“Green” Side of Export Competitiveness in Emerging Countries

Abstract

There is an intense debate on the relationship between trade and environmental performance, which is carried out on the theoretical backdrop of the trade and growth nexus. While there is theoretical and empirical support for positive effects of increased trade on economic growth, other strands of the literature focus on the positive and negative impacts of trade on the environment and, finally, the effect of environmental policies on trade and competitiveness. These arguments are incorporated in theoretical models such as the Pollution Haven Hypothesis, the Porter Hypothesis or the Environmental Kuznets Curve. The Pollution Haven Hypothesis maintains that polluting industries are shifting from developed to developing countries. In order to circumvent the strict environmental regulations, companies relocate their production in countries with less-stringent environmental regulations. Consequently, developed countries import dirty products from the developing countries with the implication that some countries in the latter group attain comparative advantage in dirty products.

In this study, the link between the comparative advantage of dirty industries and environmental performance in 25 emerging countries is explored. The period of analysis covers the years between 2002-2012. The paper first focuses on the changes in the revealed comparative advantage (RCA) of dirty industries in emerging countries in relation to developed countries. The countries, which have a comparative advantage in dirty industries are expected to have lax environmental regulations. Subsequently, we explore the effects of RCA in these dirty industries environmental quality in emerging countries. The results vary from one industry to another.

Key words: pollution haven hypothesis, revealed comparative advantage, emerging countries, dirty industries

JEL : Q56, F14

Introduction

There is an intense debate on the relationship between international trade and environmental performance. In this framework, there is growing concern regarding the link between countries' environmental policies and international competitiveness. This concern is reflected in the Pollution Haven Model which hypothesizes that strict environmental regulations push pollution-intensive industries (dirty industries) to relocate to countries with less-stringent environmental regulations. Our starting point in this study is based on this hypothesis implying that environmental regulations affect trade flows, and at the final stage environmental stringency can decrease the exports and increase the imports of "dirty goods".

The goal of this paper is to explore the effects of stringent environmental regulations on the competitiveness of pollution intensive industries. We study the link between comparative advantage of dirty industries and environmental regulation in trade between 25 emerging countries[1] and the developed world.[2] The period of analysis covers the years between 2002-2011.

The remainder of the study is structured as follows. After an exposition of related literature, we discuss the three key indicators in the study, namely, dirty industries, environmental regulation stringency and trade performance. The empirical part of the paper explores the link between the changes of revealed comparative advantage (RCA) in dirty industries between emerging and developed countries. We use carbon dioxide emissions as an indicator of environmental regulation, meaning, the higher the carbon dioxide emissions, the higher the laxity of environmental regulation and RCA in dirty goods. The expected finding is that strict environmental regulations limit the competitive advantage in polluting (dirty) industries and increase the competitive advantage of emerging countries in these industries.

Related Literature

There is a rich literature on the relationship between environmental performance and comparative advantage. There are two major views regarding this relationship. One group of researchers maintains that stringent environmental regulations force improvements in productivity in all industries which are forced to invest in more environmentally friendly and clean technologies. Consequently, this improvement increases the comparative advantage of these industries. This approach is known as the Porter Hypothesis.

The second group of researchers holds the view that stringent environmental regulations reduce competitiveness in dirty industries in comparison to countries with lax environmental regulations. The Pollution Haven Hypothesis (PHH), a well established theory in support of the latter view, traces firms' or countries' investment decisions in polluted industries to strict or lax environmental regulations. According to PHH, lax environmental regulations give an

[1] Emerging Countries; Brazil, Chile, China, Colombia, Czech Republic, Egypt, Estonia, Hungary, India, Indonesia, Latvia, Lithuania, Malaysia, Mexico, Morocco, Panama, Peru, Philippines, Poland, Romania, Russia, South Africa, South Korea (Korea Republic), Thailand, Turkey

[2] We chose the world's top importing developed countries; France, Germany, Japan, UK, USA

opportunity to increase Revealed Comparative Advantage (RCA) in polluted industries (dirty industries) in the countries with such regulations.

