

Racing to the Bottom?

Foreign Investment and Air Pollution in Developing Countries

David Wheeler*
Development Research Group
World Bank

*** The author is Lead Economist in the Infrastructure/Environment Team of the Development Research Group. Many thanks to Ashoka Mody for useful comments on a previous draft of this paper.**

Abstract

Critics of free trade have raised the specter of a "race to the bottom," in which environmental standards collapse because polluters threaten to relocate to "pollution havens" in the developing world. Proponents of this view advocate high, globally-uniform standards, enforced by punitive trade measures that neutralize the cost advantage of would-be pollution havens. To test the race-to-the-bottom model, this paper analyzes recent air quality trends in the United States and the three largest recipients of foreign investment in the developing world, China, Brazil and Mexico. The evidence clearly contradicts the model's central prediction: The most dangerous form of air pollution has actually declined in major cities of all four countries during the era of globalization. Citing recent research, the paper argues that the race-to-the-bottom model is flawed because its basic assumptions misrepresent the political economy of pollution control in developing countries

Racing to the Bottom? Foreign Investment and Air Pollution in Developing Countries

1. Introduction

Could globalization trigger an environmental "race to the bottom," in which competition for investment and jobs relentlessly degrades environmental standards? Since billions of people subsist on less than two dollars a day, it would be cavalier to dismiss this threat lightly. Indeed, the race-to-the-bottom model provokes widespread concern because its underlying assumptions have an air of plausibility.¹ In the race-to-the-bottom world, decent environmental standards impose high costs on polluters in high-income economies. To remain competitive, these firms relocate to low-income countries whose people are desperate for jobs and income. Local governments ignore regulation to promote investment and economic growth, allowing businesses to minimize costs by polluting with impunity. Driven by shareholders to maximize profits, international firms follow suit. Rising capital outflows force governments in high-income countries to begin

¹ Daly (2000) has recently provided a forceful statement of the race-to-the-bottom model. In the US, political opponents of NAFTA and the WTO frequently invoke elements of the model. For example, Congressman David Bonior has recently offered the following critique of the WTO: "... many of the world's political and economic leaders have adopted our ways of discussing the global economy. They're warning against 'a race to the bottom.' They calling for 'putting a human face on the global economy.' And they say they're supporting labor and environmental standards in trade agreements Make no mistake about what is at stake in the deliberations and decisions of the WTO. ... The WTO, as currently structured, threatens to undo internationally everything we have achieved nationally - every environmental protection, every consumer safeguard, every labor victory." (Bonior, 1999)

In a similar vein, the Nader-for-President campaign has offered this statement on Trade and Environment at its Website (<http://www.votenader.com/issues/environment.html>): "Among the most fetid examples of political cowardice and collusion between elected representatives and big business of the past thirty-five years are the passage of the North American Free Trade Agreement (NAFTA) and the revised General Agreement on Tariffs and Trade (GATT) into federal law. These agreements have little to do with the benefits of trade for citizens of member countries. The agreements were designed, largely by corporate lobbyists, as a "pull-down" mechanism and to facilitate the movement of capital across national boundaries. Such one-dimensional monetized logic tramples long-standing efforts around the world—some very successful—to protect the environment because environmental safeguards are very often considered 'non-tariff barriers to trade' and thus become targets for removal. Five years of WTO operation have made clear what a grave threat the trade organization is to the world environment."

relaxing environmental standards, but this proves fruitless because the poorest countries have no environmental standards at all. As the ensuing "race to the bottom" accelerates, all countries converge to the hellish pollution levels that afflict the poorest.

Proponents of this catastrophe model have a straightforward preventive recommendation: High, globally-uniform environmental standards and, for countries that are unwilling or unable to enforce them, tariffs or other restrictions on imports of their pollution-intensive products that neutralize their cost advantage as pollution havens. Proponents of free trade naturally view these prescriptions as anathema, arguing that their main impact would be denial of jobs and income to the world's poorest people.

2. A Simple Test of the Race-to-the-Bottom Model

If the race-to-the-bottom model is correct, then globalization will ultimately provoke a strong backlash in high-income countries as business relocation threatens jobs, wages and environmental standards. Fortunately, the potential for this reversal is easy to gauge because the simple structure of the race-to-the-bottom model yields an equally simple, robust prediction: After decades of increasing capital mobility and economic liberalization, the race to the bottom should be underway and pollution should be increasing everywhere. It should be rising in poor countries because they are pollution havens, and in high-income economies because they are relaxing standards to remain cost-competitive. Trends in available pollution data provide a reasonable basis for testing these propositions.

