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An Empirical Study of the Impact of China's Foreign Trade on the Ecological Environment

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Abstract

In order to study the impact of China's foreign trade on the ecological environment, qualitative research methods are used to make a descriptive analysis of the current situation of China's export trade and environmental pollution, and the correlation between the two is specifically studied. Secondly, the ACT model is used to quantitatively study the environmental effects of export trade, and the comprehensive effects of scale, structure and technology effects of free trade on the environment are obtained by the ordinary least square method. The research results show that, without considering the endogenous nature of environmental regulation and the spill-over of foreign direct investment, the expansion of export scale and higher degree of opening-up have negative effects on the environment, and the environmental pollution effects of foreign direct investment exceed the positive effects of technological progress. It is found that export trade is the Granger cause of environmental pollution, but pollution does not have an important impact on the development of trade. To solve the environmental pollution, the government must implement the concept of green development, start from the source, combine prevention and control, comprehensively use economic and legal means to internalize pollution into the cost of polluting enterprises, and force polluting enterprises to improve energy utilization rate and consciously reduce pollution.

Keywords: foreign trade, ACT model, ecological environment, environmental effects

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INTRODUCTION

With the flourishing development of free trade in the world, various environmental pollution and ecological destruction problems emerge one after another. Under the background of trade globalization, China's import and export trade has developed rapidly. While improving people's living standards and vigorously promoting national economic development, it has brought tremendous pressure on China's ecological environment and natural resources, resulting in excessive consumption of natural resources and pollution of the ecological environment. Since the reform and opening up, in the promotion of foreign trade, Chinese economy has gradually transformed from closed economy to open economy (Seker et al. 2015). China's accession to the World Trade Organization on December 11, 2001 marked the development of China's economic openness and trade liberalization to a new height. Chinese import and export trade has developed rapidly in the thirty years of reform and opening up and realized the transition from the China trade country to a powerful trade country.

The vigorous development of China's import and export trade not only accelerates the growth of national economy, but also increases the pressure of China's ecological environment (Ghisellini et al. 2016). China's "high input, high consumption and high pollution" mode of economic growth has made environmental pollution and ecological damage increasingly serious in the following aspects: serious air pollution, serious water pollution, serious desertification of soil, reduction of biodiversity, transboundary transfer of hazardous wastes, etc. China is the largest developing country in the world. Like many developing countries, China is in a stage of serious environmental pollution, weak environmental awareness and fragile environmental governance. With the development of international trade, China's environment is deteriorating gradually. Although China's economic development cannot be separated from the contribution of trade, if China's environmental resources damage and loss are included in the economic interests, the results of trade on China will not be as optimistic as expected. With the further development of global economic integration and

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opening up, China's increasingly serious environmental protection problem has become an urgent issue to be solved.

STATE OF THE ART

Foreign scholars have studied trade and environment for a long time. Since environmental science was proposed as a new subject in the 20th century, trade has been regarded as an important factor affecting the environment. Although foreign scholars have done a lot of research on trade and environment for a long time, and produced many important theoretical models, there are totally opposite theoretical views and opinions on the relationship between trade and environment. Hasanbeigi and Price (2015) studied the manufacturing industry in the United States, and found that the pollution emissions of the manufacturing industry in the United States have decreased dramatically in recent years. The empirical study found that imported pollution-intensive products cannot explain the reduction of pollution significantly, and concluded that the reduction of pollution is not due to the change of industrial structure to a cleaner direction, but because of technological progress in the country. Dellachiesa and Myint (2016) made an empirical analysis of water pollution, air pollution and foreign trade in China in recent years. The study found that the pollution level of industrial output has decreased in recent years, and the pollution brought by exports has decreased significantly. Therefore, it is considered that trade liberalization and decreasing tariffs are generally beneficial to the environment. Low (2016), according to the North and South trade models, found the evidence of pollution haven hypothesis, and the results of their study considered that the exports of developing countries is bad for the environment and exports of developed countries benefits the environment.

