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Trade and the Environment in Latin America: Examining the Linkage with the USA

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Abstract

This paper investigates how trade of "dirty" goods with the USA can affect the environmental pollution in Latin American (LA). By controlling for trade openness, the share of manufacturing in GDP, and the trade of pollution−intensive products with USA, CO2 emissions are estimated for 14 LA countries between 1986 and 1999. Our results show that increasing exports of "dirty" products to the USA tends to raise CO2 emissions in LA countries, while the opposite results occur for growing imports of those goods from the USA. Since the effect of "dirty" imports from the USA is larger than the effect of "dirty" exports to the USA, our results indicate that the trade of "dirty" products with the USA on the whole reduces CO2 emissions in LA countries during the estimation period.

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1. Introduction

This paper investigates how trade of 'dirty' goods with the USA can affect the environmental pollution in Latin American (LA) countries. The linkage between trade and the environment arose from Grossman and Krueger's (1991) path-breaking study on the environmental Kuznets curve (EKC). The EKC is an inverted U-shaped relationship between pollution and per capita income. This hypothesis has attracted the attention of many researchers, despite considerable criticism of early studies on the EKC on both theoretical and empirical grounds.[1]

One important criticism of the earlier studies on EKC is that they do not take changes of trade patterns into account. Several economists argue that developing countries have a comparative advantage in pollution-intensive industries, since they set less stringent environmental regulations than advanced countries.[2] If this is the case, 'dirty' industries are likely to migrate from advanced countries to developing countries.[3] This may reduce pollution in advanced countries, and increase imports of 'dirty' products from developing countries. Such reallocation of 'dirty' industries from advanced countries to developing countries can generate the downward sloping portion of the EKC of advanced countries. Thus, the EKC may just reflect a transfer of pollution from advanced countries to developing countries, but the decrease indicated by the downward slope may not contribute to a net reduction in pollution in the whole world.

A number of recent studies focus on the effect of trade composition on pollution with mixed results.[4] For example, Kander and Lindmark (2005) investigate the reasons behind Sweden's declining CO_2 emissions in recent years, but find no causal relationships between trade and declining CO_2 emissions. In contrast, Cole (2004) shows the effect of 'dirty' trade on the EKC of OECD countries. He estimates ten air and water pollutants, including as independent variables, trade of pollution-intensive

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[1] For surveys on the EKC, see Dasgupta, S. et al. (2002), Cole (2003), Yandle et al. (2004), and Stern, D. I. (2004).

[2] Antweiler et al. (2001) and Copeland and Taylor (2004) argue that there is another competing theory to determine comparative advantage. So-called factor endowments hypothesis assumes that capital-abundant countries (advanced countries) export the capital-intensive (dirty) goods to developing countries.

[3] This relationship is called the pollution haven hypothesis.

[4] Please refer to Suri and Chapman (1988), Antweiler et al. (2001), Cole and Elliot (2003), Cole (2004), Kander and Lindmark (2005), and Takeda and Matsuura (2004), for example.

industries between OECD and non-OECD countries. Like Cole (2004), Takeda and Matsuura (2004) examine how the migration of pollution-intensive industries affects the EKCs of East Asian countries. By focusing on trade of ‘dirty’ goods between East Asian countries and Japan, they show that increasing exports in ‘dirty’ industries to Japan tends to raise CO_2 emissions in East Asian countries. Both Cole (2004) and Takeda and Matsuura (2004) find that the estimated peak turning points in models that include ‘dirty’ goods are higher than those in models that do not.

This paper attempts to test whether these results hold in other developing countries. In particular, we examine the trade relationship between LA countries and the USA, which has emitted the largest volume of CO_2 in the world for more than the past fifty years. Historically, the LA countries have close economic ties with the USA through trade and investment. In addition, neither the USA nor the LA countries are obliged to reduce CO_2 emissions, since the USA has not yet signed the Kyoto Protocol, and developing countries have been exempted from obligations of the Protocol. According to the Carbon Dioxide Information Analysis Center (CDIAC), the total CO_2 emissions of Mexico ranked 11th in 2000, rising from 19th in 1950, and those of Brazil rose to 18th in 2000 from 24th in 1950. Thus, it should be very important to assess how ‘dirty’ trade with the USA affects CO_2 emissions of LA countries.