Climatic and economic factors cause pollution to vary considerably from year to year, so trend analysis requires an extended series of monitoring data. For comparison of environmental conditions in large urban regions, air pollution measures are generally

more reliable and comparable than water pollution data. Among widely-measured air pollutants, the international health community currently believes the most damaging to be suspended particulate matter (dust). Numerous health studies in low- and high-income countries have associated high concentrations of suspended particulates with higher-than-normal rates of death and illness from cardio-pulmonary problems. Over time, health research has narrowed its focus from all suspended particulate matter (SPM) to particles less than 10 microns in diameter (PM-10) and, most recently, to particles whose diameters are less than 2.5 microns (PM-2.5). Atmospheric monitoring is adjusting to these findings, but PM-2.5 readings remain scarce in low-income countries. Since all particulate concentration measures are correlated, however, even SPM measures provide useful information about pollution that severely damages human health.

Air quality monitoring is routine in high-income countries, but it remains uneven in the developing world. China, Mexico and Brazil provide notable exceptions. During the past two decades, these three rapidly-industrializing countries have begun monitoring and reporting SPM, PM-10, and other forms of air pollution in a number of industrial centers. In addition, they have had the top three shares of foreign direct investment among developing countries throughout the 1990's. China's average share has been 28%, while the averages for Mexico and Brazil have been 9% and 7%, respectively. As Figure 1 shows, their combined FDI was nearly 60% of the total for developing countries in 1998. If the race-to-the-bottom model is correct, then urban SPM and PM-10 levels should be rising in all three countries. In the United States, race-to-the-bottom proponents have been particularly vocal about more liberal trade agreements with Mexico and China. It

would seem reasonable to trace this concern to deteriorating air quality in US cities, since US industrial imports from all three countries have been expanding for decades.

To test the race-to-the-bottom prediction, Figures 2-4 present SPM and PM-10 monitoring data along with foreign direct investment statistics for China, Mexico and Sao Paulo State, which is Brazil's dominant industrial region. For comparison, Figure 5 displays PM-10 monitoring data from five US metropolitan areas (Los Angeles, Houston, Chicago, Atlanta and New York). The Chinese series is the average annual SPM reading for over 50 cities, reflecting the extensive coverage of China's air monitoring network. The Mexican data reflect SPM readings in Mexico City, while the Brazilian series are drawn from PM-10 measures for the industrial region of Cubatao in Sao Paulo State. Mexico City is by far the largest industrial center in Mexico and Cubatao has traditionally been a center for pollution-intensive industry in Sao Paulo.² These two regions, along with Los Angeles, suffer from geographic and climatic conditions that make them natural "traps" for air pollution.

The foreign investment data in Figures 1-4 provide a compelling picture of expansion in China, Mexico and Brazil during the past two decades. However, Figures 2-5 show no sign of a race to the bottom; trends in particulate pollution are downward in all four countries. Despite China's poverty and rapid industrialization, its major urban areas have experienced a significant decline in SPM. During the period 1987 - 1995, the average concentration fell from nearly 500 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) to somewhat over 300. After rising in the early 1990's, Mexico City's percentage of SPM

² Data sources: US: USEPA online at <http://www.epa.gov/oar/aqtrnd97/tables.html>; Brazil: Pollution Control Agency of Sao Paulo State (CETESB, 1996, 1990, 1994) and CETESB online at <http://www.cetesb.br>; China: China Environmental Monitoring Center and Wheeler (1999); Mexico: National Environment Ministry online at http://www.ine.gob.mx/dggia/cal_aire/libros/segu_info/mexico.html

readings above standards fell to historical lows in the latter part of the decade (the period during which NAFTA was implemented). In Cubatao, Brazil, the average PM-10 concentration fell from 180 ug/m³ in 1984 to around 80 in 1998.³ In the United States, all five metropolitan areas had declining PM-10 concentrations during the period 1988-1997. The sharpest reduction -- 32% -- was recorded in Los Angeles, the largest US urban-industrial area in the region most affected by NAFTA.

These results strongly contradict the race-to-the-bottom model. Instead of racing toward the bottom, major urban areas in China, Brazil, Mexico and the US have all experienced significant improvements in air quality. The improvements in Los Angeles and Mexico City are particularly noteworthy, since they are the dominant industrial centers in the region most strongly affected by NAFTA.

3. Problems with the Race-to-the-Bottom Model

The race-to-the-bottom model's basic assumptions must be flawed, since its predictions are inconsistent with urban air pollution trends in three of the developing world's major industrial powers. In fact, empirical research has undermined all of these assumptions.

