

Influential Mechanism Research of Environmental Control on Chinese Textile Export Trade

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Abstract. This study constructs a regression model of textile industry export trade. The panel data of nine importing countries or regions from 2006 to 2022 are used to verify whether environmental control has short-term cost effects and long-term technical effects on Chinese textile industry export trade. First of all, the panel data from 2006 to 2022 are empirically analyzed for the short-term effects. The results show that the cost effect of environmental control makes environmental control inhibit the export of textile industry in the short term. Then, the same panel data is used to empirically analyze the impact of $t - 2$ environmental governance input on t textile export trade, that is, the long-term effects. The result shows that the technical effect of environmental control is greater than the cost effect in the long run. It means environmental control has a role in promoting the export of textile industry. Finally, combining the influence factors of textile export trade, two suggestions are put forward from the enterprise level.

Keywords: Environmental control; textile export; cost effect; technology effect.

1. Introduction

In recent years, economic globalization has promoted the rapid development of Chinese foreign trade, among which the textile industry has a considerable scale of export trade. According to the economic operation report of Chinese textile industry, from 2006 to 2022, the proportion of textile industry export trade in Chinese total exports has been maintained at more than 8%, which shows that textile industry export trade has become an indispensable part of China's foreign trade.

However, although the rapid development of export trade has brought economic growth, the textile industry, as a high-polluting industry, has led to the worsening of the environment, and the chemical oxygen demand, sulfur dioxide and other substances emitted by the production of products have caused great pressure on the environment. According to the statistics of the Ministry of Environmental Protection, the total chemical oxygen demand emission of the textile industry in 2010 was 301,000 tons, accounting for 8.3% of the total industrial emissions. According to the Chinese Academy of Engineering data, in 2010, the textile industry carbon emissions of about 126 million tons of carbon dioxide equivalent, accounting for 12.6% of the total industrial carbon emissions, Chinese textile industry is one of the main greenhouse gas emissions industries.

In response, the Chinese government has formulated relevant policies to protect the environment and put forward a series of measures such as sustainable development strategy. At the same time, people are paying more and more attention to environmental problems. The promulgation of the Environmental Protection Law of the People's Republic of China in 2014 reflects China's determination to protect the ecological environment, and the treatment of environmental pollution has been carried out in an orderly manner. From the perspective of the chemical oxygen demand emissions of the textile industry during 2007-2021, the emissions in 2021 were 61,500 tons, a decrease of 94.76% compared with 2007. The exhaust emissions of the textile industry are also decreasing year by year, with a decrease of 65.97% in 2018 compared with 2013. However, environmental governance in turn has a certain impact on the textile industry export trade. According to China Statistical Yearbook data, from 2010 to 2016, the export growth rate of the textile industry showed an overall decline trend.

At present, there are a lot of studies on the impact of environmental governance on export. Some scholars believe that environmental governance has a positive effect on export, while some studies show that environmental governance will inhibit the development of export trade. In addition, existing studies show that the long-term impact of environmental governance on exports is U-shaped or inverted U-shaped. Today, Chinese textile trade is booming and has become an important pillar of China's national economic and social development. At the same time, the environmental protection work was carried out smoothly, but it had some negative effects on the export trade of the textile industry. How to protect the environment while developing the economy and achieve a win-win situation of economic growth and environmental improvement has always been the goal pursued by all mankind. However, in recent years, studies on the impact of environmental governance on textile exports are scarce. Therefore, this study takes the textile industry as the research object to explore the impact of environmental governance on textile exports and how to ensure the steady growth of exports while protecting the environment.

The rest of this paper is structured as follows. The second part is the literature review, including the explanation of the relevant theoretical basis of economics, the measurement of environmental governance, the literature review of Chinese textile industry export trade, and the related research on the impact of environmental governance on export trade. The third part mainly analyzes the current situation of export trade and environmental pollution control of Chinese textile industry, and introduces the impact mechanism of environmental governance on export trade according to relevant research. The fourth part is model estimation and empirical analysis. In this chapter, STATA software is used to establish a trade regression model, and panel data of 9 importing countries or regions from 2006 to 2022 are used to verify whether environmental governance has short-term cost effects and long-term technical effects on Chinese textile export trade. This part first empirically analyzes the short-term effect of the panel data from 2006 to 2022, then empirically analyzes the long-term effect by using the same panel data, and finally analyzes and compares the results. The fifth part gives the conclusions and policy suggestions based on the results of empirical analysis.

2. Literature Review

2.1. Determination of Environmental Government

There are many ways to measure environmental regulation. Xu et al. (2014) used CO₂ emission intensity as the standard for measuring the intensity of environmental governance [1]. Shao (2017) divided environmental regulation into two types: cost-based environmental regulation and investment-based environmental regulation. The former was measured by regional emission levy and fee, while the latter was measured by regional pollution control investment [2]. Chen & Yang (2018) used the environmental performance of various pollutants to construct a comprehensive index of environmental regulation [3]. Liu & Xie (2018) defined the intensity of environmental treatment by using the proportion of operating costs of industrial wastewater and industrial waste gas treatment facilities to industrial added value [4]. Sun & Xiong (2019) used pollution emissions per unit of output value to measure the intensity of environmental regulations in various industries and investigated the impact of environmental regulations on the competitiveness of manufacturing industry [5]. Sheng & Wei (2020) adopted the ratio of industrial SO₂ emissions to industrial energy consumption as a standard to measure the intensity of environmental regulations in a specific region [6]. Xu & Liu (2022) measure the level of environmental regulation by the ratio of industrial wastewater emissions, industrial waste gas emissions, industrial sulfur dioxide emissions, industrial smoke and dust emissions, and industrial sulfur dioxide emissions to pollution investment per unit of industrial output value [7]. The composite index of environmental regulation calculated by Feng (2022) and Guan & Qu (2023) is derived from industrial wastewater emissions, industrial sulfur dioxide emissions, and industrial soot emissions [8][9].

