

# Do Polluters Head Overseas?

## Testing the Pollution Haven Hypothesis

by

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*Critics of globalization have long alleged that multinationals essentially export pollution to developing countries by putting their dirtiest operations there. A new study says that is not true.*

### Foreign Economic Setting

In 2001, direct foreign investment was the most important source of external finance for developing countries. Following the virtual disappearance of commercial bank lending to these countries in the 1980s, many countries liberalized their restrictions on incoming foreign investment in the 1990s. Some even tilted the balance toward foreign firms by offering special incentives. Until recently in the Czech Republic, joint ventures paid lower income taxes than domestic enterprises and foreign firms in much of the Caribbean received income tax holidays, import duty exemptions and subsidies for infrastructure.

The pro-investment policies of the 1990s were very different from the wave of nationalizations which drove out foreign investment in many regions during the 1960s and 1970s. The new attitude was in part driven by the need for alternative sources of new capital, and in part driven by increasing skepticism about import-substituting trade and investment strategies.

### Research Focus

My research (conducted jointly with Gunnar Eskeland at the World Bank) tests for the possibility that foreign investors are drawn to so-called “pollution havens”—regions in which environmental regulations are either less severe or not well enforced. This research focuses on the manufacturing sectors in four countries: Mexico, Venezuela, Ivory Coast and Morocco. In the late 1980s, the share of foreign assets in manufacturing varied from 38 percent in Ivory Coast to seven percent in Venezuela. Foreign investment accounted for about 15 percent of total assets in Moroccan manufacturing, and ten percent in Mexico.

The analysis of pollution havens and foreign investors is divided into three parts. First, we examine whether foreign investors in these four

developing countries are attracted toward “dirtier” sectors, defined as product groups where either pollution emissions are high or pollution abatement costs are high (such as cement or oil refining). Second, we then compare the energy efficiency of domestic enterprises and multinationals in these same countries. This allows us to see whether foreign investors played an important role in improving the environment by using more energy-efficient technology as well as cleaner sources of energy. Finally, we examine whether the pattern of outward U.S. foreign investment is skewed toward sectors with high pollution abatement costs.

We first analyzed whether the pattern of foreign investment in the four developing countries provides any evidence of pollution havens. Is there more foreign investment in sectors with high pollution abatement costs or high emissions, after controlling for other factors that affect the pattern of foreign investment? This means that we need to control for such factors as the degree of competition, the size of the domestic market, domestic wages and other factors that make the market attractive. Once we control for these factors, we then analyze whether there is more foreign investment in sectors where pollution abatement costs in the United States are high, using annual, sector-level data drawn from U.S. surveys on pollution abatement costs among manufacturing plants.

The results suggest that pollution abatement costs in the U.S. have no impact on the pattern of foreign investment in these four countries. In other words, there is no more investment in Mexico in petroleum refining or cement, sectors with high abatement costs, than there is in other sectors. As a follow-up, we used emissions data from the U.S. toxic release inventory (TRI) to analyze whether or not there is more foreign investment in these four developing countries in areas of manufacturing where U.S. pollution emissions are high. As measures of

**Table 1: Correlations Between Pollution Emission Intensities and Abatement Costs**

	Total Particulates (TP)	Biological Oxygen Demand (BOD)	Total Toxic Releases (TOX)	Pollution Abate- ment Cost (PAC)
TP	1.0			
BOD	-0.08	1.0		
TOX	0.03	-0.10	1.0	
PAC	0.12	-0.13	0.80	1.0

*BOLD indicates statistical significance at the 5 percent level.*

emissions, we use total particulates (TP), a measure of air pollution; biological oxygen demand (BOD), which is a broad measure of water pollution; and total toxic releases (TOX).

### Impact of Emissions

Total particulates, which capture small and large dust particles, are closely related to phenomena such as the (now historic) London smog and to air pollution in cities with emissions from fuel and diesel oil combustion, energy-intensive processes such as steel and cement, two-stroke engines, coal use, and burning of wood and residues. Analysis in the World Bank and elsewhere indicates that the release of particulates is the main air pollution problem in many third world cities (as judged by health impact). Biological Oxygen Demand (BOD) indicates how discharges to water bodies deplete their oxygen levels, and is widely accepted as a broad measure of water pollution. Total toxic releases (TOX) is an unweighted sum of releases of the 320 compounds in the U.S. EPA's toxic chemical release inventory. All of these measures are by weight. Emissions are divided by the total output of the firm, measured in monetary terms, to arrive at sector-specific emission intensities for the three pollutants.

### Data Collected

Table 1 reports the correlations between these three measures of emission intensity and U.S. pollution abatement costs (PAC). Correlation coefficients are a measure of the statistical relationship between two variables. They range from  $-1.0$  (perfect inverse correlation) to  $1.0$  (perfect positive correlation). A correlation coefficient near zero implies little relationship between the two variables. Table 1 shows that, in a comparison

among different manufacturing subsectors within the United States, there is no significant correlation between air pollution, water pollution and toxicity. Thus, although these three measures of pollution are very broadly defined, there is no general tendency that a sector which pollutes in one medium also pollutes in another medium. However, Table 1 does report a statistically significant correlation between abatement costs and toxic releases. Industries which on average have high abatement costs typically also emit toxic substances. If we use these alternative measures of pollution intensity in our analysis, we again find no relationship between high emissions in the U.S. and the pattern of foreign investment abroad.