1. Pollution control is not a critical cost factor for most private firms. Research in both high- and low-income countries suggests that pollution control does not impose high costs on business firms. Jaffe (1995) and others have shown that compliance costs for OECD industries are surprisingly small, despite the use of command-and-control regulations that are economically inefficient. These results suggest that differential

³ Comparable PM-10 series for the Sao Paulo Metropolitan Area are not available. However, air quality reports from CETESB, Sao Paulo State's Environmental Agency, show that average SPM levels in Sao Paulo fell by 52% during the period 1980 - 1995.

pollution control costs do not provide OECD firms with strong incentives to move offshore. Firms in developing countries frequently have even lower costs, because the labor and materials used for pollution control are less costly than in the OECD economies. Big polluters also have lower average control costs per unit of pollution because abatement is subject to scale economies. Figure 6 displays recent econometric estimates of control costs for sulfur dioxide air pollution in large Chinese factories (Dasgupta, Wang and Wheeler, 1997).⁴ For non-state-owned enterprises, costs of a few dollars per ton are typical until control rates rise above 70%. As Figure 6 shows, state-owned enterprises have much higher costs because they are operated less efficiently. The average cost of pollution control has therefore declined as China has moved away from state ownership during the era of liberalization. In Colombia, a new pollution charge program has sharply reduced organic water pollution by large factories. Colombian factory managers have found that cleaning up is cheaper than paying charges, even when they are set at relatively low levels. No participating factory seems to have experienced financial difficulties in the process (Wheeler, 1999). Similar conclusions have emerged from studies of regulation and control costs in Malaysia (Jha, Markandya and Vossenaar, 1999; Khalid and Braden, 1993).

2. Low-income communities penalize dangerous polluters, even when formal regulation is weak or absent. Abundant evidence from Asia and Latin America shows that neighboring communities can strongly influence factories' environmental

⁴ Xu, et. al. (1994) have shown that atmospheric sulfur dioxide (SO₂) concentrations are highly correlated with damage from respiratory disease in China. Sulfur dioxide and other oxides of sulfur combine with oxygen to form sulfates, and with water vapor to form aerosols of sulfurous and sulfuric acid. Much of the health damage from SO₂ seems to come from fine particulates (PM-2.5) in the form of sulfates.

performance.⁵ Where formal regulators are present, communities use the political process to influence the strictness of enforcement. Where regulators are absent or ineffective, NGOs and community groups -- including religious institutions, social organizations, citizens' movements, and politicians -- pursue informal regulation based on convincing polluters to conform to social norms. Although these groups vary from region to region, the pattern everywhere is similar: Factories negotiate directly with local actors in response to threats of social, political or physical sanctions if they fail to compensate the community or reduce emissions.

Indeed, communities sometimes resort to extreme measures when sufficiently provoked. In the *Asian Survey*, Robert Cribb has recounted an Indonesian incident "reported from Banjaraan near Jakarta in 1980 when local farmers burned a government-owned chemical factory that had been polluting their irrigation channels." In a similar vein, Mark Clifford has reported in the *Far Eastern Economic Review* that community action prevented the opening of a chemical complex in Korea until appropriate pollution control equipment was installed.

When factories respond directly to communities, the results may bear little resemblance to the dictates of formal regulation. For example, Cribb also cites the case of a cement factory in Jakarta that -- without admitting liability for the dust it generates -- "compensates local people with an ex gratia payment of Rp. 5,000 and a tin of evaporated milk every month." In India, Anil Agarwal, et al. (1982) describe a situation where, confronted by community complaints, an Indian paper mill installed pollution abatement equipment -- and, to compensate residents for remaining damage, the mill also

⁵ See Pargal and Wheeler (1996), Hettige, Huq, Pargal and Wheeler (1996), Huq and Wheeler (1992), Hartman, Huq and Wheeler (1997), and Dasgupta, Lucas and Wheeler (1998).

constructed a Hindu temple. If all else fails, community action can also trigger physical removal of the problem. In Rio de Janeiro, for example, a neighborhood association protest against a polluting tannery led managers to relocate it to the city's outskirts (Stotz, 1991).

3. Rising income strengthens regulation. Countries regulate pollution more strictly as they get wealthier for three main reasons. First, pollution damage gets higher priority after rising wealth has financed basic investments in health and education. Second, higher-income societies have stronger regulatory institutions because technical personnel are more plentiful and budgets for monitoring and enforcement activities are more generous. Third, higher income and education empower local communities to enforce higher environmental standards, whatever stance is taken by the national government (Dasgupta and Wheeler, 1996; Pargal and Wheeler, 1996). The result is a very close relationship between national pollution regulation and income per capita, as illustrated by Figure 7.

4. Local businesses control pollution because abatement reduces costs. Although public spirit moves a notable minority of firms to control pollution, most managers are bound by pressures from markets and shareholders. Through a variety of channels, regulatory and market forces induce managers to reduce costs by controlling pollution. Where formal regulation is well-developed, financial penalties for excessive pollution can include charges, fines and revenue losses from plant closures. Where formal regulation is not present, local communities can exact penalties through political, social and economic channels. Market agents can also play an important role. Bankers may refuse to extend credit because they are worried about liability; consumers may avoid the

products of firms that are known to be heavy polluters. Responding to these factors, cost-minimizing managers will reduce pollution to the point where the marginal cost of abatement equals the marginal penalty for polluting.