In the early 1990s, Lawrance Summers of the World Bank wrote a memo about a question for policy discussion on whether it would be advantageous for dirty industries to relocate to newly industrializing countries.[3] Since then the argument that "pollution havens" exist in developing countries with the pressures from global corporations and the host country governments received much attention, and many scholars studied the Pollution Haven Hypothesis and its effects. There is a vast literature on the results of environmental regulations and the extent to which they affect comparative advantage for different countries or groups of countries. However, despite the growing literature, there is no consensus regarding consequences.

Almost all of the initial studies conducted on PHH analyzed this relationship for the US or for developed countries. This was probably done due to the unavailability of developing country data. Among the earlier studies, empirical work by Tobey (1990) and Grossman and Krueger (1993) were the most influential ones. These studies examined the relationship between the costs of pollution abatement and trade flows. Tobey did not find any evidence of a negative environmental impact on trade. Grossman and Krueger worked on the free trade between Mexico and the US and addressed the issue whether this trade lead to move polluted industries from the US to Mexico, the country with laxer environmental regulation. They also did not find any evidence in support of this hypothesis.

There are, however, some other studies examining the causal relationship between changes in environmental performance and changes in trade flows. For example, Low and Yeats (1992) using RCA figures for 109 countries, concluded that the share of polluted industries grew rapidly in developing countries, while the value of exports from developed countries in the same goods fell. Mani and Wheeler (1997) found evidence in support of pollution havens using import-export ratios for the top five dirty industries (iron and steel, non-ferrous metals, industrial chemicals, pulp and paper and non-metallic mineral products). In their study, net exports of polluted goods from developing countries increased as the pollution control costs of developed countries rise. Similarly, Van Beers and Van den Bergh (1997) also found empirical evidence to support that environmental regulations affect trade patterns. They analyzed the effects of strict environmental regulations on bilateral exports using OECD country figures and concluded that the exports of OECD countries are negatively and significantly affected by more stringent regulations. In some studies, the PHH is partially supported. For example, in the analysis of Busse (2004), the results did not support PHH except for the iron and steel industry. Using comparative advantage Broner et al. (2013) explore the question whether countries with lax environmental regulations have a comparative advantage in polluted industries. They find that countries with lax environmental regulations systematically exhibit higher US import market shares in polluting industries than in other industries.

[3] Moses N.Kiggundu (2002) *Managing Globalization in Developing Countries and Transition Economies: Building Capacities for a Changing World*, NY: Praeger, p. 323

Finally some authors emphasize the role of environmental regulations as a means of protection. Ederington and Minier (2004), for instance, modelled environmental regulation as an endogenous variable and found that the effect of regulations on trade flows is stronger than that in previous studies which used the stringency of regulations as exogenous.

Identifying Dirty Industries

Our sample consists of the major 25 emerging countries defined in the Bloomberg Best Emerging Markets list (see the footnote 1) and five-developed countries (see the footnote 2) . The period of analysis covers the years 2002-2011.

It is difficult to find an official definition for pollution intensive industries (dirty industries). A proxy created and used by environmental economists to this end is the ratio of the pollution abatement costs to value added. Using this proxy, five industries are identified as the most polluted industries. These industries are chemicals, petroleum, paper, non-metalic minerals (such as stone, slay and concrete), and primary metal industries (Cole and Elliot, 2005).

