export products. The regression coefficients of Financing and Deficit are not significant, indicating that financing constraint and deficit degree have no obvious influence on the quality of China's industrial export products.

Table 3: Benchmark regression results

Variable	(1)	(2)	(3)	(4)	(5)
EID×Post	0.0436*** (5.67)	0.0769*** (4.01)	0.0785*** (4.08)	0.0777*** (4.05)	0.0781*** (4.07)
Financing			-0.0145* (-1.79)	-0.0084* (-1.68)	-0.0377 (-1.55)
Profit				0.4355*** (3.30)	0.3717*** (3.00)
lnNum				0.0194 (1.39)	0.0743** (2.27)
lnSize					-0.0653** (-2.06)
Deficit					0.0176 (1.33)
Constant term	0.5388*** (113.78)	0.5245*** (65.40)	0.5267*** (64.72)	0.3188** (2.54)	0.4413*** (3.75)
Industry fixed effect	Yes	Yes	Yes	Yes	Yes
Year fixed effect	No	Yes	Yes	Yes	Yes
Adj R^2	0.6655	0.6976	0.6987	0.7063	0.7089

Note: the figures in brackets are t-statistics adjusted for robust standard error. ***, ** and * represent the significance level of 1%, 5% and 10% respectively. The same as below unless otherwise specified.

4.2 Robustness Test

4.2.1 Parallel Trend Test

A key assumption of the DID model is the parallel trend, that is, the treatment group and the control group have the same trend before the implementation of the policy. In order to test whether this hypothesis is met, first, this paper constructs the interaction items between the year virtual variable and the processing group virtual variable (time2005, time2006, time2007, ... , time2016). Secondly, in order to avoid the problem of collinearity, the year before the implementation of the environmental information disclosure policy is regarded as the base period, and time2007 is excluded. Finally, the remaining interaction items are added to the benchmark regression model.

The specific regression results are shown in Table 4. The results show that whether the influence of control variables is considered or not, the regression coefficients of time2005 and time2006 are not significant. It shows that there is no significant difference between the treatment group and the control

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group before the implementation of the environmental information disclosure policy, which meets the parallel trend hypothesis.

Table 4: Parallel trend test

Variable	(1)	(2)
Time2005	-0.0181 (-0.43)	-0.0167 (-0.40)
Time2006	-0.0056 (-0.13)	-0.0034 (-0.08)
Control variable	No	Yes
Constant term	0.5291*** (34.61)	0.4425*** (3.74)
Industry fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Adj R^2	0.6909	0.7012

4.2.2 Propensity Score Matching

In order to avoid the bias of sample self-selection, this paper further uses the propensity score matching method to eliminate the interference of confounding variables between the treatment group and the control group. This paper selects financing constraint, profitability, the degree of loss, the degree of government control (lnGov, which is measured by the ratio of national capital to owner's equity), capital intensity (lnCapital, which is measured by the ratio of net fixed assets to the number of employees) as covariates, and matches them with caliper nearest neighbor matching method. After the matching, the balance test is carried out to analyze the matching effect.

The specific test results are shown in Table 5. The standardized errors of each covariate in the post-matching treatment group and the control group are all less than 10%, and the p-values are greater than 0.1, so the null hypothesis cannot be rejected. This indicates that there is no significant difference between the matched treatment group and the control group, and the balance test has been passed.

Table 5: Balance test

Variable	Mean		Bias(%)	t-statistics	p-value
	Treatment group	Control group			
Financing	0.1360	0.1353	0.2	0.10	0.923
Profit	0.0823	0.0805	3.2	0.28	0.776
Deficit	0.0904	0.0837	1.2	0.33	0.743
lnGov	0.0576	0.0553	4.0	0.29	0.773
lnCapital	2.6194	2.5578	8.4	0.71	0.477

After matching, the matched samples are further used for regression. The specific regression results are shown in Table 6. Taking column (2) as an example, the significance of EID×Post has decreased, but it is still significantly positive at the significance level of 10%. It is confirmed that environmental information disclosure plays an important role in promoting the quality of China's industrial export products.

Table 6: Propensity score matching sample regression

Variable	(1)	(2)
EID×Post	0.0695** (2.75)	0.0514* (1.75)
Control variable	No	Yes
Constant term	0.5027*** (38.35)	0.2218 (0.88)
Industry fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Adj R^2	0.7864	0.8113

4.2.3 Placebo Test

In order to eliminate the interference of other random factors on the regression results, a placebo test is performed in the fictitious treatment group. Firstly, 16 industries are randomly selected from all

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samples as the treatment group, and the econometric regression is carried out again. Secondly, the process is repeated 1000 times. Finally, the t-value of EID×Post in the above 1000 regressions is summarized in the kernel density distribution map.