Polluting emissions also reflect managers' technology decisions. Pollutants are unmarketed production residuals whose disposal creates environmental damage. Improved technologies that waste fewer raw materials therefore have an environmental advantage that complements their cost advantage. In the OECD countries, innovations induced by stricter regulation have generated significantly cleaner technologies that are available at incremental cost to producers in developing countries. Even in weakly-regulated economies, many firms have adopted cleaner technologies simply because they are more profitable. Empirical studies have shown that firms in relatively open developing economies adopt such technologies more quickly (Birdsall and Wheeler, 1993; Huq, Martin and Wheeler, 1993).

5. Large multinational firms generally adhere to OECD environmental standards in their developing-country operations. Multinational firms operate under close scrutiny from consumers and environmental NGOs in the OECD economies. While the influence of these groups is well-known, recent research has suggested that investors also play an important role in encouraging clean production. Heavy emissions may signal to investors that a firm's production techniques are inefficient. Investors also weigh potential financial losses from regulatory penalties and liability settlements. Several studies have confirmed that the US and Canadian stock markets react significantly to environmental

news, generating gains from good news and losses from bad news in the range of 1-2%.⁶

According to a recent study of toxic polluters (Konar and Cohen, 1997), firms whose bad press has the greatest impact on stock prices subsequently reduce emissions the most. Similar effects have been identified by recent research on new stock markets in Argentina, Chile, Mexico and the Philippines (Dasgupta, Laplante and Mamingi, 1997). In fact, the responses are much larger than those reported for US and Canadian firms: Gains average 20% in response to good news and losses range from 4-15% in the wake of bad news.

Multinationals have responded to such factors. A recent study of 89 US-based manufacturing and mining multinationals with branches in developing countries found that nearly 60% adhere to a stringent internal standard that reflects OECD norms, while the others enforce local standards (Dowell, Hart and Yeung, 2000). Controlling for other factors (e.g. physical assets, capital structure), the study found that firms with uniform internal standards had an average market value \$10.4 billion higher than their counterparts. To illustrate the implications for local environmental quality, Figure 8 reports results from a careful audit of Indonesian factories undertaken in 1995 (Afsah and Vincent, 1997). Almost 70% of domestic plants failed to comply with Indonesian water pollution regulations, while around 80% of the multinational plants were fully compliant.

4. Implications of the Evidence

A large body of evidence suggests that the predictions of the race-to-the-bottom model are inaccurate because its assumptions are not realistic. Although pollution

⁶ See Muoghalu et al. (1990); Lanoie, Laplante (1994); Klassen, McLaughlin (1996); Hamilton (1995); and Lanoie, Laplante and Roy (1997).

control costs matter to factory owners and managers, they are generally not a critical factor in location decisions. In addition, emissions are strongly affected by the increased availability of clean technologies and the ubiquity of penalties for polluting. Even where formal regulation is weak or absent, local communities use numerous informal channels to penalize polluters when they suffer from severe environmental damage. At the national level, governments display a remarkably consistent tendency to tighten regulation as incomes grow. Within countries, regional differences in income and education also produce variations in community-based enforcement of environmental norms. At the international level, scrutiny from customers and investors has led the majority of firms to standardize their environmental performance on OECD norms. The rest subscribe to local norms, which rise over time with income.

In this more realistic view of the world, an environmental "race to the bottom" appears extremely unlikely. In fact, the converse appears to occur as "the bottom" rises with economic growth. The poorest societies persistently improve their environmental quality as investment increases employment and income. Mutually-reinforcing feedback mechanisms at the local, national and international levels produce increasing pressures for pollution control as societies develop.

While the evidence suggests that globalization has been generally compatible with pollution reduction, several caveats are in order. First, to invert Keynes' maxim, "in the short run a lot of us might be dead." Under rapid liberalization, a sudden increase of industrial investment could create pockets of severe pollution before national governments or local communities could respond effectively. This could occur even if "clean" multinationals expanded locally, since domestic firms would also be attracted by

increased production and export opportunities. Second, communities' capacity to control pollution formally or informally depends on the quality of available information about emissions sources and damages. Some dangerous pollutants can be seen or smelled, but others cannot be detected without specialized equipment. So, information gaps may well lead to much higher levels of contamination than local communities would tolerate if they were better-informed.

Third, globalization is almost certain to produce an increase in average pollution intensity (emissions/output) as developing countries increase their share of world industrial production. High-income countries have stricter formal and informal regulation than low-income countries, so production in the latter has higher pollution intensity (on average -- exceptions have been noted in the previous section). To illustrate, Figure 9 summarizes a recent econometric result from a cross-country analysis of organic water pollution: Relative to the highest-income countries, the poorest countries have an approximately tenfold differential in pollution intensity. The biggest improvements come relatively early in the growth process, as countries grow from around \$500 per capita to \$3,000 per capita. After that, the marginal improvements level off considerably (Mani and Wheeler, 1998).