Table 1. Growth Rates of Dirty Industries in 25 Emerging Countries, 2002-2012

SITC	**251**	**33**	**51**	**52**	**562**	**59**	**634**	**635**	**64**	**661**	**67**	**68**	**69**
BRA	3,0	7,8	3,4	2,7	3,3	1,8	-0,03	-0,2	1,2	1,8	1,8	0,5	3,5
CHL	2,0	2,7	-0,4	3,9	7,6	4,5	1,6	-0,1	1,6	1,3	5,9	4,5	3,6
CHN	7,1	5,3	7,4	3,6	20,3	6,0	10,5	1,5	7,6	3,8	15,2	4,6	5,1
COL	1,7	8,5	2,2	2,5	4,0	0,8	0,01	0,18	1,4	-0,6	2,1	1,3	1,0
CZE	1,5	0,5	-0,1	2,2	3,8	1,8	2,5	1,1	0,9	1,7	2,7	4,5	2,5
EGY	-0,9	3,2	75,9	4,6	28,5	39,2	6,5	11,3	18,4	0,9	2,3	8,3	15,0
EST	56,1	13,5	8,2	2,6	0,04	6,8	1,4	2,4	0,4	2,8	5,1	4,2	1,2
HUN	10,9	4,0	2,6	3,4	8,4	1,3	0,7	0,3	2,1	0,8	2,7	0,8	1,9
IND	10,7	22,8	6,0	5,8	44,2	4,5	1,3	9,1	2,7	1,7	5,3	6,3	4,0
IDN	1,1	1,5	1,8	2,6	3,2	9,4	0,01	-0,3	0,9	-0,3	3,0	4,0	2,4
LVA	4,2	289	7,2	6,7	2,2	10,1	3,1	1,3	3,0	33,5	6,1	0,6	6,5
LTU	24,0	6,9	10,1	15,2	4,7	29,5	1,5	4,6	6,7	6,2	2,0	4,0	8,4
MYS	69,4	4,3	2,1	3,4	2,9	2,0	0,6	0,7	2,0	2,6	3,2	4,4	2,3
MEX	1,8	2,6	1,8	1,7	15,8	2,1	-0,2	-0,1	0,5	0,4	1,8	5,1	0,6
MAR	0,4	3,3	0,3	2,5	6,3	3,7	-0,3	-0,1	1,9	1,9	3,1	1,9	2,8
PAN	1,5	-0,9	0,4	-0,1	-0,1	-0,9	-0,8	-0,8	0,9	-0,9	2,2	0,5	-0,2
PER	9,0	7,1	11,3	7,5	29,6	4,2	1,6	0,8	5,5	0,9	4,5	1,9	5,8
PHL	1,7	1,7	9,4	7,9	1,1	4,0	0,9	17,8	0,4	-0,4	12,5	3,5	2,4
POL	5,1	7,4	3,6	3,2	4,0	6,6	1,1	1,8	2,6	2,0	4,0	4,7	2,9
ROU	0,9	1,9	0,8	1,7	4,1	5,1	5,9	1,2	1,5	-0,2	1,7	1,8	6,2
RUS	1,1	6,3	2,9	5,0	5,9	1,6	2,9	2,8	1,3	5,9	2,6	2,0	1,8
ZAF	1,5	3,1	3,3	0,8	1,5	2,1	1,1	0,2	1,4	1,3	1,7	8,2	3,7
KOR	12,4	7,8	4,1	6,0	3,2	3,3	0,2	0,5	0,9	2,7	4,3	4,3	2,7
THA	0,02	7,9	7,5	4,9	3,2	3,8	3,2	-0,2	1,4	1,2	3,2	4,0	4,2
TUR	10,4	9,8	3,1	4,5	3,2	5,8	6,7	6,5	4,3	2,2	3,7	6,5	5,6

Source: Authors' calculations based on the UN Comtrade Database (27.07.2015)

In the present study we consider the growth rate of exports of these industries in each emerging country of our sample (Table 1). Although we include in our analysis all the industries identified as "dirty" and shown in Table 1, we also focus those industries that exhibited the highest growth rates during 2002-2011. These industries are organic chemicals (SITC51), inorganic chemicals (SITC52), fertilizers (SITC562) and chemical materials and products (SITC59).

Indicator for Environmental Regulation Stringency or Laxity

In the literature, finding a suitable indicator of regulatory stringency or laxity is difficult. In the present study, we use high levels of pollution (CO_2 emissions per capita) as the indicator for lax environmental regulations. The regulation also determines environmental quality. Data reveal that almost all emerging countries exhibit an increase in their CO_2 per capita during the period of analysis (Table 2). Some European Union member countries (Czech Republic, Hungary and Romania) undergo a decrease their emissions per capita. On the other hand all five-developed countries have lowered their emissions during the said period.

Table 2. CO_2 per capita in 25 Emerging and 5-Developed Countries, 2002-2012

Brazil		Chile		China		Colombia		Czech Rep.	
2002	**2012**	**2002**	**2012**	**2002**	**2012**	**2002**	**2012**	**2002**	**2012**
1,9	2,2	3,49	4,58	2,88	6,71	1,35	1,53	11,72	10,43
Egypt		Estonia		Hungary		India		Indonesia	
1,86	2,78	10,82	14,04	5,52	4,86	1,13	1,69	1,42	2,31
Latvia		Lithuania		Malaysia		Mexico		Morocco	
2,87	3,78	3,83	4,53	5,53	7,84	3,67	3,90	1,30	1,76
Panama		Peru		Philippines		Poland		Romania	
1,84	2,58	1,01	1,79	0,88	0,86	7,71	8,33	4,24	4,21
Russia		South Africa		South Korea		Thailand		Turkey	
10,71	12,64	7,63	9,25	9,77	11,84	3,38	4,55	3,16	4,39
France		Germany		Japan		UK		USA	
6,13	5,18	10,04	8,91	9,54	9,29	8,87	7,08	19,63	17,02

