Is environmental regulation a trade barrier? The evidence from developing countries

Shanshan Wu, Baoguo Shan
State Grid Energy Research Institute, Beijing, China
wushanshan@sgeri.sgcc.com.cn; shanbaoguo@sgeri.sgcc.com.cn;

Abstract - Since 1960s, the importance of environmental protection has come into world's vision. The application of environmental regulation in international trade has got more and more along of the deepening of globalization. The prevailing view suggests that when some country carry out more stringent environmental regulation, the export from other country getting harder. Is this true even the two countries in trade are developing countries? In this paper, we will use the panel data of China's exports to ASEAN to study the export trade effect of environmental regulation. Environmental regulation has become to be the most common kind of trade policy. Therefore, there must be some realistic significance by focusing on the effect of ASEAN's environmental regulation on China's export. The conclusion includes: 1. Not every environmental regulation could affect trade; 2. Export to some country who implements more stringent environmental regulation may increase, not decline at least. That means, not all environmental regulation will become trade barriers. 3. Explain the mechanism of how this happened.

Keywords: environmental regulation; export; developing countries.

1. Introduction

Since 1960s, when Rachel Carsen discuss the damage coursed by using DDT in *Silent Spring*, the importance of environmental protection has come into world's vision. The link between trade and environmental protection — both the impact of environmental policies on trade, and the impact of trade on the environment — was recognized as early as 1970.The application of environmental regulation in international trade has got more and more along of the deepening of globalization.

The prevailing view suggests that when some country carry out more stringent environmental regulation, the export from other country getting harder. Ederington and Minier (2003) indicated that the environmental regulation is essentially a trade barrier, which was proved by using U.S. 4-digit SITC manufacturing industries over the period 1978-92. In addition, they suggested the effect on trade flows is significantly higher when the environmental regulation is modelled as an endogenous variable. Jug and Mirza (2004)tested the effect on trade using a new Western and Eastern European dataset, which consider the degree of differentiation of goods produced by industries and/or countries. The results showed the there was a robust impact of a 'pure cost' effect of stringency lying generally from -0.3 to -3.5. Cole, Elliott and Okubo (2010) estimated the environmental regulations by using 41 Japanese manufacturing sectors over the period 1989-2003. They found that environmental regulation was the statistically significant determinants of Japanese net imports from the rest of the world. The magnitude of the impact of regulations on trade flows is greater when the trade is between Japan and developing world. As we see, the data samples used in above are all from developed word. Is this true even the two countries in trade are developing countries?

In this paper, we will use the panel data of China's exports to ASEAN to study the export trade effect of environmental regulation, mainly based on the following two considerations: on the one hand, the studies on the export effect of the developing countries' environmental regulation were rare due to the limitation of theory and data. There could do some help to the study of trade and environmental regulation by using Chinese and ASEAN's trade data, which are the largest emerging economies. On the other hand, the trade policy of ASEAN is very important to China due to the Geographic advantage (there are seven countries of ASEAN are the neighbour of China). Environmental regulation has become to be the most common kind of trade policy. Therefore, there must be some realistic significance by focusing on the effect of ASEAN's environmental regulation on China's export.

2. Key variables specification

2. 1 measurement of environmental regulation

As a policy, the measurement of environmental regulation is complicated. Generally, there are two major basic methods to measure the environmental regulation, qualitative and quantitative. To be more reliable, we tend to use quantitative method. Most of the researchers in this area used the share of abatement costs in total production costs to be the measurement of environmental regulation (Grossman and Krueger, 1991; Alanen, 1996; Ederington and Minier, 2003; Josh and Jenny, 2003; Jug and Mirza, 2004; Levinson and Taylor, 2008). But considering the differences of production structures and technology level among countries, the abatement costs would lose lots of important information about environmental regulation. There were also many researches were working on ESI (the Environmental Sustainability Index[1]), which was developed by CIESIN as the official data of Environmental governance and Participation in international cooperative efforts (Busse, 2004; Lu, 2009). The

[1] Data source: Center for International Earth Science Information Network (CIESIN).

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limitation of this method is the data is not continuous (only the year of 2001, 2004 and 2005), and this data only updated to 2005, which means this method would be lack of time effect.