The air monitoring data in Figures 2-5 reveal the consequences of differential pollution intensity. In the late 1990's, Cubatao's PM-10 concentration was around 80 while PM-10 concentrations in most US cities were below 30. After a decade of decline, China's urban SPM readings were still around 300 in 1995 -- far higher than readings in OECD cities. This differential may have created the mistaken view that globalization is creating a "race to the bottom," even though air quality seems to be improving in

countries at all income levels. If current trends continue, the "bottom" will continue to rise and international average pollution intensities will begin to fall at some point in the future. The critical point for the globalization debate is that cities in developing countries have actually improved their environmental quality during a period of rapid liberalization and industrial growth.

7. Conclusions and Policy Implications

A large body of evidence suggests that there will be no environmental "race to the bottom" for two main reasons. First, communities in developing countries are neither passive agents nor focused exclusively on material gain. Empowered with good information about the benefits and costs of environmental protection, they will act to protect their own interests. As their income and education levels improve, they will control pollution more strictly. Second, consumers and investors assign significant value to environmental performance and, if they are well-informed, their market decisions will provide powerful incentives to reduce pollution. On both counts, the most plausible long-run forecast is for rising, not falling, environmental quality in both high- and low-income economies. A significant gap may remain, but pollution damage should decline significantly in poor countries as they develop.

While this news is good for the global commons in the long run, adjustment to a cleaner world is not likely to be smooth. Countries whose economic policies induce a rapid expansion of income and employment may also experience severe environmental damage unless direct measures are taken to accelerate regulation's positive long-run response to income growth. On the macro-policy front, the persistence of a regulatory gap between rich and poor countries may lead to continuing controversy over trade policy

and international assistance strategy. OECD interest groups that support protectionist measures for other reasons may continue to invoke the race-to-the-bottom model, relying on a common misperception that the regulatory gap automatically implies a race to the bottom. Despite clear evidence to the contrary, they may continue to argue that a race to the bottom can only be avoided through enforcement of uniform environmental standards in all countries. Lacking any direct means of creating such a regime, they may argue for trade restrictions and aid cutbacks until poor countries close the gap. The available evidence suggests that such measures will retard, not advance, the day when the gap actually disappears.

In summary, the basic assumptions of the race-to-the-bottom model are contradicted by a large body of empirical research. Its flaws invalidate its main conclusion (the inevitability of the race to the bottom) and its main policy prescription (uniform standards, enforced by any means necessary). Abandoning this theory, however, does not imply that poor countries must resign themselves to bad environmental quality for an extended period. Several recent benefit-cost analyses have made a persuasive case for stricter pollution control, even in very low-income economies. In China, for example, a recent study has shown that the economic returns to pollution abatement would justify significant tightening of regulation (Dasgupta, Wang and Wheeler, 1997). Similar studies in Indonesia and Brazil have produced similar conclusions.⁷

How can environmental quality improvement be accelerated in the era of globalization? Recent international experience has identified four keys to rapid progress:

1. Sustained support for programs that provide public, easily-accessible information about polluters, pollution damages, local environmental quality and the cost of pollution

abatement. Such programs significantly improve the ability of local communities to protect themselves, national regulators to enforce decent environmental standards, and market agents to reward clean firms and punish heavy polluters. International institutions such as the World Bank have begun supporting this idea in collaborative programs with environmental agencies in Indonesia, Philippines, China, Thailand, Vietnam, Mexico, Colombia, Brazil and elsewhere.⁸

2. Sustained support for development of stronger regulatory institutions and cost-effective measures to reduce pollution. Sustained support is critical, because institutional development takes time. Although private sector clean-production initiatives can play a valuable role, only public sector institutions can protect society's general interest in a cleaner environment.

3. Rejection of trade and aid sanctions as levers to force closure of the regulatory gap between low- and high-income countries. First, such sanctions are unjust because they fail to discriminate between clean and dirty firms in the affected countries. Numerous studies have shown that factories with world-class standards are operating even in the poorest countries (Huq and Wheeler, 1992; Hartman, Huq and Wheeler, 1997; Afsah and Vincent, 1997; Wheeler, 1999). Second, such blunt instruments will inevitably penalize workers in poor countries by reducing opportunities for jobs and higher wages. Finally, they won't work anyway. As previous sections have noted, poor countries have weaker regulation and higher pollution intensity for a host of reasons.

⁷ See Von Amsberg (1997) on Brazil and Calkins (1993) on Indonesia.

⁸ For more information about these programs, see the World Bank's "New Ideas in Pollution Regulation" Website at <http://www.worldbank.org/nipr>.

Governments of low-income countries could not deliver on promises of OECD-level regulation, even if they were willing to make them.