Source: World Bank, http://data.worldbank.org/data-catalog/world-development-indicators (27.07.2015)

RCA as the Indicator of Trade Performance

For trade performance, we compute sectoral RCA and evaluate the trade of each 25 emerging economy with the five developed countries in the polluted industries. We track the changes in the RCA of a polluted industry during the period covering 2002-2011.

In order to measure a country's relative export performance in individual product categories, many studies have used the concept of revealed comparative advantage (RCA). The RCA of country *i* in the export of product *j* is measured by the ratio of commodity *j*'s share in the country's exports relative to the share of that commodity in world trade. The RCA index takes the form:

$$RCA_{ij} \ (X_{ij}/X_i/(X_{jw}/X_w)$$

where X_{ij} country i's exports in commodity j; X_{jw} world exports in commodity j; X_i country i's total exports; and X_w the world's total exports. When estimating each emerging country's RCA with a particular developed country, X_w and X_{jw} are replaced by the flow of total five developed countries (see footnote 2).

Data and Econometric Methodology

In order to evaluate the impact of environmental regulation laxity on trade performance, we employ a balanced panel data set of 25 emerging countries over the period 2002-2011. The environmental quality is proxied by CO_2 emissions (metric tons per capita) and real GDP per capita is used as a control variable. Both of these variables are extracted from World Development Indicators.

The empirical model to be estimated is the following equation:

$$lnCO_{2it} = \beta_i + \beta_1 lnGDPPC_{it} + \beta_2 SITC51_{it} + \beta_3 SITC52_{it} + \beta_4 SITC562_{it} + \beta_5 SITC59_{it} + \varepsilon_{it} \quad (1)$$

where CO_2 is carbon dioxide emissions per capita, $GDPPC$ is real gdp per capita, SITC51 is RCA of organic chemical industry, SITC52 is RCA of inorganic chemicals industry, SITC562 is RCA of fertilizers and SITC59 is RCA of chemical materials. In this equation β_i is the country-fixed effect that captures the effects specific to each country do not change over time, such as culture and climate and ε_{it} is the idiosyncratic error term which is allowed to be heteroskedastic and autocorrelated. Subscripts i and t represent country and year, respectively.

Table 3 represents the estimation results. In column 1, equation 1 is estimated via fixed effects, whereas in column 2 random effect estimation is carried out. As shown by the Hausman statistics p-value, fixed effect regression results are preferable. However, Table 3 reveals no difference between these two estimation methods.

Results indicate that among the industries, SITC51 and, SITC562 are statistically significant with a positive sign, while SITC52 is statistically significant with a negative sign and SITC59 is positive but insignificant. Therefore, as the emerging economies gain higher RCA in those industries, the CO_2 emissions increase significantly. Regarding the GDP per capita, its coefficient is positive and significant as expected. A 1 percent increase in GDP is estimated to cause a 0.48 percent increase in the CO_2 emissions.

Table 3: Revealed Comparative Advantage and CO_2 Emissions

	(1) FE	(2) RE
lnGDPPCAP	0.479***	0.482***
	(0.062)	(0.056)
SITC51	0.023*	0.023*
	(0.014)	(0.014)
SITC52	-0.013**	-0.013**
	(0.006)	(0.006)
SITC562	0.001***	0.001***
	(0.000)	(0.000)
SITC59	0.001	0.001
	(0.031)	(0.031)
Constant	-2.445***	-2.469***
	(0.520)	(0.482)
Hausman Test *(p-value)*	0.00	
Observations	250	250
R^2	0.63	0.63

Notes: Robust standard errors are in parenthesis. (***), (**), and (*) indicate %1,%5 and %10 significance levels respectively.