Since the domestic research on trade and environment started relatively late, most of the studies are carried out based on the mature theoretical models abroad. According to the research done by Shahbaz et al. (2015), the impact of trade on the environment is not as great as that of per capita income, and the impact direction of trade on the environment is different in different regions. But although the impact of trade on the environment is small, the impact of trade on the environment throughout the country is still favourable. Du et al. (2018) selected sulfur dioxide emissions as pollutant indicators, and added foreign direct investment. By examining the relationship between pollutant emissions and foreign trade, it was concluded that foreign trade aggravated China's environmental pollution. Yin et al. (2015) also used the model to select a longer period of time for research, and adopted four kinds of pollutants as environmental pollution indicators. The conclusion is that although China's foreign trade has caused some adverse effects on the environment, it may improve in the long run, and trade plays a great role in China's economic development, and may also be conducive to improving China's environmental quality in the long run.

METHODOLOGY

Scale Effect

Scale effect means that it is assumed that production technology and structure will not change significantly for a long time. With the specialization and scale development of free trade, the consumption of natural resources such as timber and coal will continue to increase, and the pollution will also increase on a large scale. Free trade promotes the expansion of economic activities and the improvement of market level, thus increasing revenue, so that more funds can be used for environmental protection, which has a positive scale effect. Free trade promotes the free flow of goods and services in the market, and enables production activities to obtain low-cost and high-yielding resources. Countries with different resources and advantages can use their comparative advantages to promote their own development. Free trade provides countries with financial funds to control environmental pollution through economic growth, and raises national environmental awareness by increasing per capita income. However, while expanding the market, trade may also lead to further deterioration of natural resources and accelerated consumption, resulting in negative scale effect because of the inability to internalize environmental costs, to define and distribute property rights. China's export trade brings about the consumption of various resources and energy in production activities, but the cause of environmental protection started relatively late, so the total amount of pollution may accumulate and increase with the expansion of foreign trade.

Structure Effect

Structure effect refers to the impact of industrial structure on the environment caused by free trade and specialized division of labour under the premise of assuming that production technology and scale do not change dramatically in a certain period of time. Structure effect plays an indirect role through production forms and resource use. It is difficult to

determine the positive and negative effects relative to other factors. The impact of trade on the environment is realized through the adjustment of world market prices on production and consumption. If the endowments of environmental factors are allocated optimally in economic activities, environmental assets are correctly evaluated and measured in the international market, and the value of environmental assets is reflected in the international price and is not distorted by the government policy, then the structure effect is positive effect. If market and government intervention fail, environmental assets are not properly valued, and trade produces and consumes in areas not suitable for such activities or intensity of activities, it will have negative structure effects. For instance, when a country's environmental carrying capacity does not adapt to certain production activities, or some natural capitals of a country are not properly applied, in short, if a country has a comparative advantage in pollution-intensive products and concentrates on the production of such products for export, then its export trade may bring about environmental pollution. If a country's comparative advantage is concentrated on products that have no impact on the environment or are beneficial to the environment, then its foreign trade will be conducive to environmental protection. Therefore, the positive and negative structure effects of free trade are related to the comparative advantage and commodity structure of the country.

Technology Effect

Technology effect refers to the effect on environmental quality caused by technological changes brought about by foreign trade and investment, assuming that production scale and production structure change little in a certain period of time. Free trade can realize the free flow of production technology and other factors among regions. The impact of technology transfer on the environment may depend on the level of technology output from the investor to the host country. Generally, free trade will encourage foreign capital to introduce cleaner production technology, which can reduce both resource use and pollution emissions per unit of output value. At this time, the technological effect is positive; but in fact, foreign capital may transfer the relatively backward production technology eliminated by the country to the host country with less environmental regulation, so the technology effect is negative. On the one hand, technology diffusion is driven by foreign investors' technology investment in the host country. If these technologies can improve the production efficiency and resource utilization efficiency of polluting enterprises, they may reduce environmental pollution. However, the limited technology absorptive capacity of enterprises brought by foreign investment may not reflect the production and pollution discharge in time. On the other hand, if the amount of pollution reduced by technological improvement is relatively high and the increase of pollution caused by foreign investment in pollution-intensive enterprises leads to more expansion of production, then the technology brought by foreign investment is not entirely environmentally friendly.