The second part of the study examines the behavior of foreign and domestic enterprises in these four host countries. We find that multinational firms are significantly more efficient in their use of energy than domestic plants. In addition, multinationals tend to use cleaner types of energy, such as electricity and natural gas. Even if we take into account the fact that multinational enterprises are typically younger than domestic firms, we still find that multinational firms of the same vintage are more energy efficient. To the extent that energy use is a good proxy for pollution emissions, this suggests that multinationals in developing countries tend to use cleaner technologies than domestic firms.

To test whether energy use is a good proxy for emissions, we explore the relationship between energy use and toxicity across sectors, using U.S. data. We show that even in the U.S., where respectable air pollution control programs have been in place for more than 20 years, and the choice of fuels and electricity is highly varied, there is a strong statistical relationship between air pollution coefficients and energy use. As in Table 1, we use three measures of emissions: particulates, which measure air pollution; BOD, which measures water pollution; and toxics.

We report the rank correlations between those emissions and six different factor inputs in Table 2: the share of unskilled labor in total value of shipments, the skilled labor share, capital share, manufactured input shares, raw material input shares, and the share of energy inputs in total output. Energy use is highly correlated with different measures of emissions. The correlation between energy use and particulates is .58; between toxics and energy use

the correlation varies between 0.52 and 0.55. The correlation with BOD is lower at 0.22, though also significantly different from zero. Table 2 also shows that the correlation between pollution and energy use is much higher than for other factor inputs.

Yet even if energy intensity could provide a good proxy for emissions across industries, energy intensity may not be a good proxy for differences in emissions between plants within the same industry. To investigate this issue, we used a cross section of U.S. manufacturing firms to examine the relationship between different types of factor inputs and plant-specific emissions, one industry at a time. The strength of the relationship between energy use and emissions varies with the type of industry. Specifically, particulates are highly correlated with energy use at the plant level for only four industries: chemicals, petroleum refining, lumber and wood products, and non-electrical machinery. Two of the most polluting activities in manufacturing—chemicals and petroleum refining—are included in these four sectors. Consequently, we repeated the analysis, restricting ourselves to only those four sectors where energy use serves as a reasonable proxy for emissions. We find that in those sectors, foreign firms are indeed more efficient in their use of energy.

### U.S. Foreign Investment

The third part of the study shifts the focus from developing countries to the United States. We examined the pattern of outbound U.S. foreign investment, asking whether, after controlling for other factors, there is any indication that most foreign investment originating in the United States and relocating abroad is located in pollution-intensive sectors. We find some evidence in support of this hypothesis, but the results are too weak to make strong claims.

### Conclusion

In summary, our research provides little evidence for the hypothesis that foreign investors are drawn to

**Table 2: Energy Intensity and Pollution Emissions Across Industries: Rank Correlation Coefficients**

	Particulates	BOD	TOC	Unskilled Labor	Skilled Labor	Capital	Manufactured Inputs	Raw Material Inputs	Energy
Particulates	1.00								
BOD	0.29	1.00							
TOX	0.30	0.19	1.00						
Unskilled Labor	-0.15	-0.16	0.10	1.00					
Skilled Labor	-0.25	-0.35	0.05	0.36	1.00				
Capital	0.28	0.09	0.38	0.01	0.48	1.00			
Manufactured Inputs	-0.19	-0.13	0.06	-0.01	-0.20	-0.33	1.00		
Raw Material Inputs	0.44	0.34	0.17	-0.33	-0.42	0.06	-0.24	1.00	
Energy	0.58	0.22	0.52	0.04	0.04	0.62	-0.19	0.34	1.00

*BOLD indicates statistical significance at the 5 percent level.*

pollution havens. There is no tendency for multinational firms to locate in dirtier sectors, although there is weak evidence that they do locate in sectors with higher abatement costs. These conclusions are consistent with earlier studies which find no evidence that multinationals are drawn to pollution havens. One reason is that pollution abatement costs are typically not a major component of operating costs for firms. Another reason is that foreign investors find other factors more important in deciding to relocate abroad—such as the size of the domestic market.

The results of this study were featured recently in the June 24, 2002 issue of *Business Week*. As I pointed out to the reporter, multinationals are becoming increasingly sensitive to their image both in the host country and in the U.S. One important outcome of shareholder and consumer activism has been to put greater pressure on corporations to treat the environment well. The firms know they have an image problem, and eventually regulations in developing countries will begin to resemble those in developed countries. For these reasons, it is not surprising that foreign firms are not flocking to pollution havens. My study, which used data from the 1980s and 1990s, would have probably led to even stronger results if we had used data solely from the 1990s.

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