Effects of Environmental Regulations on Exports in Transportation and Communication Facilities and Policy Implications in China

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Abstract: In the current low-carbon economy, consciousness regarding environmental protection is rising worldwide, leading to increasingly stringent environmental regulations. China, the world's largest exporter, is undoubtedly affected, especially in transportation and communication facilities, which constitute one of China's leading export products. We analyzed data from 1994–2014 to examine the effects of environmental regulations on the exportation of transportation and communication facilities. The empirical results show that stringent environmental regulations on the export of transportation and communication facilities in China have a stimulating effect; additionally, there is a long-term stable relationship between them. Therefore, it is necessary to establish and develop environmental regulations within the related administrative system in China.

Introduction

Trade and environmental protection has traditionally been two separate fields; however, with the development of economic globalization, the impact of trade on the environment has continued to expand. Consequently, environmental policies have increasingly influenced trade. Since the financial crisis of 2008, to safeguard the sustainable development, countries have increased their trade protection, and environmental regulations have been more frequently implemented. Increasingly, environmental standards have caused countries to considerably modify their trade patterns. As the world's largest exporter, China has increased the intensity of its environmental regulations to adapt to such environmental standards; whether the purpose of this increase is to promote or control exports has gradually become the focus of attention. Because of the development of the low-carbon global economy, the transportation and communication facilities industry, which entails high energy consumption and relatively high pollution, was the focus of this study. Transportation and communication facilities are highly critical to a country's industrialization process and considerably reflect the standard of a country's manufacturing industry. With the increase in interregional trade, China should increase the pace of industrialization; therefore, expanding transportation and communication facilities industry is particularly necessary to improve the country’s critical core competitiveness. Although the financial crisis of 2008 caused a considerable impact on China, the government has actively adjusted its economic structure, and has exhibited gradual economic recovery and steady development. The overall trend in the development of transportation and communication facilities industry is positive because of an increase in exports. Exports increased by US$90.828 billion in 2013, compared with that in 2000. Machinery and

transportation equipment comprises a large proportion of the country's total exports, and has been rising; exports of these products increased from 33.15% in 2000 to 47.07% in 2013.The transportation and communication facilities industry is facing opportunities and challenges because of global recession, economic restructuring and transformation, and the influence of enhancement in world environmental standards. Because reducing carbon emissions in the transportation industry is becoming a global topic of interest, realizing sustainable transport is the only plausible approach for the continuing development of nations.

This study used data from 1994–2014 regarding exports of the transportation and communication facilities industry, information concerning investment in environmental pollution control, and regression analysis to explore the effects of environmental regulations on the exportation of transportation and communication facilities. The structure of the paper is as follows: Section 2 focuses on the discussion of the stylized facts of environmental regulations in China, Section 3 describes the empirical test and its conclusions, and, finally, Section 4 discusses the policy implications from different perspectives.

Stylized Facts of Environmental Regulation in China

Instruments of Environmental Regulation in China

Over time, China has successively enacted many laws and regulations to form a sound environmental regulation system, which has improved environmental protection through the accumulation of practical experience and the gradual development of environmental management and regulation. China has established a series of environmental laws and regulations centered on Environmental Protection Law. Currently, environmental regulation in China is based on the implementation of central legislation and local infiltration. However, numerous problems exist concerning local implementation. For example, local governments pay attention to the development of the economy and neglect environmental protection; this phenomenon remains an objective reality in varying degrees.

The main mechanism for implementing environmental regulation in China comprises three types. The first type is “command–control," which is the first type to be implemented and is still the most crucial of the implementation types. Command–control involves laws and regulations on environmental protection enacted by the government that are enforced by mandatory requirements of administrative orders, which enterprises must comply with. Such enterprises will be punished if they break these laws and regulations. For example, The People's Republic of China Environmental Protection Law (Trial) of1979,which introduced “Three Simultaneities” to the legal system, requires that prevention, pollution control, and project implementation be performed simultaneously to protect the environment. The second type is “market-oriented regulatory,” which includes environmental taxes and emissions trading. Market-oriented regulation involves the discharge conduct of enterprises, and directs enterprises to act independently according to market trends. The third type is “voluntary environmental regulation,” such as the ISO1400 series standard. Under the circumstances of ensuring quality, such environmental labels can enhance the competitiveness of products and promote exports.

Implementation of Environmental Regulation in China

This overview analyzes the implementation of environmental regulation in China from direct and indirect perspectives.

Direct Indicators

Among previous direct indicators, two main indicators were observed: the proportion of investment in environmental pollution in GDP, and the implementation effect of the three simultaneities.