RESULTS AND DISCUSSION

Model Selection

Antweiler, Copeland and Taylor, based on the traditional Heckschel-Orlean factor endowment theory, introduced environmental factors to create a general equilibrium model of pollution supply and demand for pollution discharge, referred to as ACT model. After simplification, the basic equation between environmental pollution and economic factors is shown as follows:

$$\hat{Z} = \pi_1\hat{S} + \pi_2\hat{k} - \pi_3\hat{I} + \pi_4\hat{\alpha} + \pi_5\hat{p}^w - \pi_6\hat{T} \quad (1)$$

In Formula (1), $\hat{Z}$ represents the rate of change in pollution emissions, π refers to the percentage of economic variables that affect the environment, $\hat{S}$ indicates the rate of change in the economic scale, $\hat{k}$ denotes the rate of change in capital labour ratio, $\hat{I}$ suggest the rate of change in per capita income, $\hat{\alpha}$ represents the degree of openness of a country, $\hat{p}^w$ means the changes in world prices, and $\hat{T}$ represents the change in the environment policy of a country. Because the world price of contaminated products cannot be estimated, it is generally assumed that its price will remain unchanged within one year, that is, $\hat{p}^w=0$.

Both economic scale and per capita income can express the scale effect, and they are highly correlated. There will have serious multi-collinearity in the model, so GDP per capita is used instead of both to express the scale effect. Foreign direct investment promotes technology progress in export trade industry through international technology transfer and economic development. Therefore, it affects the role of export trade on the environment, so the degree of dependence on foreign capital is used to represent the technology effect. The degree of opening-up first shows whether a country or region has relatively stable foreign trade imports and exports, so the dependence on exports is chosen to express it. In order to eliminate the heteroscedasticity of time series, the logarithmic

processing of each variable is carried out, and the improved form of ACT model is obtained.

$$lnZ = \pi_0 + \pi_1 lnrgdp + \pi_2 lnk + \pi_3 lnf + \pi_4 lnED \quad (2)$$

In the above formula, π_i (i=0, 1, … , 4) is a constant term and coefficient, representing the environmental effects of each factor. Z represents a certain amount of pollution emissions, $rgdp$ represents per capita GDP, K represents capital labour ratio, f represents the degree of dependence on foreign capital, and ED represents the degree of dependence on exports.

Variable and Data Selection

The empirical data are collected from China Statistical Yearbook and China Environmental Statistical Yearbook from 1990 to 2014 of the National Statistical Bureau of China. 1990-2000 is the second decade after China's reform and opening up. At this stage, China's economic achievements are remarkable, but environmental pollution problems are beginning to emerge. China's accession to the World Trade Organization in 2001 is not only an opportunity and challenge for China's economic development, but also a new stage for China to undertake international environmental obligations. On the one hand, after China's entry into the World Trade Organization, the export market has developed vigorously, and the scale and structure of export trade have undergone profound changes. On the other hand, due to the rapid economic growth and the increasing pressure of industrial environmental protection, China, as a permanent member of the United Nations, should shoulder the international responsibility of environmental protection. Therefore, the economic data of 25 years before and after China's accession to the World Trade Organization are selected to study the impact of China's export trade liberalization on the environment, which is of great significance to achieving China's modernization and improving international prestige.