According to the data limitation of developing countries, we choose two variables, the carbon dioxide emissions per capita and the energy consumption per capita, to measure the environmental regulation. The energy consumption per capita could tell the real demand of one country, and the carbon dioxide emissions per capita could reveal the real level of pollution emission. For the same country, when the energy consumption is large but the pollution emission is relatively small, we can say that they have very strong capacity of dealing with the pollutions, which means the environmental regulation is more stringent in this country, and vice versa for the reverse case.

2.2 define of energy-intensive product

By comparing previous literatures (Tobey, 1990; Mani & Wheeler, 1997; Luo, 2011; Fu et al., 2011), we define energy-intensive product is the product of the industry which needs more energy in product process than other industries. Then we rank the industries according to their energy consumption, and choose the top 10 as the energy-intensive product studied in this paper (for the reason of space, the specific process is not presented). The result is listed in TABLE I, concluding 10 industries totally.

TABLE I The Energy-intensive Product

The industries	SITC(Rev.3)
Non-metallic mining industry	273~274; 277~278
Ferrous metal mining industry	281~282
Non-ferrous metal mining industry	283~289
Coal mining and washing industry	321~322; 325
Oil extraction and processing industries	333~335
Chemical materials and chemical products manufacturing	591~593; 597~598
paper products industry	641~642
Non-metallic mineral products industry	661~667
Ferrous metal smelting and extended processing industry	671~679
Non-ferrous metal smelting and extended processing industry	681~687; 689

3. Model and data

We use extended gravity model, which concluded the variable of environmental regulation. Because of the consistency of the ten countries of ASEAN, we excluded three variables -- the distance, land area and landlocked countries. The log-linear version of extended gravity equation is given by

$$\begin{aligned} LnExport_{i,t} = {} & \alpha_{i,t} + \beta_1 LnGDP\_chn_t + \beta_2 LnGNI\_chn_t \\ & + \beta_3 LnEnergy\_chn_t + \beta_4 LnCO_2\_chn_t + \beta_5 LnGDP_{i,t} \\ & + \beta_{6i} LnGNI_{i,t} + \beta_{7i} LnEnergy_{i,t} + \beta_{8i} LnCO_{2\ i,t} \\ & + \beta_{9i} LnEnergy_{i,t-1} + \beta_{10i} CO_{2\ i,t-1} + u_{i,t} \end{aligned}$$

where $Export_{i,t}$ is exports from country i to country j; GDP_chn_t and GNI_chn_t are the GDP and income per capita of China, respectively; $Energy\_chn_t$ and $CO_2\_chn_t$ are energy consumption per capita and carbon dioxide emissions per capita of China, respectively; $GDP_{i,t}$ 、$GNI_{i,t}$ are the GDP and income per capita of country i, respectively; $Energy_{i,t-1}$ and $CO_{2\ i,t-1}$ are energy consumption per capita and carbon dioxide emissions per capita of country i at time t-1, respectively; $i = 1,2,\ldots,10$ represent 10 countries, that are Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam, respectively; $t = 1990,1992,\ldots,2007$ is the year from 1990 to 2007.

The individual fixed effects regression model of panel data is given by

$$y_{it} = \alpha + X_{it}\beta + \xi_i + u_{it}$$

where ξ_i is factor which is unobservable and not vary with time. To determine whether exist the individual fixed effect, we use redundant fixed effects tests. The principle as follows:

$$H_0\text{: } \xi_1 = \xi_2 = \ldots = \xi_{N-1} = 0$$

$$F = \frac{(SSE_{res} - SSE_{ures})/(N-1)}{SSE_{ures}/((N-1)(T-1)-K)} \sim F(N-1, NT-N-K)$$

The result of testing the export from China to ASEAN is:

TABLE Ⅱ The Test Result

redundant fixed effects test	statistic values	degree of freedom	probability
cross-section F	4.894803	(7,54)	0.0002

The results suggest that H_0 is objected in the significant level of 0.02%. Therefore, we will use the varying-coefficient fixed-effects panel data model, in which allowed cross-section heteroscedasticity, to study the effect of environmental regulation on China's export. The estimate result using Cross-section Weights (GLS) Method is listed in TABLE III.