2.2. Chinese Textile Export Trade

As the world's largest textile producer and exporter, the development of textile export trade is crucial to the sustainable development of Chinese textile industry. How to improve the export competitiveness of textile industry has attracted extensive attention from scholars. Jiang et al. (2018) concluded from micro-level analysis that the fulfillment of environmental responsibility by Chinese textile companies has a positive effect on textile export trade [10]. Liang (2018) found that the export value of Chinese textile industry showed a trend of increasing in value and decreasing in proportion, and found that the development of Chinese textile export trade had a significant promoting effect on the development of Chinese export trade [11]. Qiu (2020) found that Chinese textile industry has obvious first-mover advantage in the international market, but problems such as low value-added products and green trade barriers need to be solved [12]. Jiang & Xu (2021), through studying the international competitiveness of Chinese textile industry, believe that Chinese textile industry should speed up industrial transformation and upgrading [13]. Wu et al. (2022) found that the United States is Chinese largest textile exporter, and based on this study, it was found that the export competitiveness of Chinese textile industry to the United States was significantly affected by GDP, added value of the textile industry and the exchange rate [14]. Yao (2023) found that factors such as labor cost, domestic demand, research and development intensity and government policies have a significant impact on the export competitiveness of Chinese textile industry [15].

2.3. The Impact of Environment Regulations on Exports

Existing studies on the impact of environmental regulations on exports are mainly divided into positive and negative. Zheng & Chen (2016) found that environmental regulations had a small promoting effect on the export of China's textile industry [16]. The empirical study of Xu et al. (2014) shows that environmental governance increases the cost burden of exporters and has a significant negative impact on export trade [1]. Shao (2017) studied the influence of environmental regulations on export trade by using GMM estimation method and concluded that there is a U-shaped relationship [2]. Chen & Yang (2018) studied the impact of environmental regulations on export trade from the perspective of local government competition, and the research results showed that the current strict environmental governance standards would inhibit exports [3]. Sun & Xiong (2019) believe that environmental regulations have a negative impact on exports in the short term, but in the long run, due to innovative activities, environmental regulations have a promoting effect on exports [5]. From the perspective of technological innovation, Sheng & Wei (2020) show that the impact of environmental regulations on export trade has the technical effect pointed out in Porter's hypothesis [6]. Li et al. (2021) believe that the impact of carbon pilot city policies on the export of cities above prefecture level depends on the superposition of two influence mechanisms: negative cost effect and positive technological innovation effect [17]. Xu & Liu (2022) concluded that environmental regulations and agricultural exports present a U-shaped relationship [7]. Feng (2022) proved through research that the cost increase effect of environmental regulatory policies on enterprise exports is greater than the innovation promotion effect, which ultimately reduces the export volume of enterprises and narrates the range of export products of enterprises [8]. Twerefou et al. (2019) concluded that environmental protection policies would not directly affect carbon dioxide emissions [18]. Matsuda et al. (2021) studied the impact of environmental protection measures taken by China since 2013 on the export trade of waste products in other countries, and concluded that the implementation of environmental governance measures resulted in a decrease in the export trade of waste products [19].

2.4. Marginal Contribution

According to the summary of the above relevant literature, it can be seen that at present, there are many studies analyzing the impact of environmental regulation on export trade, but there are few relevant studies on the impact of environmental governance on export trade, and there are few relevant studies focusing on the textile industry, and most of the studies focus on other industries. This paper

focuses on the textile industry, constructs a trade regression model, and uses panel data of nine importing countries or regions from 2006 to 2022 to verify whether environmental governance has short-term cost effects and long-term technical effects on Chinese textile industry export trade. The marginal contribution of this paper includes: (1) the textile industry as the research object. The textile industry, as a serious industrial pollution area, is the key implementation industry of environmental governance, and at the same time, the textile industry is also an important part of Chinese export trade. Therefore, it is very important to study the impact mechanism of environmental governance on textile exports. (2) The measurement of environmental governance indicators. This paper uses the sum of water environment treatment cost and atmospheric environment treatment cost to measure the intensity of environmental treatment. (3) Short term versus long term. This paper firstly uses the panel data from 2006 to 2022 to empirically analyze the short-term effect, and then uses the same panel data to empirically analyze the impact of environmental governance input in period $t - 2$ on textile export trade in period t , that is, the long-term effect. This will facilitate the comparison of short-term results with long-term results and better demonstrate the conclusions of current studies on cost effects and technical effects.