4. Willingness by the World Bank, the IMF and other institutions to take explicit account of environmental risks in the design and implementation of adjustment operations and other economic reform programs. Rapid structural change could inflict severe pollution damage on some localities unless public environmental information and regulation keep pace with changing conditions. Willingness to recognize and compensate for this risk with targeted programs will greatly strengthen the credibility of international institutions that support continued economic liberalization in the name of sustainable development.

References

- Afsah, S. and J. Vincent, 1997, "Putting Pressure on Polluters: Indonesia's PROPER Program," A Case Study for the HIID 1997 Asia Environmental Economics Policy Seminar (Harvard Institute for International Development), March.
- Agarwal, A., R. Chopra, and K. Sharma, 1982, "The State of India's Environment, 1982," New Delhi, India: Centre for Science and Environment.
- Birdsall, N. and D. Wheeler, 1993, "Trade Policy and Industrial Pollution in Latin America: Where Are The Pollution Havens?" **Journal of Environment and Development**, 2,1, Winter.
- Bonior, D., 1999, "Defending Democracy in the New Global Economy," statement to an AFL-CIO conference on workers' rights, trade development, and the WTO, Seattle, Washington, December.
- Calkins, R., et. al., 1994, **Indonesia: Environment and Development** (Washington: World Bank).
- Clifford, M., 1990, "Kicking up a stink: South Korean Government reels from anti-pollution backlash," **Far Eastern Economic Review**, Oct. 18, 72-73.
- Cribb, R., 1990, "The Politics of Pollution Control in Indonesia," **Asian Survey**, 30: 1123-35
- Daly, H., 2000, "Globalization," presented at the 50th Anniversary Conference of the Aspen Institute, Aspen, Colorado, August.
- Dasgupta, S. and D. Wheeler, 1996, "Citizen Complaints As Environmental Indicators: Evidence From China," **World Bank Policy Research Department Working Paper**, No. 1704, November.
- Dasgupta, S., B. Laplante and N. Mamingi, 1997, "Capital Market Responses to Environmental Performance in Developing Countries," **World Bank Development Research Group Working Paper**, No. 1909, October.
- Dasgupta, S., A. Mody, S. Roy and D. Wheeler, 1995, "Environmental Regulation And Development: A Cross-Country Empirical Analysis," **World Bank Policy Research Department Working Paper**, No. 1448, March.
- Dasgupta, S., H. Wang and D. Wheeler, 1997, "Surviving Success: Policy Reform and the Future of Industrial Pollution in China," **World Bank Policy Research Department Working Paper**, No. 1856, October.

- Dasgupta, S., R. Lucas and D. Wheeler, 1998, "Small Manufacturing Plants, Pollution and Poverty: New Evidence from Brazil and Mexico," **World Bank Development Research Group Working Paper**, No. 2029, December.
- Dowell, G., S. Hart and B. Yeung, 2000, "Do Corporate Global Environmental Standards Create or Destroy Market Value?" **Management Science**, August.
- Hamilton, J., 1995, "Pollution as News: Media and Stock Market Reactions to the Toxic Release Inventory Data," **Journal of Environmental Economics and Management**, 28, 98-103.
- Hartman, R., M. Huq and D. Wheeler, 1997, "Why Paper Mills Clean Up: Determinants of Pollution Abatement in Four Asian Countries," **World Bank Policy Research Department Working Paper**, No. 1710, January.
- Hettige, H., M. Huq, S. Pargal and D. Wheeler, 1996, "Determinants of Pollution Abatement in Developing Countries: Evidence from South and Southeast Asia," **World Development**, Vol. 24, No. 12, 1891-1904.
- Huq, M. and D. Wheeler, 1992, "Pollution Reduction Without Formal Regulation: Evidence from Bangladesh," **World Bank Environment Department Working Paper**, No. 1993-39.
- Jaffe, A., S. Peterson, P. Portney, and R. Stavins, 1995, "Environmental Regulation and the Competitiveness of U.S. Manufacturing. What does the Evidence tell Us?", **Journal of Economic Literature** 33: 132-63.
- Jha, V., A. Markandya, and R. Vossenaar, 1999, **Reconciling Trade and the Environment. Lessons from Case Studies in Developing Countries**, Edward Elgar Publishing Co.
- Khalid, R., and J.B. Braden, 1993, "Welfare Effects of Environmental Regulation in an Open Economy: The Case of Malaysian Palm Oil," **Journal of Agricultural Economics** 44: 25-37, January
- Klassen, R.D. and C.P. McLaughlin, 1996, "The Impact of Environmental Management on Firm Performance," **Management Science**, 42(8), 1199-1214.
- Konar, S. and M. Cohen, 1997, "Information as Regulation: The Effect of Community Right to Know Laws on Toxic Emissions", **Journal of Environmental Economics and Management**, Vol. 32, 109-124.
- Lanoie, P. and B. Laplante, 1994, "The Market Response to Environmental Incidents in Canada: a Theoretical and Empirical Analysis", **Southern Economic Journal**, Vol. 60.