According to data from the National Environmental Statistics Bulletin (2003–2013), investment in environmental pollution controlling is rising: Investments of US$162.73 billion in 2003 increased to US$903.72 billion in 2013. The growth rate reached an annual average of 143.77%. In the corresponding period, the proportion of investment in environmental pollution in GDP increased from 1.39% to 1.59% in China. However, the growth rate is limited, and has not reached 2%. Compared with developed countries, a considerable gap remained. Wang Yi, a foreign minister, mentioned that "the proportion of investment in environmental protection in GDP cannot be too low and great efforts should be made to achieve the goal of 3%. Therefore, there is a great space for improving environmental regulation in China."

This directly reflects the intensity of environmental regulation in China to a certain extent because the implementation rate of the three simultaneities is based on command–control. We did not investigate the environmental protection investment of the three simultaneities project in this study because the annual inflation rate varies, and a single investment amount cannot reflect the degree of implementation degree in the system. We developed diagram on the implementation rate of the three simultaneities system. In general, the implementation rate of the three simultaneities is higher, although the curve is inconsistent.

Indirect Indicators

Indirect indicators can be divided into two aspects. First, industrial waste water, waste gas, dust emissions, and the number of environmental institutions reflect the intensity of environmental regulation from a lateral perspective. A decrease in emissions indicates strengthening of environmental regulation. According to the National Environmental Statistics Bulletin, industrial sulfur dioxide emissions in China are rising, whereas industrial smoke dust (powder) and industrial waste water emissions are decreasing.

Second, the number of environmental institutions in China can indirectly reflect the intensity of environmental regulation. From 2003 to 2013, the number of environmental institutions in China increased by an average of 26.03, from 116.54 to 142.57, indicating that the intensity of China's environmental regulation is growing stronger laterally.

Empirical Test

Data Collection and Methodology

Several dimensions are relevant to environmental quality, and each dimension may respond to economic growth differently. Hence, studies on the environment and economic growth should be as extensive as possible. However, the extent of research is restricted because of a lack of data, and only a few indices can be measured in numerous countries at different stages of development. China has not publicized any accurate data on environmental management, especially data on specific industries; therefore, studies on the impact of environmental regulations in specific industries are difficult to obtain. According to data availability, we incorporated data from Statistical Yearbook of China, National Environmental Statistical Communiqué, and the Environmental Statistical Yearbook of China from 1994 to 2013 for empirical examination. Regarding environmental regulations, investments in pollution regulation can directly reflect governmental input on environmental regulations; therefore, we used investments in regulation projects on industrial pollution as the measure of intensity for Chinese environmental regulations for examining the impacts that environmental regulations have on exports in the transportation and communication facilities industry.

This study investigated the impacts of environmental regulation on exports in the transportation and communication facilities industry; thus, we performed a univariate regression. To eliminate the

influences of the volatility of time series, heteroscedasticity, and conflicting units, we first developed a logarithm for both exports in the transportation and communication facilities industry and investments in regulation projects on industrial pollution; we then performed stationarity and regression analyses; finally, to control for residual errors, we employed an Engle–Granger co-integration test. Export statistics of the transportation and communication facilities industry were collected from the Statistical Yearbook of China, and data on the investments in regulation projects on industrial pollution were collected from the National Environmental Statistical Communiqué and the Environmental Statistical Yearbook of China.

Descriptive Statistics

Table 4.2 provides descriptive statistics for identifying the main characteristics of industry export and environmental regulation. The mean value of exports in the transportation and communication facilities industry was US$41.6778 billion, the maximum was US$120.91 billion, and the minimum was US$2.823 billion. The exports in the transportation and communication facilities industry from 1994 to 2014 increased rapidly. The mean value of the investments in regulation projects on industrial pollution wasCNY35.48 billion, the maximum was CNY99.77 billion and the minimum wasCNY7.9 billion, which was also a substantial increase. According to the mean value, investments in regulation projects on industrial pollution were relatively limited, and a definite gap was observed between China and developed countries, indicating that room for improvement remains regarding the intensification of China's environmental regulations. The skewness of frequency distribution was0.98, indicating that the investments in regulation projects on industrial pollution had positive skewness, and that the data to the right of the mean value were less than those to the left. This also indicated that the implementation of environmental regulations is limited and requires improvement (Table 3.1). In general, exports in the transportation and communication facilities industry and the investments in regulation projects on industrial pollution experienced substantial growth, reflecting a collaborative rise between industry exports and the intensity of environmental regulations.