3. Development Status and Influencing Mechanism

3.1. Development Status

3.1.1. Develop status of Chinese textile export trade

Fig.1 shows the export volume of Chinese textile industry and the proportion of textile industry's export trade in total exports from 2002 to 2022. Among them, the textile exports in 2002 were 57.849 billion US dollars, and the textile industry exports in 2022 were 316.964 billion US dollars, which shows that the textile industry exports are growing rapidly. However, from the perspective of the proportion of textile exports in Chinese total exports, the maximum value is 17.77% in 2002, while the minimum value is only 8.90% in 2022. As can be seen from Figure 1, the overall export volume of Chinese textile industry shows an upward trend, but the proportion of textile industry exports in total exports shows a downward trend. Textiles are labor-intensive products, and China is a huge labor market, textile production is easy to develop in China, so the export volume of textiles is large. However, in the face of environmental pollution control, environmental costs appear, the textile industry is low in technology content, unable to carry out technological innovation that can offset environmental costs, so the textile industry may be replaced by other industries, exports will also be affected. Zhang (2014) pointed out that the international textile market is increasingly shifting from labor-intensive to capital-intensive, which has a negative impact on the international competitiveness of Chinese textile exports [20].

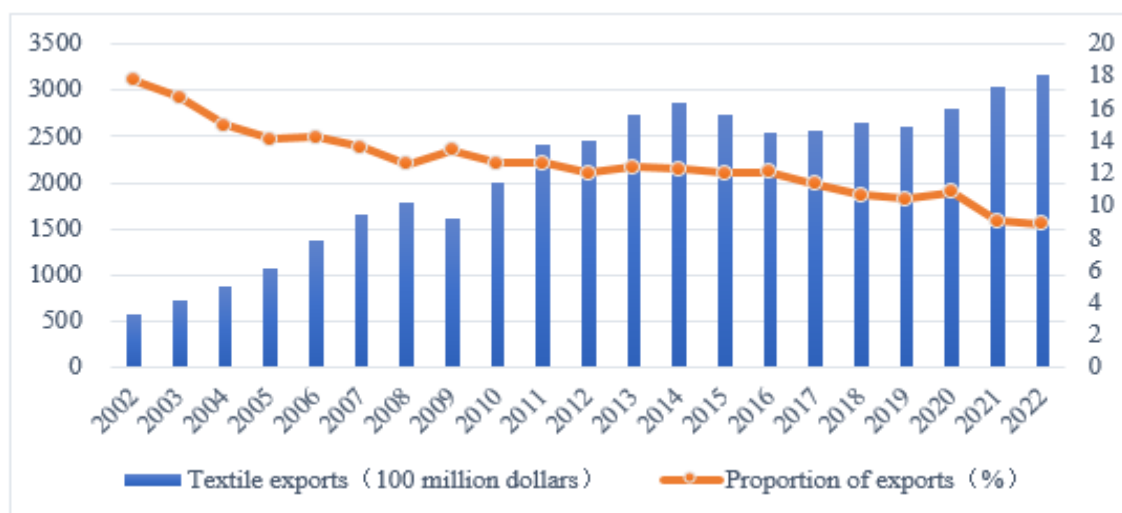


Fig 1. Export data of China textile industry from 2002 to 2022.

Fig.2 selects the export value of Chinese textile industry in 9 typical countries and regions. Among them, the United States, as the largest trade exporter of Chinese textile industry in recent years, gradually rose from \$11.786 billion in 2006 to \$56.350 billion in 2022, which showed a very large growth, especially in 2007, the most rapid growth, compared to 2006 growth more than doubled. The trade volume of Chinese textile industry exported to Japan has been at a high level, and Japan has always occupied an important position in Chinese textile industry exports.

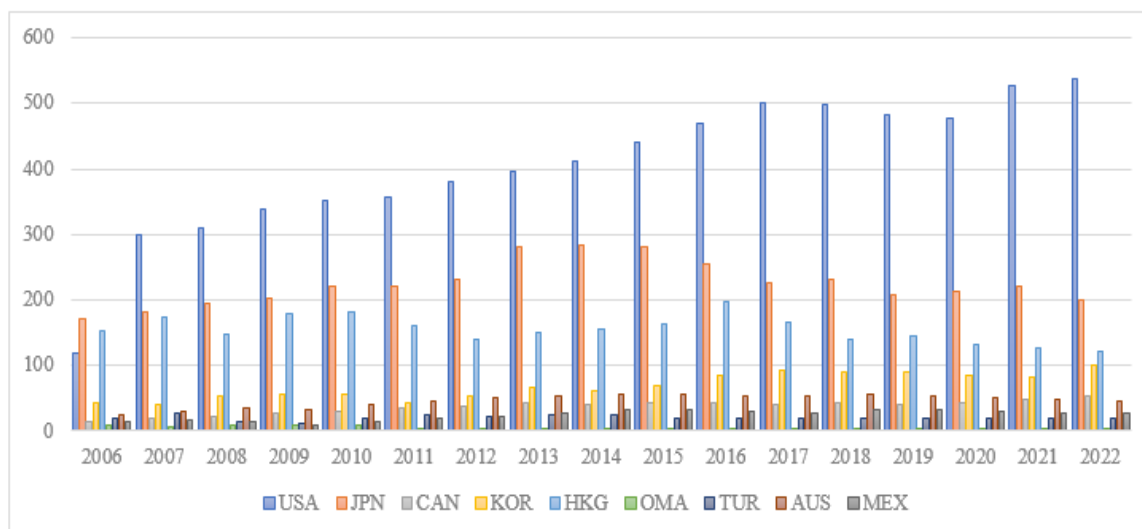


Fig 2. Chinese textile exports to typical countries and regions from 2006 to 2022 (10 million dollars).

