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The Impact of Trade on Environmental Quality: A Business Ethics Perspective and Evidence from China

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Abstract

This paper summarizes the arguments and counterarguments within the scientific discussion on the issue of the environmental impact of trade liberalization in the business ethics perspective. The main purpose of the research is to estimate different effects of trade on environment performance, namely the scale effect, technique effect, and trade-induced composition effects. Systematization literary sources and approaches for solving the problem of trade and environment indicate that they ignored country-specific factors and different economic development stages. The relevance of the decision of this scientific problem is that the research will provide profound insights on the impact of freer trade on the environment. Investigation of trade and environment performance in this paper is carried out in the following logical sequence: literature review, model specification, empirical estimation, and discussion. Methodological tools of the research are panel regression of data at the provincial level over the time period from 1997 to 2008. The object of research is China because China has experiences of fast development in trade. The paper presents the results of an empirical analysis by panel regression techniques for the estimation, which shows that trade itself has significantly positive effects on the environment. The research empirically confirms and theoretically proves that the impacts of trade liberalization on environment performance differ from pollutant to pollutant, and it rather depends upon the specific indicator in question. The results of the research can be useful for a number of policy implications for China as well as other developing economies in terms of business ethics.

Keywords: trade liberalization, China, environmental quality, business ethics.

JEL Classification: F1, Q5, Q56, M1, M2.

1. Introduction

In recent years the topic of the impact of trade liberalization on the environment has become a focus of attention for academics and policy makers. Jayadevappa and Chhatre (2000) establish some of the links between international trade and environmental quality by performing a comprehensive literature review. They discuss issues such as establishing direct and indirect effects of international trade on environmental quality, effects of trade on economic development, environmental quality, and energy and their relation with each other, and, finally, the role of governments and international organizations in this context.

Grossman and Krueger (1993, 1995) were the pioneers to conduct the empirical research on the effects of economic growth and international trade on the environment. In their works, Grossman and Krueger (1993, 1995) decomposed the impact of trade on the environment into scale effect, composition effect and technique effect. However, theorized and modeled explicitly trade openness as an explanatory variable was not used until Antweiler, Copeland and Taylor (2001). They examined it for the impact of free trade on environmental quality. Following Grossman and Kruger (1993), Antweiler, Copeland and Taylor (2001) divided trade effects into three specific effects. They summed up the scale effect, composition effect and technique effect to find an overall effect of trade liberalization on environment performance. Extensions and modifications to this model have been made since then by many other researchers.

As the research findings presented in Grossman and Krueger (1993) and Copeland and Taylor (2004), freer trade has positive impacts on environment, and negative ones as well. While there are lots of empirical studies on the impact of trade liberalization on the environment, they are largely cross-country studies and limited to developed countries. Chua (1999) sorts out work on the effect of freer trade liberalization on environment and obtained mixed results. Grossman and Krueger (1993) explored some of the empirical

evidence that bear on the likely environmental effects of the North American Free Trade Agreement (NAFTA) as a result of international trade and foreign investment liberalization in the United States, Canada, and Mexico. Treating trade and income as endogenous, Managi, AkiraHibiki, and Tsurumi (2009) estimated the general impacts of trade on environmental quality by using the instrumental variables (IV) method. Kellenberg (2009) finds robust confirmation of a pollution haven effect in a cross-country context by accounting for strategically determined environment, trade, and intellectual property right (IPR) policies.

In the case of developing countries, Jena and Grote (2008) evaluated the impacts of economic growth and trade liberalization on environment in India. Khalil and Inam (2006) use Johansen co-integration technique for the valid long-run relationship among the variables and error correction models to determine the short-run dynamics of the system to time series data for Pakistan's economy. Feridun, Ayadi and Balouga (2006) investigate the impact of trade openness on pollution and resource depletion in Nigeria.

Chai (2002) focuses on the Chinese manufacturing sector assesses the environmental impact of trade liberalization in China. The results show that China's experience with the trade liberalization–environment nexus is consistent with international evidence. On one hand, trade liberalization has had various positive effects on the environment. Dean (2002) establishes a simultaneous equation system incorporating multiples effects of trade liberalization on the environment and applies it to Chinese water pollution. The empirical results suggest that the freer trade aggravates environmental damage via the terms of trade but mitigates via income growth. Jalil and Mahmud (2009) examine the long-run relationship between carbon emissions and energy consumption, income and foreign trade in the case of China by employing time series data of 1975-2005. The estimations suggest that trade has a positive but statistically insignificant impact on CO^2 emissions.