We can see the most coefficients β_{10} are very significant, which means the ASEAN's environmental regulation could affect the trade flows from China to ASEAN. Also, the coefficients β_{10} of seven countries among ASEAN are not positive, except for Singapore. Take Malaysia for example, when the carbon dioxide emissions per capita decline a unit with constant energy consumption, the export from China will increase 1.44 units. Considering the constant energy consumption, we excluded the possibility of decreasing production, which could be caused by economic depression or something else. The most reliable explanation is Malaysia government has carried out more stringent environmental regulation. The same results are seen in Brunei, Vietnam, Cambodia and Indonesia. The coefficients β_{10} of Philippines and Thailand are not significant, which indicate there are no effects of environmental regulation on trade flow. At least, the ‘trade barrier’ is not existed. The only exception is Singapore, the one of Four Asian Tigers, who is the only developed country in ASEAN. The coefficient β_{10} of Singapore is positive (0.94). This estimate result is consistent with previous study (Ederington and Minier, 2003; Cole, Elliott and Okubo, 2010; Jug and Mirza, 2004).

4. Conclusions

In this paper, we firstly reviews the prevailing view about the environmental regulation effect on trade flows, which suggest that regulation did work as a trade barrier. Then, we raise a question: Could this be true if the two countries in trade are developing countries? We use the export trade data from China to ASEAN to answer this question. The answer is no. From the results of panel data, when energy consumption per capita is constant in some country, the less carbon dioxide emissions per capita (namely more stringent regulation), the more export from China to this country. Then, this is the proof that the environmental regulation is not always to be trade barriers. The previous empirical results is opposite because they just study the issues among developed world. We use data of China and ASEAN to avoid to misunderstanding environmental regulation. The point is, when the environmental regulation is applied by developing countries, it could not only work as a trade barrier, but also increase the cost of related industries, which could enlarge the gap of supply and demand. Therefore, not all the environmental regulations applied by other countries could do harm to China’s export trade. Of course, when this situation happened in developed countries, the result may be quite different. The Singapore is just an example.

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TABLE Ⅲ The Estimate Result

ASEAN / coefficient	Brunei	Cambodia	Indonesia	Malaysia	Philippines	Singapore	Thailand	Vietnam
β_1	0.74(6.57)***							
β_2	-0.69(-7.62)***							
β_3	-4.62(-10.18)***							
β_4	6.24(14.49)***							
β_5	-11.86*** (-17.99)	1.99*** (14.28)	-0.57** (-2.43)	2.24*** (10.48)	0.04 (0.16)	-0.47** (-2.41)	-1.71*** (-8.85)	13.19*** (41.7)
β_6	2.64*** (18.72)	29.77*** (33.74)	1.09*** (13.08)	0.85*** (7.48)	1.00*** (6.63)	1.33*** (6.81)	1.32*** (21.43)	-5.87*** (-13.29)
β_7	-2.41*** (-7.7)	-256.36*** (-58.07)	0.21 (0.27)	1.78*** (8.06)	-8.5*** (-9.53)	-0.73*** (-3.78)	11.75*** (15.97)	-0.08 (-0.07)
β_8	-0.04 (-0.06)	44.11*** (62.14)	0.004 (0.02)	-1.43*** (-7.84)	1.71*** (5.33)	-0.38 (-1.62)	-6.96*** (-13.38)	-0.05 (-0.13)
β_9	0.31 (0.87)	-431.28*** (-23.78)	5.65*** (7.27)	-4.44*** (-14.51)	6.55*** (7.83)	-1.67*** (-7.26)	-0.12 (-0.2)	11.03*** (9.83)
β_{10}	-4.12*** (-8.81)	-82.71*** (22.34)	-1.3*** (-8.63)	-1.44*** (7.72)	-0.19 (-0.57)	0.94*** (3.73)	-2.06 (-5.27)	-6.16*** (-16.26)
α	301.79*** (22.56)	3980.88*** (22.56)	-2.07*** (22.56)	-15.52*** (22.56)	32.37*** (22.56)	47.13*** (22.56)	-8.54*** (22.56)	-328.34*** (22.56)
R^2	0.998931							
Adjusted R^2	0.997763							
F 值	855.3437							
$D.W.$ 值	2.073015							

Note: a. ***,** and * indicate significance at the 1 per cent, 5 per cent or 10 per cent level, respectively; b. Due to the unavailability of data of Laos and Myanmar, these two countries are excluded from the estimate.