3.1.2. Current situation of environmental governance in Chinese textile industry

As shown in Fig.3, the number of facilities used in the textile industry for waste gas treatment from 2005 to 2021 shows an overall upward trend, with 9,486 sets of waste gas treatment equipment in the textile industry in 2021, and 7,376 sets of waste gas equipment in 2016, which shows that the national measures to treat air pollution are being steadily implemented. As shown in the figure, from 2005 to 2012, the treatment capacity of wastewater treatment facilities in the textile industry has gradually improved, and this stage is in the initial exploration stage of water pollution treatment, and experience in all aspects is not yet rich. From 2012 to 2021, except for 2017, the data is relatively stable, indicating that the level of water pollution treatment is gradually stable, and the textile industry has accumulated experience in water pollution treatment, so the treatment capacity of wastewater treatment facilities in the textile industry is stable at a level.

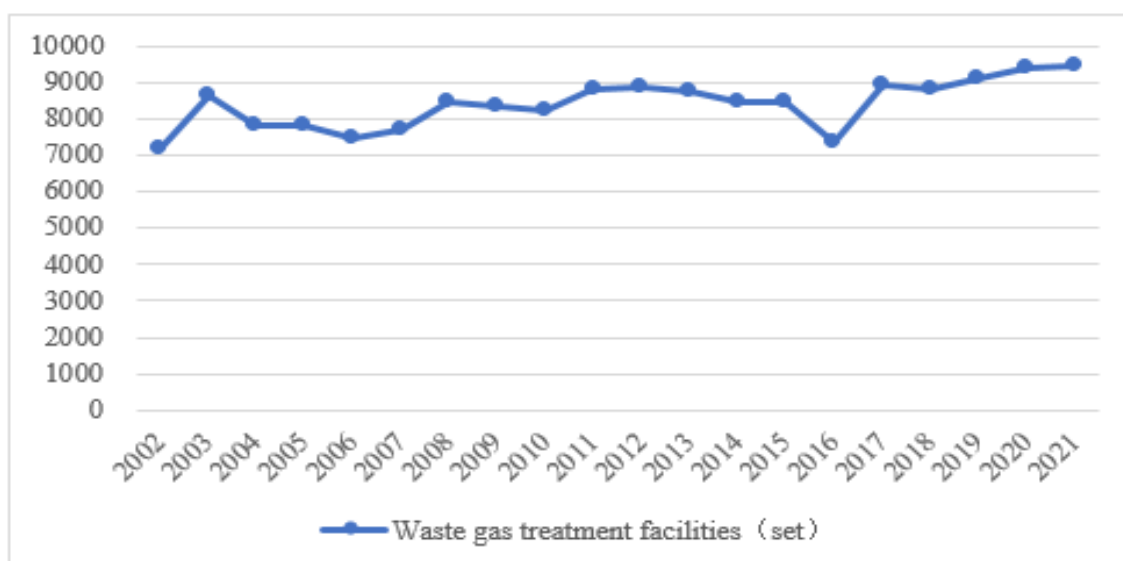


Fig 3. Waste gas treatment facilities of textile industry from 2005 to 2021.

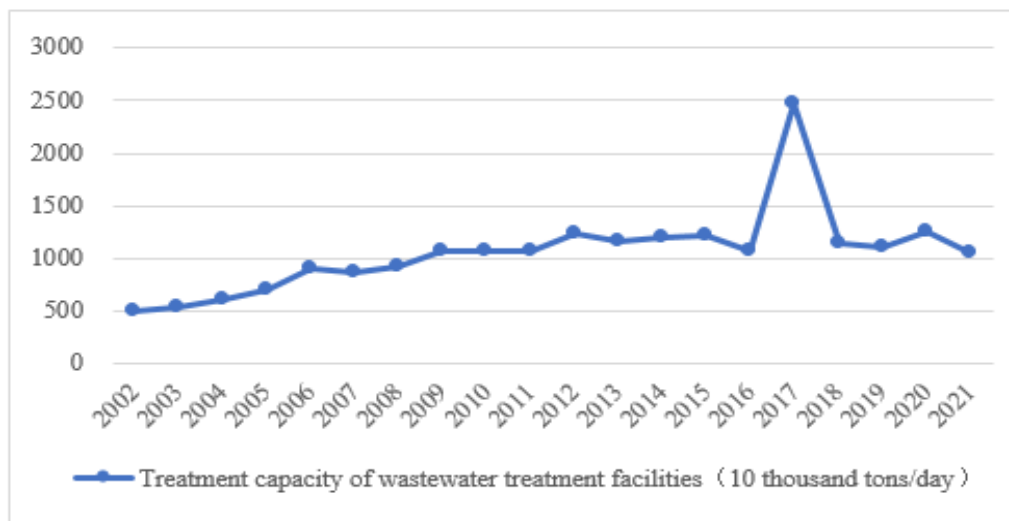


Fig 4. Treatment capacity of textile industry wastewater treatment facilities from 2005 to 2021.