The empirical studies reviewed suffer from methodological drawbacks. Firstly, country-specific factors were ignored in the cross-country studies. These factors may have a significant effect on the research outcomes. Secondly, developing countries are staying in a very different economic development stage compared with developed countries and among developing countries themselves. Thus, the study on a specific country will provide profound insights on the impact of freer trade on the environment. This paper intends to study the case of China using the province-level data from 1997 to 2008 to overcome these shortcomings. The study covers the period from 1997 to 2008 as it was the years between the two financial crises in Asia and in the western economies, to see if there were special cases for the Chinese trade on environment.

The policy relevance of motivation is a great concern for the international society. Governments usually use domestic policy instruments internalized environmental distortions (Copeland, 2011). The motivation behind Chinese export tax policies sent itself in two WTO dispute settlement cases (WTO, 2014). Yet, in a recent study, Eisenbarth (2017) analyses if China is driven by environmental concerns to exercise export VAT rebates and export taxes, showing little evidence that these policies are motivated by environmental concerns.

In addition, this study will put business ethics implication for trade and environmental relations. In this sense, a country and a company are supposed to keep an eye on the environment quality when developing international trade. The business ethics in trade is a vital factor for trade sustainability.

The paper is organized as follows: the first section puts forward the research question and reviews the literature briefly, the next section specifies the model, followed by empirical estimation for solid wastes and waste gas, the last section concludes the paper.

2. The Model and Data

2.1 The Model

Grossman and Kruger (1993) distinguish three separate mechanisms by which a change in trade and foreign investment policy can affect the level of pollution and the rate of depletion of scarce environmental resources. Scale effect: if trade and investment liberalization cause an expansion of economic activity, and if the nature of that activity remains unchanged, then the total amount of pollution generated must increase. Composition effect: that results from any change in trade policy. When trade is liberalized, countries specialize to a greater extent in the sectors in which they enjoy a competitive advantage. Technique effect: output need not be produced by exactly the same methods subsequent to liberalization of trade and foreign investment as it has been prior to the change in regime. In particular, the output of pollution per unit of economic product need not remain the same.

The empirical strategy adopted in this paper is based on the Antweiler et al. (2001) estimating equation. Antweiler et al. (2001) decomposed the impacts of trade on pollution into scale effect, technique effect and trade-induced composition effects. The scale effects refer to the impact on the environment of an increase in output due to trade liberalization. The technique effect reflects the impact of changes in production technique on the environment. As incomes rise, the demand for a better environment causes the adoption of environment-friendly production technology. Generally, the technique effect is likely to benefit the environment. The composition effect states that due to trade liberalization, the output structure of a province will change it increasingly specialize in those activities in which it has a comparative advantage.

That is, total emission is a function of the scale of the economy, the composition of output, openness to trade, and income per capita. The basic estimation is given by the following equation.

$$E_{git} = \alpha + \beta_1 ECI_{it} + \beta_2 INC_{it} + \beta_3 KLR_{it} + \beta_4 TRI_{it} + \beta_5 \delta_{it} * TRI_{it} + \varepsilon_{it}$$

$$\delta_{it} = \delta_0 + \delta_1 RIN_{it} + \delta_2 RIN^2{}_{it} + \delta_3 RKL_{it} + \delta_4 RKL^2{}_{it} + \delta_5 RIN_{it} * RKL_{it} \tag{1}$$

where E_{git} is the waste g, ECI is province-specific economic intensity measured by GDP/km^2, which captures the scale effect, KLR is the capital-to-labour ratio at province level, capturing the composition effect, INC is real income per capita at province level, capturing the technique effect, TRI is the trade intensity measured with (Export + Import)/GDP. RKL is province's capital-to-labour ratio that is relative to the country's average, while RIN captures province's relative real income per capita measured relative to the national average. ε_{it} is a province-specific error showing economic and physical variables which are not measured elsewhere. Equation (1) also captures interaction terms between the trade intensity variable and relative income per capita as well as a relative capital-to-labour ratio.

Equation (1) serves as Model 1 in my estimations. Model 1 assumes the responses to product scale, production technique, and trade-induced composition variables are in linear form. However, but provinces differences in income per capita suggests they will also differ in production technology. This means the impact of income per capita on technique effect is not in linear form. Similarly, the impact of capital on the trade-induced composition effect is not a linear function of capital-to-labour ratio (KLR). So is the impact of income per capita on pollution.