In this paper the CO_2 emissions of 14 LA countries between 1986 and 1999 are estimated by using trade intensity, the share of manufacturing in GDP, and ‘dirty’ trade with the USA as independent variables. We find that increasing exports of ‘dirty’ products to the USA tends to raise CO_2 emissions in LA countries, while the opposite results occur for growing imports of those goods from the USA. The latter result is consistent with the findings of Aguayo and Gallagher (2005), who show that Mexico’s declining energy intensity has been accompanied by increased imports of energy intensive goods. Since the effect of ‘dirty’ imports from the USA is larger than the effect of ‘dirty’ exports to the USA, our results indicate that the trade of ‘dirty’ products with the USA on the whole reduces CO_2 emissions in LA countries during the estimation period.

The remainder of the paper is organized in the following manner: Section 2 describes the estimation method used and the data, and Section 3 discusses the results. Concluding remarks are provided in Section 4.

2. Estimation method

The EKCs of CO_2 emissions are estimated for 14 LA countries[5] between 1986 and 1999. Specifically, we consider the following equation, using balanced panel data.

$$\ln E_{it} = \alpha + F_i + K_t + \beta_1 \ln Y_{it} + \beta_2 \left(\ln Y_{it}\right)^2 + \delta \ln I_{it} + \gamma \ln M_{it} + \eta \ln DX_{it} + \lambda \ln DM_{it} + \varepsilon_{it}$$

where E is per capita CO_2 emission, F represents country-specific effects, K refers to year-specific effects, Y is per capita real GDP based on 1995 dollar, I and M represent trade intensity and the share of manufacturing in GDP, respectively, DX refers to the share of 'dirty' exports in total exports from the USA to the LA country in question, and DM is the share of 'dirty' imports in the total imports of the USA from an LA country. Subscripts i and t represent country and year, respectively. These variables are taken logarithm. Sources and description statistics of data are presented in Table 1 and 2, respectively.

The trade intensity I is the ratio of the sum of exports and imports to GDP. The share of manufacturing in GDP (M) is included to capture the effects of structural economic change on pollution. DX and DM are included to analyze the effects of 'dirty' trade between the USA and LA countries. 'Dirty' goods here consist of iron and steel, chemicals and chemical products, non-metallic mineral products, and paper-pulp products, which are the top four industries in terms of CO_2 emissions.

Given the relatively short span of our time series (T=14), we test for the existence of a unit root in a panel data setting. In particular, we conduct tests due to Levin, Lin and Chu (LLC) (2002), in which the null hypothesis is that of a unit root. The LLC test supports the view that the variables used in the estimation do not contain a unit root.

Then we conduct tests for strict exogeneity following Wooldridge (2002).[6] The results of the tests support the strict exogeneity for all the variables used in the estimation. The estimation model uses White's adjusted standard errors.

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[5] 14 LA countries here consist of Mexico, Brazil, Chile, Argentina, Peru, Venezuela, Ecuador, Colombia, Costa Rica, Guatemala, Guyana, Honduras, Paraguay, and El Salvador.

[6] A test of strict exogeneity using fixed effects is obtained by specifying the equation.

$$y_{it} = \mathrm{X}_{it}\beta + \Omega_{i,t+1}\gamma + c_i + u_{it}$$

where y is the dependent variable, X is a set of independent variables, Ω is a subset of X that would exclude time dummies. Under strict exogeneity, we should obtain $\gamma = 0$.

3. Results

Table 3 presents estimation results. Model 1 picks up the relationship only between income and pollution, Model 2 adds the relationship trade intensity and the share of manufacturing in GDP, and Model 3 use all the independent variables discussed in the previous section. For all regressions, the coefficients of all independent variables are statistically significant at a 1% or 5% level and have the same sign.

For all regressions, the income-squared term is statistically significant, providing a peak turning point in the relationship between income and pollution. However, the estimated turning points are far out of the income range of the sample for all types of estimation. This indicates that although the estimated coefficients of the income-squared term are negative, in the realistic range of the income, CO_2 emissions exhibit rather an increasing function of income than an inverted U shape. Our results also provide evidence of a positive relationship between the share of manufacturing in GDP. That is, domestic industrialization tends to increase CO_2 emission in LA countries.