3.2. Influencing Mechanism

The influence mechanism of environmental governance on export mainly has cost effect and technical effect. On the one hand, the production cost of enterprises has increased significantly due to the impact of environmental governance, resulting in the weakening of the competitiveness of enterprises [21], which in turn has an inhibiting effect on exports. On the other hand, environmental governance will encourage technological innovation of enterprises, promote the production efficiency of enterprises, and thus promote the export of enterprises. Therefore, the specific impact of environmental governance on enterprise exports depends on the superimposed effect of cost effect and technical effect.

3.2.1. Cost effect

The neglect of environmental externalities will affect the export results of the industry, and then lead to the overestimation of trade benefits, so the environmental costs should be internalized [22]. According to neoclassical economics, in the short run, environmental governance has short-term cost effects. On the surface, environmental governance improves the environment and increases the overall welfare of society. However, due to the existence of environmental costs, the cost required for environmental governance is internalized, the price of export products rises, and the competitiveness of enterprises decreases, which makes the profits of enterprises decrease in the short term, resulting in a downward trend in exports [23].

Fig. 5 shows the short-term cost-effectiveness of environmental regulations on export trade. Taking textiles as an example, D is the demand curve of the importing country for textiles, MR is the marginal revenue curve, MC and is the marginal cost curve. Before the implementation of environmental regulation measures, based on the principle of profit maximization, the equilibrium point at this time is E_0 , that is, the export trade volume is Q_0 , the export price is P_0 , and the unit production cost is C_0 . After the implementation of the management measures, the manufacturer's marginal cost curve moves to the left to MC' , at this time the equilibrium point is E' , the unit cost increases to C' , the export trade volume decreases to Q' , and the export price also rises to P' . By comparison, the manufacturer's profit before the implementation of the treatment measures is the area of the rectangle $AE_0C_0P_0$ in the figure. After the implementation of the measures, the manufacturer's profit is a rectangular $BE'C'P'$ area. It is not difficult to see that in the short term, the implementation of environmental regulatory policies will lead to a decline in the manufacturer's profit.

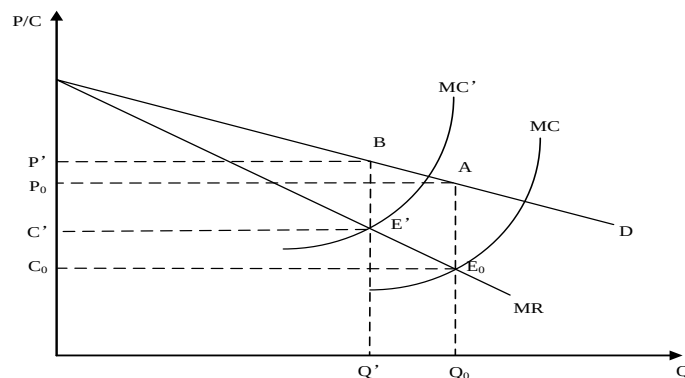


Fig 5. Short-term cost effect.

3.2.2. Technical effect

Porter's hypothesis holds that environmental protection will reduce export trade in the short term, but in the long run, due to the existence of technical effects, environmental protection will increase export trade. Due to the implementation of pollution control policies, enterprises need to pay environmental costs, resulting in a decline in corporate profits. In order to get rid of this dilemma, enterprises will carry out some technological innovation activities, and the profits brought by such technological innovation can improve the productivity of enterprises [24], offset the losses caused by environmental costs, and thus improve the competitiveness of enterprises.

Fig.6 depicts the long-term technical effects of environmental regulations on export trade. When the environmental protection measures have not been implemented, the equilibrium point of the product is E_0 ; After the implementation of the measure, due to the emergence of environmental costs, the elasticity of the supply curve continues to become smaller and move to the left until it moves to S_1' , at which time the equilibrium point is E_1' , and the export trade volume of the product decreases. However, under the appropriate environmental protection policy, manufacturers will carry out technological innovation in order to ensure their status. Due to the time lag, technological innovation cannot bring great benefits in a short period of time, but in the long run, technological innovation makes the supply curve of manufacturers move to the right to S' , and the import demand curve also moves to the right to D' . At this time, the new equilibrium point is E' , and the export trade volume of products increases, so does the price. Therefore, technological innovation can offset the negative impact of cost effect, making the competitiveness of enterprises rise.

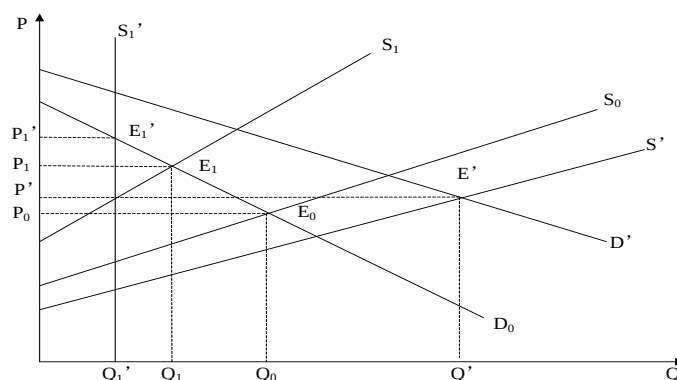


Fig 6. Long-term technical effect.