To reveal these features and to show if Environmental Kuznets Curve (EKC) holds, Model 1 is modified to include the squares of income per capita (INC^2), the capital-to-labour ratio (KLR^2) and their cross-product (INC*KLR). This is Model 2 to be estimated. Further, the square of economy intensity (ECI^2) is added to Model 2 to reveal the nonlinearity of the impact of economy scale on pollutions, which arise from province differences in production or consumption. This is Model 3.

2.2 The Data

Due to these disadvantages of Chinese IO tables, direct emission intensities are used rather than overall emission intensities as Dean and Lovely (2010) did in their study. The data used here are collected for various issues of China Statistic Yearbook edited by the State Statistic Bureau of China. The data are for 31 provincial districts over the period from 1997 to 2008. Table 1 summarises the core variable values.

Table 1. Descriptive Statistics

Variable	Mean	Median	Minimum	Maximum	Std. Dev.
Economy Intensity (million *Yuan*)	8.82	2.20	0.01	236.18	24.98
Income Per Capita (10 000 *Yuan*)	1.30	0.98	0.22	7.25	1.09
Capital-to-Labour ratio	1.20	0.82	0.15	7.45	1.09
Trade Intensity	0.31	0.13	0.04	1.71	0.38
Relative Income	1.00	0.73	0.31	3.63	0.65
Relative Capital-to-Labour ratio	1.00	0.81	0.28	4.78	0.75
Solid Wastes Per Capita (ton)	0.92	0.75	0.02	4.75	0.73
Waste Gas Per Capita (10 000 cu. m)	1.91	1.45	0.04	9.32	1.52

Source: *China Statistic Yearbook*, various issues

3. Empirical Results

The study focuses on solid wastes and waste gas and present the estimation results for Models 1, 2 and 3 in Table 2. The three effects will be discussed followed by the discussion of the trade-induced composition effects. The dependant variable here is the log value of wastes emission per capita.

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3.1 Scale Effect, Technique Effect and Trade-induced Composition Effect

Table 2 suggests a confused relationship between the GDP/km^2 measured scale of economic activity and emissions for both solid wastes and waste gas. It is significantly negative in Model 1 but significantly positive in Model 2 for both wastes, but not significant in Model 3. When moving to Model 3, the square of economy intensity is significantly positive. The technique effect captured by income per capita are significantly positive across the three Models for both wastes, but the square of income per capita is significantly negative. This shows that EKC holds in China. The capital-to-labour ratio. Now turn to the composition effect as measured by the impact of the capital-to-labour ratio.

As shown in Table 2, a negative trade-induced composition effect is found as an increase in capital-to-labour ratios with column (1) an exception. For both wastes, the cross-product of income and capital-to-labour ratio (INC*KLR) are not statistically significant, while the square of economy intensity (ECI^2) is statistically significant and positive. The three models have a very high adjusted R-square value.