With regard to the 'dirty' trade between the USA and LA countries, the 'dirty' imports share in the total imports of the USA has a significantly positive relationship with CO_2 emissions. That is, an increase in exports of 'dirty' goods to the USA raises the production of 'dirty' goods and CO_2 emissions in LA countries. In addition, the coefficients for the 'dirty' exports share in total exports of the USA are significantly negative. This result indicates that imports of 'dirty' goods from the USA can substitute for domestic production, and reduce CO_2 emissions in LA countries. The latter result is consistent with the findings of Aguayo and Gallagher (2005), who show that Mexico's declining energy intensity has been accompanied by increased imports of energy intensive goods. Since the effect of increasing 'dirty' exports from LA countries to the USA is relatively small compared to the effect of increasing 'dirty' imports of LA countries from the USA, the overall effect of the trade of 'dirty' products with the USA reduces CO_2 emissions in LA countries during the estimation period.

In addition to the negative relationship between 'dirty' trade with the USA and CO_2 emissions, our estimation also shows a negative relationship between trade intensity and CO_2 emissions. This indicates that trade liberalization tends to decrease CO_2 emission. Although theoretically trade openness may either reduce pollution by providing industries an incentive to advance technology, or increase pollution by promoting migration of 'dirty' industries, our evidence could support the positive aspects of trade liberalization of developing countries.

4. Concluding remarks

This paper investigated how trade of ‘dirty’ goods with the USA can affect the environmental pollution in LA countries. By controlling for trade openness and the trade of pollution-intensive products with the USA, CO_2 emissions were estimated for ten LA countries between 1986 and 2000. Our results showed that increasing exports of ‘dirty’ products to the USA tends to raise CO_2 emissions in LA countries, while the opposite results occur for growing imports of those goods from the USA. Since the effect of ‘dirty’ imports from the USA is larger than the effect of ‘dirty’ exports to the USA, our results indicate that the trade of ‘dirty’ products with the USA on the whole reduces CO_2 emissions in LA countries during the estimation period.

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Table 1: Data Sources

Variable	Source
CO_2 emission	Marland, G., T. A. Boden, and R. J. Andres (2003)
Real GDP per capita	World Bank (2003)
Trade as % of GDP	Penn World Tables 6.1
Share of dirty US imports and exports in total imports and exports	Calculated using trade statistics from OECD ITCS International Trade Data. The following categories were sclassed as dirty sectors. 5 Chemicals and related products, n.e.s. 64 Paper, paperboard, articles of paper, paper-pulp/board 66 Non-metallic mineral manufactures, n.e.s. 67 Iron and steel

Table 2: Description Statistics

	Real GDP per capita Constant price (1995 $)	CO_2 emission (kg/person)	DX (%)	DM (%)	I (%)	M (%)
Mean	2,681.8	551.4	5.2	18.8	57.4	19.2
Median	2,245.5	415.0	2.9	18.7	46.5	19.1
Maximum	8,462.6	1,940.0	27.2	37.0	285.3	33.0
Minimum	603.6	110.0	0.1	3.4	9.1	9.4
Std. Dev.	1,710.9	433.5	5.6	6.8	45.9	4.4
Skewness	1.3	1.5	1.8	-0.1	2.3	0.5
Kurtosis	1.7	1.4	2.9	0.0	7.1	0.4
Observation	196	196	196	196	196	196

Table 3: Estimation Results for the CO_2 Emissions

	1			2			3		
lnY	1.036	(0.08)	**	0.983	(0.10)	**	1.018	(0.12)	**
$\ln Y^2$	-0.023	(0.01)	*	-0.024	(0.01)	*	-0.027	(0.01)	*
lnI				-0.168	(0.05)	**	-0.162	(0.03)	**
lnM				0.328	(0.05)	**	0.337	(0.05)	**
lnDX							-0.068	(0.03)	*
lnDM							0.038	(0.01)	**
Turning point	99,925,463			820,000,000			135,000,000		
Adjusted R2	0.999			0.997			0.996		
S.E.	0.113			0.104			0.102		
n	196			196			196		

Notes 1: Standard errors are in parenthesis.

2. ** and * denote statistical significance at 99% and 95% confidence levels, respectively.