4. Empirical Research

4.1. Data Sources

The data on environmental governance of textile industry in this study came from China Environmental Statistical Yearbook and Ecological Environmental Statistical Annual Report. Data

related to textile export trade are collected according to China Textile Industry Development Report, China Textile Industry Economic Operation Report and China Statistical Yearbook; GDP data of each country and region comes from the World Economic Network. Trade distance between countries or regions based on CEPII data; FDI data come from China Statistical Yearbook. Data related to human capital were collected according to China Science and Technology Statistical Yearbook; the textile industry Innovation index comes from the “China City and Industry Innovation Report 2017” [25]; some missing data are calculated by linear interpolation method.

4.2. Model Building

The export trade of Chinese textile industry is affected by the operating cost of environmental governance, GDP of the importing country or region, China’s GDP, the distance between the two countries or regions, foreign direct investment in the textile industry, human capital, the level of innovation and the number of enterprises in the textile industry. This study refers to the trade gravity models [26] commonly used in international trade studies at home and abroad as follows, where T_{ij} represents the trade flow between countries i and j , GDP_i and GDP_j represent the gross national product of countries i and j respectively, and D_{ij} represents the trade distance between countries i and j .

$$\ln T_{ij} = \beta_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_4 \ln D_{ij} + \varepsilon \quad (1)$$

Firstly, control variables are introduced into Equation (1), and the following model is established for the study of short-term effects:

$$\ln Volume_{ti} = \beta_0 + \beta_1 \ln Expense_t + \beta_2 \ln GDP_{i_{t-2}} + \beta_3 \ln GDP_{e_t} + \beta_4 \ln D_t + \beta_5 \ln FDI_t + \beta_6 Hcl_t + \beta_7 I_t + \beta_8 N_t + \varepsilon \quad (2)$$

Then, the explanatory variables in Equation (2) are delayed to study the impact of environmental governance input in $t - 2$ period on textile industry exports in t period, and the following model is established:

$$\ln Volume_{ti} = \beta_0 + \beta_1 \ln Expense_{t-2} + \beta_2 \ln GDP_{i_{t-2}} + \beta_3 \ln GDP_{e_{t-2}} + \beta_4 \ln D_{t-2} + \beta_5 \ln FDI_{t-2} + \beta_6 Hcl_{t-2} + \beta_7 I_{t-2} + \beta_8 N_{t-2} + \varepsilon \quad (3)$$

See Table 1 for the specific definitions of the variables in the above formula. In this paper, Chinese textile exports to the United States, Japan, Canada, South Korea, Hong Kong, Macao, Turkey, Australia and Mexico from 2006 to 2022 and the operating costs of environmental governance in Chinese textile industry in the past 17 years are selected as research samples. China’s exports to the above nine countries or regions account for about 60% of the total exports of Chinese textile industry, so the data selected from these countries or regions is more representative.

Table 1. Meaning of variables.

Variable name		Meaning	Prediction	Theoretical explanation
Explained variable	<i>Volume</i>	Number of textiles exported by China to the i exporting country or region in Year t (unit: 100 million dollars)		Exports of Chinese textile industry, this index can reflect the development trend of Chinese textile industry export trade.
Key independent variable	<i>Expense</i>	Operating costs of environmental governance in Chinese textile industry in Year t (unit: 10 thousand yuan)	-/+	Environmental treatment costs are the sum of water environment treatment costs and atmospheric environment treatment costs, representing the investment for environmental pollution treatment, the higher the cost, the greater the intensity of pollution treatment.

Control variable	GDP_i	Nominal GDP of the i importing country or region in Year t (unit: 100 million dollars)	–	For the importing country or region, the stronger the economic strength, the higher the level of consumption, the greater the demand for textile imports.
	GDP_e	Total nominal GDP of China in year t (unit: 100 million dollars)	+	For exporting countries, the stronger the economy, the higher the productivity, the greater the export volume.
	D	Trade distance between the i importing country or region and China (unit: km)	–	The trade distance between import and export countries or regions, where the distance between the economic centers between the two countries or regions indicates the trade distance.
	FDI	Foreign direct Investment in textile industry in Year t (unit: 100 million dollars)	+	The increase of foreign direct investment can promote the technological progress of the industry while improving the conditions of domestic capital factors [27].
	Hcl	Proportion of professional and technical personnel in Chinese textile industry in Year t (unit: %)	+	The level of human capital is expressed by the proportion of professional and technical researchers in the Chinese workforce. The improvement of human capital level is conducive to the upgrading of industrial structure of textile industry.
	I	China Textile Industry Innovation Index in Year t	+	The level of innovation is expressed by the textile industry innovation index. The stronger the innovation, the more significant the technical effect of environmental governance.
	N	Number of enterprises in Chinese textile industry in Year t (Unit: households)	+	The increase in the number of enterprises in the industry will increase the output of products in the industry to a certain extent, thus affecting the export volume from the perspective of supply.
Others	ε	Random disturbance term		Error.

4.3. Model Test

In this study, 9 groups of panel data from 2006 to 2022 were selected for analysis, and the model was tested first.