Table 2. Estimation Results

Models	Solid Wastes			Waste Gas		
	(1)	(2)	(3)	(1)	(2)	(3)
const	-1.048***	-1.343***	-1.340***	-0.535***	-0.918***	-0.916***
	(0.045)	(0.0502)	(0.050)	(0.047)	(0.047)	(0.048)
Economy Intensity	-0.009***	0.0163***	-0.009	-0.017***	0.019***	0.003
	(0.003)	(0.004)	(0.010)	(0.004)	(0.004)	(0.010)
(Economy Intensity)^2			0.00007***			0.00004*
			(0.00002)			(0.00002)
Income per capita	0.430***	1.209***	1.332***	0.816***	1.605***	1.682***
	(0.090)	(0.142)	(0.148)	(0.095)	(0.133)	(0.139)
(Income per capita)^2		-0.163***	-0.128***		-0.184***	-0.162***
		(0.029)	(0.032)		(0.0273)	(0.030)
Capital-to-Labour Ratio	0.0290	-0.272**	-0.371***	-0.152**	-0.325***	-0.388***
	(0.065)	(0.105)	(0.110)	(0.068)	(0.098)	(0.104)
(Capital-to-Labour Ratio)^2		0.039	0.062*		0.0227	0.037
		(0.033)	(0.034)		(0.031)	(0.032)
INC*KLR		-0.017	-0.053		-0.024	-0.047
		(0.063)	(0.064)		(0.059)	(0.060)
TRI	1.729**	0.855	1.168*	1.800**	0.897	1.094*
	(0.687)	(0.611)	(0.616)	(0.724)	(0.571)	(0.579)
TRI*RIN	-1.592**	-1.445**	-1.975***	-3.405***	-3.116***	-3.449***
	(0.804)	(0.705)	(0.724)	(0.847)	(0.658)	(0.680)
TRI*RIN^2	-0.267	0.6137	0.695*	0.109	1.074***	1.125***
	(0.393)	(0.393)	(0.390)	(0.414)	(0.367)	(0.367)
TRI*RKL	0.688	1.022*	1.052*	2.719***	2.621***	2.640***
	(0.620)	(0.570)	(0.565)	(0.653)	(0.532)	(0.530)
TRI*RKL^2	-0.414**	0.340*	0.268	-0.601***	0.328*	0.283
	(0.187)	(0.203)	(0.203)	(0.197)	(0.190)	(0.191)
TRI*RIN*RKL	0.787	-1.028*	-0.818	0.494	-1.495***	-1.363***
	(0.517)	(0.551)	(0.551)	(0.545)	(0.514)	(0.517)
n	372	372	372	372	372	372
Adj. R^2	0.9340	0.9508	0.9517	0.9312	0.9598	0.9601
Log-likelihood	52.02	108.4	112.6	32.65	134.1	136

Standard errors are in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% respectively.

Source: Author's own calculation

3.2 The Trade-induced Composition Effect

In this subsection, a further analysis will be put on the estimations for the trade-induced composition impact. The variable is interpreted as a trade-induced composition effect, which measured by the relative importance of trade (exports and imports) in GDP. It predicts the changes in concentration when the share of trade in GDP changes. trade intensity (TRI) captured the change in the composition of output due to trade liberalization. The result from models (1) and (3) reject the hypothesis: the terms capturing the trade-induced composition effect are jointly zero. The estimation results are significantly positive.

3.3 Factor Endowment or Pollution Haven Motives for Trade

In the models, the factor endowment and pollution haven were estimated as two major motives for their relative significances to trade. Factor endowment motives are measured by TRI*RKL, while the pollution

haven motive is measured by TRI*RIN. The empirical results of the estimations on these interaction terms suggest that coefficients of TRI*RIN are significantly negative while coefficients of TRI*RKL are significantly positive.

4. Conclusion

The primary objective of this study is to investigate the effects of freer trade on environmental performance in China. Following most literature, the effects are decomposed into scale effect, technique effect and trade-induced composition effect. In this paper, the model devised in Antweiler et al. (2001) is adapted to study these effects with provincial-level data from China. These effects are measured as the changes in pollution concentrations as the value of economic density, real income per capita, capital-to-labour ratio and their cross-products with trade intensity change. The dependant variables are the log values of solid wastes per capita and waste gas per capita.

The scale effect is significantly negative in Model 1 but significantly positive in Model 2 for both wastes, but not significant in Model 3. The technique effect captured by income per capita are significantly positive across the three Models for both wastes, but the square of income per capita is significantly negative. This suggests that the EKC holds in China. The negative composition effect arises from an increase in capital-to-labour ratios.

The estimation suggests that trade itself has significantly positive effects on the environment. The interaction term of relative income and relative capital-to-labour ratio show different effects. The empirical results of the estimations on these interaction terms suggest that coefficients of TRI*RIN are significantly negative while coefficients of TRI*RKL are significantly positive.

It is essential to address the relationship between domestic environmental policies and international trade policies for a better understanding of the need for consistency and complementarity between these areas (Garsous, 2019). China has launched an ambitious agenda in recent years, to deal with the country's environmental problems. For one thing, China set ambitious targets to reduce pollution and energy consumption in recent developed Five-Year-Plans. For the other thing, the Chinese government has carried out substantial reforms efforts on its administrative structure to give environmental protection a more important role in its political system and economic development.

The results of this study can be useful for a number of policy implications for China as well as other developing economies in terms of business ethics. When developing international trade, countries need to balance the trade gains and environment pollutions. And companies involved in international trade are supposed to carry out business ethics and social responsibility to protect the environment. Governments have the responsibility to initiate programs to ban the use of hazardous products. And business enterprises should take the lead to solve environmental issues. It is their ethic responsibility to exam the consequences and environmental effects of their actions and to protect environmental resources as well.

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