Laplante, B., P. Lanoie and M. Roy, 1997, "Can Capital Markets Create Incentives for Pollution Control?" **World Bank Policy Research Department Working Paper**, No. 1753, April.

Mani, M. and D. Wheeler, 1998, "In Search of Pollution Havens? Dirty Industry in the World Economy, 1960-1995," **Journal of Environment and Development**, Fall.

Muoghalu, M., D. Robison and J. Glascock, 1990, "Hazardous waste lawsuits, stockholder returns, and deterrence," **Southern Economic Journal**, October, 357-70.

Pargal, S. and D. Wheeler, 1996, "Informal Regulation of Industrial Pollution in Developing Countries: Evidence From Indonesia," **Journal of Political Economy**, Vol. 104, No. 6, 1314+.

Stotz, E., 1991, "Luta Pela Saude Ambiental: A AMAP Contra Cortume Carioca, S.A., Uma Experiencia Vitoriosa," V. V. Valla and E. N. Stotz (eds.) **Participacao Popular, Educacao e Saude**, Rio de Janeiro, 133-160.

Von Amsberg, J., 1997, "Brazil: Managing Pollution Problems, The Brown Environmental Agenda," World Bank Report #16635-BR, June.

Wheeler, D., et. al., 1999, **Greening Industry: New Roles for Communities, Markets and Governments**, (New York: Oxford/World Bank).

Wheeler, D., M. Huq and P. Martin, 1993, "Process Change, Economic Policy, and Industrial Pollution: Cross Country Evidence from the Wood Pulp and Steel Industries," presented at the Annual Meetings, American Economic Association, Anaheim, California, January.

Xu, X., J. Gao, D. Dockery and Y. Chen, 1994, "Air Pollution and Daily Mortality in Residential Areas of Beijing, China," **Archives of Environmental Health**, 49(4), 216-22.