4.3.1. Unit root test

Considering that if there is unit root, there will be serious consequences such as false regression, so the unit root test is carried out on the panel data. In order to balance panel data, two test methods, LLC and Hadri, were selected in this study, and the test results are shown in Table 2.

Table 2. Unit root test results.

	LLC		Hadri	
	P value	stationary	P value	stationary
$\ln Volume$	0.0053	steady	0.0000	steady
$\ln Expense$	0.0000	steady	0.0000	steady
$\ln GDP_i$	0.0000	steady	0.0083	steady
$\ln GDP_e$	0.0130	steady	0.0093	steady
$\ln FDI$	0.0002	steady	0.0082	steady
Hcl	0.0041	steady	0.0005	steady
I	0.0000	steady	0.0111	steady
N	0.0001	steady	0.0000	steady

4.3.2. Heteroscedasticity, intra-group autocorrelation, inter-group cross-sectional correlation tests.

Firstly, the likelihood ratio (LR) is used to conduct a heteroscedastic test, and the result P is 0.0000, strongly rejecting the null hypothesis of “in-group homoscedasticity”. Secondly, the Wald test of intra-group autocorrelation is tested, and the result P has a value of 0.0000, indicating that the null hypothesis of “no intra-group autocorrelation exists in the first order” is rejected. Finally, Breusch-Pagan LM is used to test the correlation between the sections of the long panel groups, and the results show that there is correlation between the sections of the groups.

4.4. Short-term Static Panel Model Estimation

In order to verify the short-term cost effect and long-term technical effect of environmental governance on textile industry exports, this study conducted short-term panel estimation on the panel data from 2006 to 2022 to verify whether the short-term cost effect was in line with the short-term panel estimation, and then delayed the explanatory variables for two periods for long-term panel estimation to verify whether the long-term technical effect existed.

Firstly, the panel data from 2006 to 2022 are analyzed. Since $n < T$, this is long panel data and is estimated using the feasible generalized least squares method (FGLS). Considering the previous test results, the FGLS method, which deals with intra-group coincident correlation and intra-group autocorrelation meanwhile, is adopted for the model. Stata regression results are shown in Table 3.

Table 3. Short-term model estimates from 2006 to 2022.

Type	Intra-group autocorrelation and inter-group coincident correlation (FGLS)	
Variable	Coefficient	Robust standard deviation
<i>lnExpense</i>	-0.1171***	0.0330
<i>lnGDPI</i>	-0.0081	0.0636
<i>lnGDPe</i>	0.2380	0.1656
<i>lnD</i>	6.7504***	0.5140
<i>lnFDI</i>	-0.1417	0.0881
<i>Hcl</i>	-0.7630**	0.2979
<i>I</i>	-0.0035*	0.0021
<i>lnN</i>	0.2375***	0.0612
Cons	-59.2952***	5.1052
Wald		4760.97
Chi2(12)		
<i>P</i> value		0.0000

Note: ***, ** and * are significant at 1%, 5% and 10%, respectively

From the comparison of the estimation results of the empirical model, the model constructed by the feasible generalized least square method which deals with both intra-group autocorrelation and inter-group contemporaneous correlation is as follows:

$$\begin{aligned} \ln Volume = & -59.2952 - 0.1171 * \ln Expense - 0.0081 * \ln GDPI + 0.2380 * \ln GDPe \\ & + 6.7504 * \ln D - 0.1417 * \ln FDI - 0.7630 * Hcl - 0.0035 * I + 0.2375 * \ln N \end{aligned} \quad (4)$$

According to the estimated results of the above model, the estimated coefficients of *lnExpense* for pollution control are all negative (-0.1171). This means that Chinese textile industry exports and environmental pollution control investment reverse change, in the case of other conditions unchanged, for 2006-2022, each 1% increase in environmental governance intensity, textile industry exports decreased by 0.1171%. This result confirms the cost effect of environmental governance on export trade, indicating that environmental governance will restrain the export trade of textile industry in the short term.

4.5. Long-term Static Panel Model Estimation

Similarly, according to equation (3), the panel data from 2006 to 2022 can be studied, and the model estimation results can be obtained as shown in Table 4.

Table 4. Long-term model estimates from 2006 to 2022.

Type	Intra-group autocorrelation and inter-group coincident correlation(FGLS)	
Variable	Coefficient	Robust standard deviation
<i>L2.lnExpense</i>	0.1037***	0.0322
<i>L2.lnGDPI</i>	-0.2968***	0.0666
<i>L2.lnGDPe</i>	1.1917***	0.2081
<i>L2.lnD</i>	5.6094	5.6062
<i>L2.lnFDI</i>	-0.2237***	0.0828
<i>L2.Hcl</i>	-0.4834	0.2956
<i>L2.I</i>	0.0068**	0.0033
<i>L2.lnN</i>	-0.0464	0.0498
Cons	-55.5982	49.8292
Wald		4828.77
Chi2(12)		0.0000
P value		0.0000

Note: ***, ** and * are significant at 1%, 5% and 10%, respectively

As can be seen from Table 4, the model constructed by the feasible generalized least square method that simultaneously deals with intra-group autocorrelation and inter-group contemporaneous correlation results are as follows:

$$\ln Volume = -55.5982 + 0.1037 * L2.lnExpense - 0.2968 * L2.lnGDPI + 1.1917 * L2.lnGDPe + 5.6094 * L2.lnD - 0.2237 * L2.lnFDI - 0.4834 * L2.Hcl + 0.0068 * L2.I - 0.0464 * L2.lnN \quad (5)$$

For the operating cost of environmental governance (*lnExpense*), the estimated coefficient is positive (0.1037). This means that there is a positive correlation between the export value of Chinese textile industry and the investment in environmental pollution control. Under the condition that other conditions remain unchanged, the export value of the textile industry increases by 0.1037% for every 1% increase in the investment in environmental control. This result shows that environmental pollution control has technical effect on export trade, indicating that environmental control is beneficial to textile export trade in the long run, that is, the technical effect of environmental control exceeds the cost effect.