Conclusion

By using a sample of 25 emerging countries we adopt a panel analysis to test the effects of competitiveness in pollution-intensive industries on environmental performance during the period covering 2002-2011. The conclusions are as follows:

(1) We include in our analysis those industries exhibiting the highest export growth among the dirty industries. These are mostly chemicals (SITC 51-52-562 and 59). The main results are based on these commodities. Our analysis partially supports the PHH hypothesis . We find that emerging countries serve as pollution havens in organic chemicals (SITC 51) and fertilizers (SITC 562) for the five developed countries.

(2) The inclusion of the other dirty industries in our analysis, on the other hand, wipes out any positive evidence on the relationship between higher RCA and worsening environmental performance (lax environmental regulation). On the contrary, the relationship between higher RCA of some dirty industries (such as SITC 52) can promote improvement in environmental performance. This result shows that in these industries the Porter hypothesis works.

(3) Finally, we need to mention two shortcomings of this study. Firstly, the simultaneous use GDP per capita and emission per capita, may distort the results since the two variables are probably correlated. Secondly, when we compute polluting sectoral RCA for each emerging country, we have to do not the imported content of exports in our calculations due to data constraints.

References

Antweiler, Werner, Brian R. Copeland and M. Scott Taylor (2001) "Is Free Trade Good for the Environment?", *American Economic Review*, Vol. 91 No.4 pp. 877-908

Broner, Fernando, Paula Bustos and Vasco M. Carvalho (2013) "Sources of Comparative Advantage in Polluting Industries", Barcelona GSE Working Paper Series, WP No: 655, http://www.princeton.edu/~pbustos/Comparative_Advantage_Polluting_Industries.pdf (29.07.2015)

Busse, M (2004) "Trade, Environmental Regulations and the World Trade Organization: New Empirical Evidence", *Journal of World Trade*, Vol. 38 No. pp.285-306

Copeland, B. And S. Taylor (2004) "Trade, Growth and the Environment", *Journal of Economic Literature*, Vol. 42 No.1 pp.7-71

Ederer, Stefan and Stefan Weingartner (2014) "Structural Disparities in Carbon Dioxide Consumption and Trade in the Worl Economy", *WIFO Working Papers* No. 478 http://www.wifo.ac.at/jart/prj3/wifo/resources/person_dokument/person_dokument.jart?publikationsid=47460&mime_type=application/pdf (29.07.2015)

Ederington, J. And J. Minier (2003) "Is Environmental Policy a Secondary Trade Barrier? An Empirical Analysis", *Canadian Journal of Economics*, Vol. 36 No.1 pp. 137-154

Elliott, Robert J.R. and Kenichi Shimamoto (2008) "Are ASEAN Countries Havens for Japanese Pollution Intensive Industry?", http://works.bepress.com/cgi/viewcontent.cgi?article=1021&context=rob_elliott (30.07.2015)

Grossman, Gene M., and Alan B. Krueger (1993). "Environmental Impacts of a North American Free Trade Agreement" in Peter Garber (ed.), *The US-Mexico Free Trade Agreement*. Cambridge, MA: MIT Press.

Grossman, Gene M., and Alan B. Krueger (1995) "Economic Growth and the Environment", *Quarterly Journal of Economics*, Vol. 110 No.2 pp.353-377

Low, P. And A. Yeats (1992) "Do 'Dirty Industries' Migrate), in P. Low (ed.) *International Trade and the Environment*, World Bank Discussion Paper No. 159, World Bank, Washington DC, pp. 89-103

Marconi, Daniela (2010) "Environmental Regulation and RCA in Europe: Is China a Pollution Haven?", *Banca D'Italia Occasional Paper*, No. 67

Quiroga, Miguel, Thomas Sterner and Martin Persson (2007) "Have Countries with Lax Environmental Regulations a Comparative Advantage in Polluting Industries?" *RFF Discussion Paper* No: 07-08 http://www.rff.org/documents/RFF-DP-07-08.pdf (29.07.2015)

Ratnayake, Ravi (1998) "Do Stringent Environmental Regulations Reduce International Competitiveness? Evidence from an Inter-Industry Analysis", *International Journal of the Economics of Business,* Vol 5 No. 1, pp. 77-96

Tobey, J. (1990) "The Effects of Domestic Environmental Policies on Patterns of World Trade: An Empirical Test", *Kyklos* Vol. 43 No.2 pp.191-209