The specific results are shown in Figure 1. The dotted line represents the nuclear density distribution of EID×Post's t-value in 1000 regressions. The solid line perpendicular to the abscissa axis are the t-value positions corresponding to the 10% significance level under large samples. It can be seen that in 1000 random sampling regression, most of the results are not significant. It shows that the role of environmental information disclosure in promoting the quality of China's industrial export products is stable.

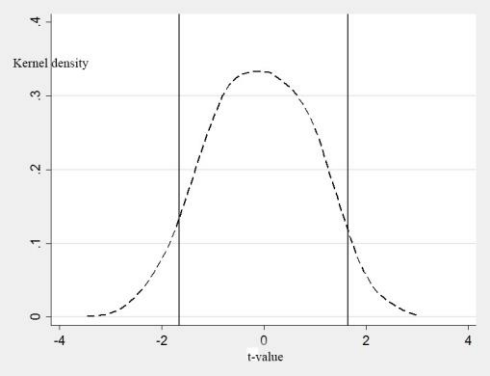

Figure 1: Placebo test

4.3 Heterogeneity Test

In order to analyze the heterogeneity effect of environmental information disclosure on the quality of China's industrial export products, this paper investigates it from the following perspectives.

4.3.1 Financing Constraint

Column (1) in Table 7 reports the results of the industry heterogeneity test of financing constraint. The coefficient of EID×Post×Financing is significantly negative, indicating that higher financing constraint will weaken the promotion of environmental information disclosure on the quality of China's industrial export products. It is not difficult to understand that excessive financing constraint will limit the development of the industry, which is not conducive to the improvement of the quality of export products.

4.3.2 Profitability

Column (2) in Table 7 reports the results of the industry heterogeneity test of profitability. The coefficient of EID×Post×Profit is significantly positive, indicating that the stronger the profitability of the industry, the greater the promotion effect of environmental information disclosure on the quality of export products. This may be because high profitability means more abundant funds will be used to improve the quality of export products.

4.3.3 Labor Intensity

Column (3) in Table 7 reports the industry heterogeneity test results of labor intensity (lnLab, which is measured by labor remuneration after sales revenue reduction). With the improvement of labor-intensive quantiles, the role of environmental information disclosure in promoting the quality of China's industrial export products has gradually become greater. In industries with high labor intensity, the advantage of products mainly lies in low price (Zhang and Ji, 2018)[15]. The environmental information disclosure policy puts forward higher requirements for product quality. In industries with high labor intensity, a large number of low-cost and low-quality products are reduced or even stopped production, and high-quality products continue to survive. Therefore, environmental information disclosure plays a more obvious role in improving the quality of export products in high labor-intensive industries.

4.3.4 The Degree of Government Control

Column (4) in Table 7 reports the industry heterogeneity test results of the degree of government control. The coefficient of EID×Post×lnGov is significantly positive, indicating that in industries with

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high degree of government control, environmental information disclosure has a greater positive impact on the quality of export products. The government has a high degree of control and strong ability to control risks, which is conducive to improving the quality of export products.

Table 7: Heterogeneity test

Variable	(1) Financing constraint	(2) Profitability	(3) Labor intensity	(4) The degree of government control
EID×Post	0.0965*** (4.86)	0.0404* (1.75)	0.0351* (1.90)	0.0649*** (3.26)
EID×Post×Financing	-0.0972** (-2.44)			
EID×Post×Profit		0.5257** (2.54)		
EID×Post×lnLab(Q25)			0.0341*** (3.03)	
EID×Post×lnLab(Q50)			0.0607*** (3.75)	
EID×Post×lnLab(Q75)			0.0745*** (3.46)	
EID×Post×lnGov				0.2052* (1.84)
Control variable	Yes	Yes	Yes	Yes
Constant term	0.4196*** (3.58)	0.4640*** (4.01)	0.5839*** (4.60)	0.5109*** (3.62)
Industry fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Adj R^2	0.7109	0.7123	0.7035	0.7090

Note: Q25, Q50 and Q75 respectively represent the quantile grades of corresponding variables in 0% - 25%, 25% - 50% and 50% - 75%.