Table 3.1 Descriptive Statistics of the Exports of the Transportation and Communication Facilities Industry and the Investments in Regulation Projects on Industrial Pollution

	Mean Value	Maximum	Minimum	Measure of skewness
Exports of transportation and communication facilities industry	416.778	1 209.1	28.23	0.715791
Investments of regulation project of industrial pollution	354.8	997.7	79	0.977243

Unit Root Test

The explained variable is exports of the transportation and communication facilities industry (E), and the explanatory variable is investments in regulation projects on industrial pollution (I). To eliminate the influences of data fluctuation, heteroscedasticity, and conflicting units, the logarithm of these two variables was first developed. ADF was then employed to analyze the stationary characteristics of the logarithm of exports of the transportation and communication facilities industry (InE) and the logarithm of investments in regulation projects on industrial pollution (InI). The original sequences at a significance horizon line of 1% were all stationary series. Therefore, the original sequence was astationarity sequence (Table 3.2). Both logarithms of the exports of transportation equipment manufacturing (lnE) and industrial pollution control project investments (lnI) were first-order stationary series.

Table 3.2 Unit Root Test

	ADF Test	Critical Value (5%)	P Value	Results
lnE	-4.768672	-3.831511	0.0014	stationary
lnI	-2.897502	-2.692358	0.0062	stationary

Regression Analysis

We constructed a unitary regression model estimated through the use of an ordinary least square, and assumed that environmental regulation has an impact on the transportation and communication facilities industry. The model is as follows:

$$lnE=\beta 0+\beta 1 lnI+\mu \quad (1)$$

We conducted regression analysis on the logarithms of the exports and the investments in regulation projects on industrial pollution; the results are listed in Table 3.3. The results of the regression model can be expressed through formula (2):

$$lnE= -3.567144+1.592602 lnI \quad (2)$$

We conducted at test on the regression results, setting the significance level at $a=0.01, t_{0.005}(18)=2.878$;the results of the regression model exceeded the critical value of t, which passed the significance test.

Table 3.3 Regression Analysis

Variable	Correlation index	T-value	P	F-value	Goodness of fit (R^2)
lnI	1.592602	13.41918	0.0000	180.0744	0.904558
C	-3.567144	-5.306360	0.0000		

According to the regression results, the model had a high goodness of fit. The R-square is 0.904558, indicating that in the linear regression model, the dispersion of investments in regulation projects on industrial pollution occupied90.46% of the total dispersion of the exports in the transportation and communication facilities industry. The model had a high goodness of fit. The regression coefficient of lnI was positive, illustrating that the investments in regulation projects on industrial pollution increased by 1%, and that the exports in the transportation and communication facilities industry increased by 1.59%. Furthermore, the increase in environmental regulation intensity stimulated export in the transportation and communication facilities industry.

Co-integration Test

These results could not confirm long-term relationship between two variables, thus, conducting the co-integration test was necessary. An Engle–Granger test was employed as the co-integration test. First, we assumed that a co-integration relationship between variables existed. We then performed an ordinary least squares estimate, and the residual error of the equation was analyzed through ADF. If the residual error was stationary, these variables indicated a co-integration relationship.

A co-integration test can be performed only when the integrated variables are in the same order. The preceding part of the paper shows that both InE and InI were integrated in a first-order series; therefore, their regression residuals were a single-integer sequence. The results indicated that the residual sequence was stationary at a significance level of 1%.Therefore; a co-integration relationship existed between InE and InI. Furthermore, the investments in regulation projects on industrial pollution and the exports in the transportation and communication facilities industry influence each other over a long-term period. The results are listed in Table 3.4. Intensifying

environmental regulations can influence exports in the transportation and communication facilities industry over a long-term period. We conclude that the impact of environmental regulations is positive according to the regression results. Hence, over a long-term period, it is necessary to intensify environmental regulations.

Table 3.4 Co-integration Test

ADF Test	T Statistical Magnitude	Critical Value（5%）	Result
Regression Residual	-6.011035	-3.857386	Stationary

Discussion

According to our analysis, environmental regulations do not affect exports in China. Stringent environmental regulation does not affect exports in the transportation and communication facilities industry. On the contrary, exports increase to a certain extent. The two influence each other over a long-term period; therefore, the Porter hypothesis is reflected in the impact that environmental regulations have on the transportation and communication facilities industry in China.

Conclusion and Policy Implications

China is among a few developing countries that have a globally competitive transportation and communication equipment industry. This study demonstrated the effects of environmental regulations and laws on the transportation and communication equipment industry. We found that strict environmental regulations enhance export trade in the transportation and communication facilities industry. However, only by establishing a set of standardized environmental regulations and possessing a set of complete executive systems can environmental regulations play a greater promoting role in export for the Chinese transportation and communication facilities industry.

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