Sulfur dioxide emission is chosen as a dependent variable to measure environmental pollution, because the size of sulfur dioxide emission is closely related to the process of economic development, and has a certain correlation with the scale and structure of export trade. At the same time, sulfur dioxide is the main component of waste gas, which not only has a wide range of impact and great harm, but also is difficult to control. China's National Bureau of statistics has complete data, which is easy to find and analyze. Export scale and per capita income represent the environmental scale effect of free trade. To avoid multiple collinearities, GDP per capita is used instead of export scale. The ratio of capital to labour is equal to the ratio of investment in fixed assets to employment in the whole society, indicating the environmental structural effect of free trade. The degree of dependence on foreign capital is equal to the proportion of actual utilization of foreign capital in GDP, indicating the environmental and technological effects of free trade. The degree of dependence on exports is equal to the ratio of exports to GDP.

Table 1. Used variables and representation symbols

Variable name	Unit	Symbol
Industrial sulfur dioxide	Ten thousand tons	SO_2
Per capita GDP	Yuan	rgdp
Capital labour ratio	Yuan / person	k
Dependence on foreign capital % f	%	F
Export dependence	%	ED

Table 2. General least squares regression results

Variable	Coefficient	Std.Error	t-Statistic	Prob.
LNRGDP	1.494	0.362	4.127	0.0005
LNK	-0.639	0.170	-3.749	0.0013
LNF	0.055	0.038	2.453	0.0018
LNED	0.474	0.096	4.940	0.0001
c	-1.010	1.463	-0.691	0.4976

Empirical Results and Analysis

In order to eliminate the influence of price and exchange rate changes and make the empirical results more accurate, the per capita GDP is adjusted to real per capita GDP based on the GDP index (the base period of the previous year, the last year=100) in 1990; and the real foreign direct investment is converted into RMB from US dollar in accordance with the average exchange rate of RMB against US dollars in that year (US dollar=100 yuan). The names, units and symbols of all variables are shown in **Table 1**.

With the help of Eviews 6.0 software, general least squares regression is carried out by using the data of sulfur dioxide and export trade of China from 1990 to 2014, R^2 obtained and adjusted R^2 are 0.9188 and 0.9025, respectively and the fitting coefficient is very high. According to **Table 2**, it can be seen that the t value of the coefficients of each variable rejects the original hypothesis at the 5% significance level. The significance test shows that lnrgdp, lnk, lnf and lnED have significant effects on $lnSO_2$. In addition, the combined test statistic F=56.56 shows that the linear combination of variables has a significant impact on sulfur dioxide emissions. The results are as follows:

$$lnSO_2 = -1.01 + 1.494lnrgdp - 0.639lnk + 0.055lnf + 0.474lnED \quad (3)$$

R^2=0.9188

Adj.R-squared=0.9025

DW=1.585051

There is a negative correlation between sulfur dioxide emissions and capital labour ratio, that is, the structure effect is positive. The results show that when the ratio of capital to labour rises by one percentage point, sulfur dioxide emissions will decrease by 0.64 percentage points. Capital labour ratio reflects the factor endowment of a country or region. Generally speaking, capital-intensive industries will produce more pollution. However, the coefficient of the model is negative. Due to the rapid development of China's export trade, the substantial increase of domestic capital stock leads to the rapid increase of per capita capital, and the capital investment in products also substantially increases, which makes the technology content of products continuously improved and the utilization rate of resources increased, thus reducing sulfur dioxide emissions.

There is a positive correlation between industrial sulfur dioxide emissions and foreign direct investment, that is, the technology effect is negative. The estimated results show that for every percentage point increase in foreign direct investment, sulfur dioxide emissions will increase by 0.055 percentage points, indicating that the development of foreign direct investment has exacerbated the deterioration of environmental quality in China to a certain extent. This may be due to the fact that foreign direct investment industries are mainly concentrated in pollution-intensive enterprises such as iron and steel, textiles and other industries, which not only occupy a large number of natural resources and labour resources in China, but also bring about serious environmental problems. However, the technology quantity brought by foreign direct investment are too small and technology level is too low, which has limited effect on improving the utilization rate of resources and reducing the intensity of environmental pollution. As a result, it is difficult to offset the environmental pollution caused by the expansion of production. This can also verify the hypothesis that China has become a "polluted paradise" to a certain extent.