4.4 Influence Mechanism Test

4.4.1 Innovation Compensation Effect Test

The previous regression results show that environmental information disclosure improves the quality of China's industrial export products. This paper believes that this is because environmental information disclosure stimulates innovation and improves productivity, which is conducive to the improvement of the quality of export products. In order to test the existence of this influence mechanism, this paper selects industry productivity (lnPro, which is measured by the ratio of industrial output value to the number of employees) as the intermediary variable to construct the following intermediary effect model:

$$Quality_{ht} = \alpha_0 + \alpha_1 EID_h \times Post_t + \alpha_2 X_{ht} + \mu_h + \eta_t + \varepsilon_{ht} \quad (17)$$

$$\ln Pro_{ht} = \beta_0 + \beta_1 EID_h \times Post_t + \beta_2 X_{ht} + \mu_h + \eta_t + \varepsilon_{ht} \quad (18)$$

$$Quality_{ht} = \gamma_0 + \gamma_1 EID_h \times Post_t + \gamma_2 \ln Pro_{ht} + \gamma_3 X_{ht} + \mu_h + \eta_t + \varepsilon_{ht} \quad (19)$$

The specific regression results are shown in Table 8. Column (1) is the benchmark regression, and the results show that environmental information disclosure improves the quality of China's industrial export products. The regression results in column (2) show that environmental information disclosure improves the productivity of China's industrial industry. The regression results in column (3) show that the improvement of productivity can significantly promote the quality of China's industrial export products. On the whole, environmental information disclosure promotes the quality of China's industrial export products by improving industrial productivity.

In addition, the direct effect of environmental information disclosure on the quality of China's industrial exports is 0.0703, and the total effect is 0.0781. The direct effect is smaller than the total effect, and both are significant, indicating that it is a partial intermediary effect.

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Table 8: Innovation compensation effect test

Variable	(1)Quality	(2)lnPro	(3)Quality
EID×Post	0.0781*** (4.07)	0.0697*** (3.14)	0.0703*** (4.06)
lnPro			0.1062** (2.01)
Control variable	Yes	Yes	Yes
Constant term	0.4413*** (3.75)	0.9734*** (3.27)	0.3604** (2.56)
Industry fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Adj R^2	0.7089	0.9829	0.7097

4.4.2 Cost Effect Test

The results of benchmark regression show that the innovation compensation effect of environmental information disclosure is greater than the cost effect. Although the cost effect does not play an important role, it is still necessary to examine it. First, this paper tests whether environmental information disclosure increases the production cost of the industry (Cost, which is measured by the ratio of main business cost to sales output value). Secondly, the interactive term between environmental information disclosure and production cost (EID×Post×Cost) is added to the model to test whether the impact of environmental information disclosure on the quality of China's industrial export products depends on the production cost.

The specific regression results are shown in table 9. Among them, the regression results in column (1) show that environmental information disclosure increases the production costs of the industry. The regression results in column (2) show that the regression coefficient of EID×Post×Cost on the quality of China's industrial export products is significantly negative. On the whole, environmental information disclosure will have an adverse impact on the quality of China's industrial export products by increasing the production costs of the industry.

Table 9: Cost effect test

Variable	(1)Cost	(2)Quality
EID×Post	0.0164** (1.98)	0.3128** (2.45)
EID×Post×Cost		-0.2821* (-1.93)
Control variable	Yes	Yes
Constant term	0.5050*** (5.89)	0.6352*** (3.45)
Industry fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Adj R^2	0.8454	0.7106

5. Conclusions and Policy Recommendations

This paper uses the generalized DID model to investigate the impact of environmental information disclosure on the quality of China's industrial export products. The regression results show that: firstly, environmental information disclosure significantly promotes the improvement of the quality of China's industrial export product. Secondly, the promotion shows industry heterogeneity in terms of financing constraint, profitability, labor intensity and the degree of government control. Thirdly, environmental information disclosure will improve the quality of China's industrial export products through innovation compensation effect, and reduce the quality of China's industrial export products through cost effect.

The policy recommendations of this paper are as follows: in order to realize the simultaneous progress of ecological benefits and export benefits, firstly, the government should further supplement and improve the existing environmental information disclosure policies, and further clarify the relevant punishment and incentive mechanism. Secondly, financial institutions should try to divert funds to green economy, green industry and green products, and promote the concept of green development. Finally, the industry itself should also actively respond to the call of the state and improve their

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awareness of social responsibility and environmental responsibility.

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