4.6. Comparative Analysis of Empirical Results

By comparing the results of Section 4.4 and 4.5 and analyzing them, we can see that in the short term, environmental governance has cost effect, that is, the cost generated by environmental governance will inhibit the development of textile export trade, and Table 3 shows that this cost effect has a significant impact on textile export. In the long term, as environmental governance becomes more and more standardized, it stimulates technological innovation in the textile industry, produces technical effects, and gradually exceeds the harm of cost effects, so environmental governance has a positive impact on the export trade of the textile industry. Therefore, the empirical results are consistent with the influence mechanism mentioned in Section 3: In the short term, the cost of environmental governance input has a negative effect on the export trade of China's textile industry; In the long run, the increase in textile exports caused by industry innovation caused by environmental governance has more than suppressed the cost.

4.7. Robust Test

In order to facilitate the comparison of results, this paper shortened the sample period from 2006 to 2019 for comparison, as a robustness test of the research. On the one hand, because of the

implementation of the “double carbon” strategy proposed in 2020, the production cost of the textile industry has increased, which has led to a decrease in the export of the textile industry. On the other hand, the epidemic will also have an impact on the export trade of the textile industry between 2020 and 2022, so the sample period will be shortened. The regression results of the two models after the shortened period are shown in Table 5.

Table 5. Model estimates from 2006 to 2019.

Model	Short-term model (Equation (2))		Long-term model (Equation (3))	
Variable	Coefficient	Robust standard deviation	Coefficient	Robust standard deviation
<i>lnExpense</i>	-0.1437***	0.0389	0.1111***	0.0181
<i>lnGDPi</i>	-0.4455***	0.0586	-0.6041***	0.0544
<i>lnGDPe</i>	0.3123	0.2952	1.5726***	0.2895
<i>lnD</i>	9.7362***	0.4931	11.4591***	0.4755
<i>lnFDI</i>	-0.1996*	0.1156	-0.1785	0.1709
<i>Hcl</i>	-0.6703***	0.3596	-0.9038**	0.3599
<i>I</i>	0.0035	0.0049	0.0123***	0.0046
<i>lnN</i>	0.2319***	0.0619	-0.0316	0.6105
Cons	-81.5789	5.7247	-108.93***	4.8582
Wald		7528.70		11132.92
Chi2(12)				
P value		0.0000		0.0000

The robustness test results in Table 5 were compared with those in Table 3 and Table 4. It was found that the significance and positive and negative correlation of the core explanatory variables were consistent with the model estimation results before the shortening period, so the robustness test of the model passed.

5. Conclusions and Policy Recommendations

5.1. Conclusions

Environmental protection policies such as green development and sustainable development will become an eternal theme in future production and life. How to minimize the impact of environmental costs on Chinese textile export trade while protecting the environment is of great practical significance.

From the above empirical analysis, it can be seen that the key variable environmental governance cost is an important factor affecting the export trade of Chinese textile industry. In the short term, the environmental costs generated by environmental governance need to be borne by manufacturers, which will result in the increase of textile export costs, and ultimately lead to the negative impact of environmental governance on textile industry exports. In the long term, environmental governance promotes technological innovation, and the technological innovation of the enterprise industry enhances the competitiveness of the products, improves the quality of the products, and ultimately has a positive promoting effect on the export of the textile industry. Therefore, the impact of environmental governance on exports depends on the superposition of cost effects and technical effects.

5.2. Policy Recommendations

Based on empirical analysis, this study puts forward the following two suggestions for the development of Chinese textile industry.

Firstly, rationalize environmental governance and reduce environmental costs. The main reason for the negative impact of environmental governance on textile exports is the emergence of environmental costs. In order to reduce the impact of environmental costs, we must rationalize environmental governance, make good use of every penny of environmental governance, on the basis

of summarizing the experience of environmental governance in the past ten years, rationally plan the cost of pollution control, and formulate more appropriate pollution control programs.

Secondly, increase investment in research and development to improve the technical content of textiles. China's textile industry as China's traditional craft industry, the technology is relatively backward, the innovation ability is insufficient, and there is a certain gap with the world's advanced level, so innovation and research and development are particularly important. In view of the research in this paper, under the influence of environmental governance, Chinese textile industry exports have a long-term technical effect. In order to maintain the advantage of technical effect greater than cost effect, it is necessary to speed up the technological innovation of the textile industry, carry out transformation and upgrading, make it change from labor-intensive to technology-intensive, and improve the technical content of products. Therefore, enterprises need to increase research and development investment in the textile industry to create high-quality and high-tech products.

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