The degree of dependence on exports represents the degree of opening up, which is directly proportional to the sulphur dioxide emissions from industry. The regression results show that the sulfur dioxide emissions will increase by 0.474 percentage points for every percentage point of increase in export dependence. It indicates that the more open the export market is, the higher the contribution rate of exports to GDP is, and the lower the environmental quality of China is. It may be that although China's export trade has led to the development of national economy, its growth mode is extensive, processing and production technology is low, and export commodities consume a lot of resources and energy, resulting in more industrial pollutants. Since China's per capita income is still at a low level, according to the theory of environmental Kuznets curve, with the increasing dependence on exports, China's sulfur dioxide emissions will further increase.

CONCLUSION

China's sulfur dioxide emissions are positively correlated with per capita GDP, that is, the scale effect is negative, indicating that the trend of increase and decrease of sulfur dioxide emissions and per capita GDP is the same. Because per capita GDP represents the scale of domestic economy and export trade to a certain extent, it can also be said that the continuous expansion of export scale will lead to the aggravation of environmental pollution. The regression results show that for every percentage point increase in per capita GDP, industrial sulfur dioxide emissions increase by 1.49 percentage points. The relationship between domestic environmental quality level and per capita income is in the left rising stage of the environmental Kuznets curve. The elastic coefficients of free trade on the environment are different. The elasticity coefficient of GDP per capita is the largest, which indicates that the scale effect is more obvious, and the significant expansion of export scale can cause environmental deterioration to a greater extent. The elasticity coefficient of capital labour ratio and export dependence is relatively small, and the coefficient of capital labour ratio is positive. It may be that on the one hand, China's economic structure adjustment promotes the development of labour-intensive industries and capital-intensive industries to environmental protection; on the other hand, capital-intensive products have more capital than labour-intensive products. In addition, more investment in cleaner production and technology improvement is provided. The elasticity coefficient of dependence on foreign direct investment is the smallest, which indicates that foreign direct investment has caused a certain degree of damage to the environment, but not obvious. The reason may be that the negative effect of foreign direct investment on the environment exceeds the positive effect of technology transfer.

REFERENCES

Dellachiesa AE, Myint AP (2016) Trade openness and the changing water polluting intensity patterns of 'dirty' and 'clean' industrial sectors. Ecological Economics, 129: 143-151.

Du G, Liu S, Lei N, et al. (2018) A test of environmental Kuznets curve for haze pollution in China: Evidence from the penal data of 27 capital cities. Journal of Cleaner Production, 205: 821-827.

Ghisellini P, Cialani C, Ulgiati S (2016) A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. Journal of Cleaner production, 114: 11-32.

Hasanbeigi A, Price L (2015) A technical review of emerging technologies for energy and water efficiency and pollution reduction in the textile industry. Journal of Cleaner Production, 95: 30-44.

Low P (2016) International trade and the environment. UNISIA, (30): 95-99.

Seker F, Ertugrul HM, Cetin M (2015) The impact of foreign direct investment on environmental quality: a bounds testing and causality analysis for Turkey. Renewable and Sustainable Energy Reviews, 52: 347-356.

Shahbaz M, Loganathan N, Sbia R, et al. (2015) The effect of urbanization, affluence and trade openness on energy consumption: A time series analysis in Malaysia. Renewable and Sustainable Energy Reviews, 47: 683-693.

Yin J, Zheng M, Chen J (2015) The effects of environmental regulation and technical progress on CO2 Kuznets curve: An evidence from China. Energy Policy, 77: 97-108.