Figure 1: Foreign Direct Investment in China, Brazil and Mexico

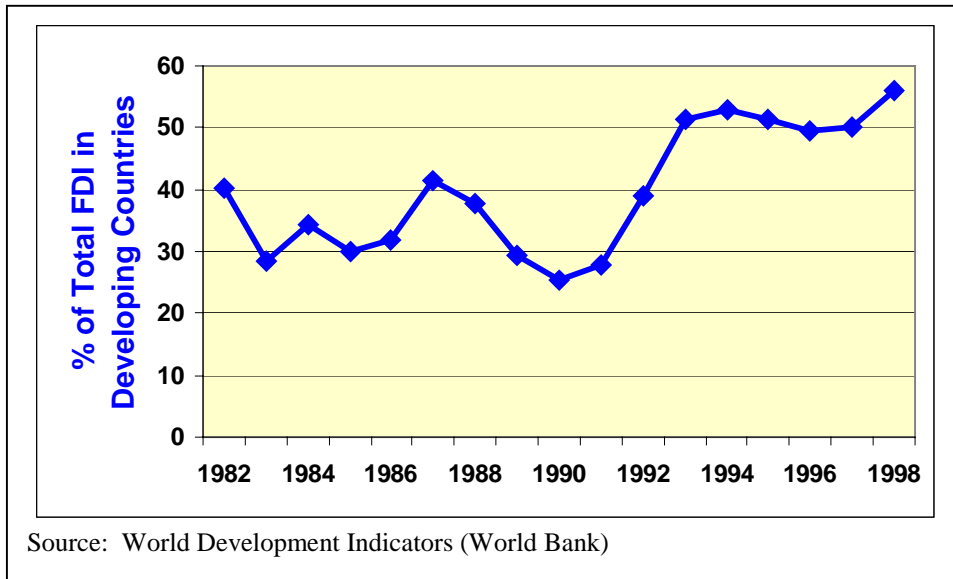


Figure 2: China: Urban Air Pollution vs. Foreign Direct Investment

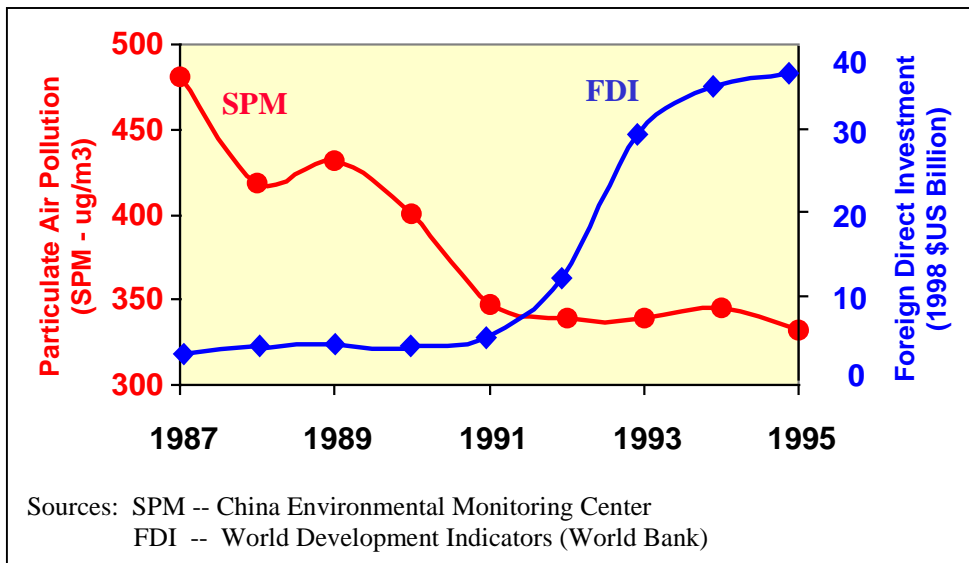


Figure 3: Air Pollution in Mexico City vs. FDI in Mexico

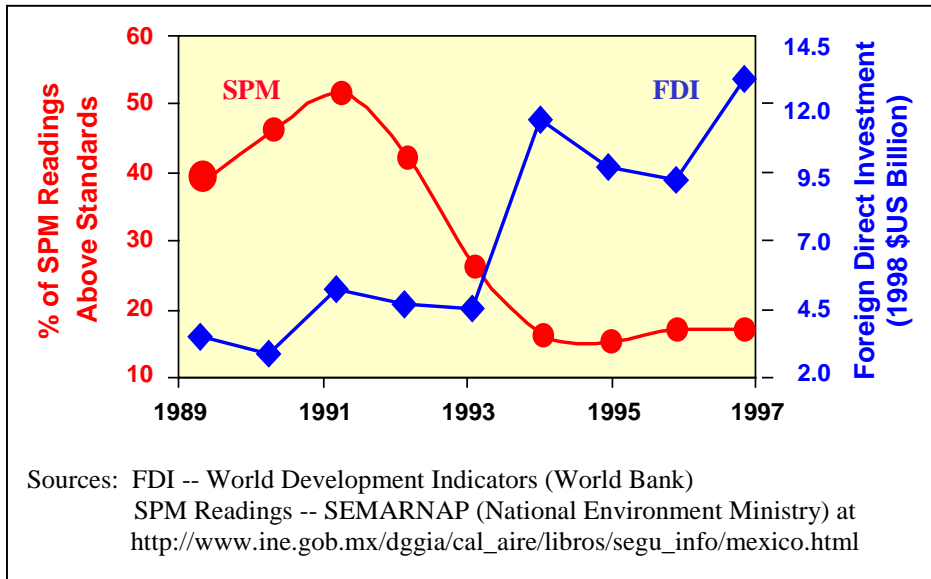


Figure 4: Brazil: Air Pollution in Cubatao vs. FDI in Sao Paulo State

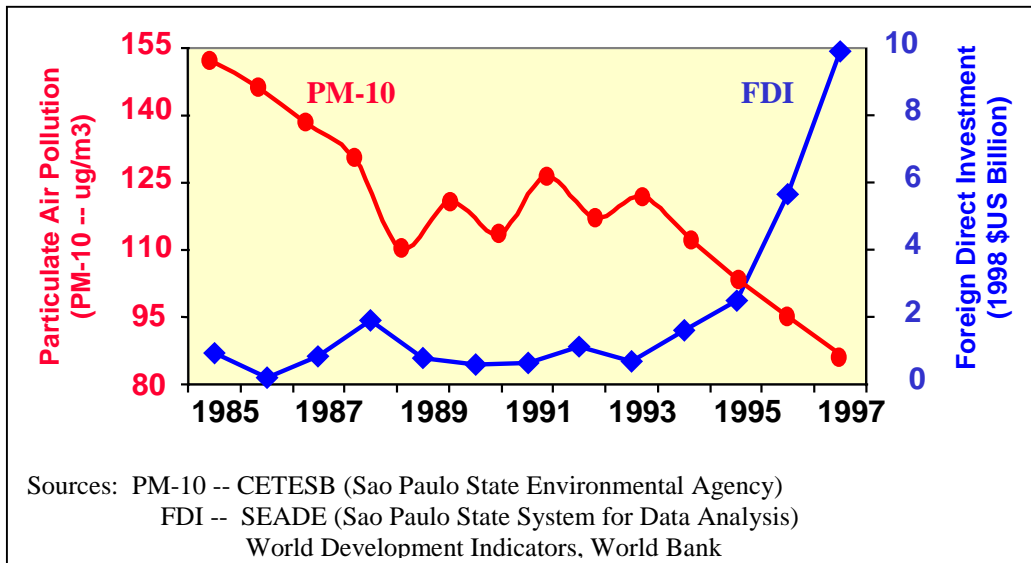


Figure 5: Air Pollution in US Metropolitan Areas, 1988 - 1997

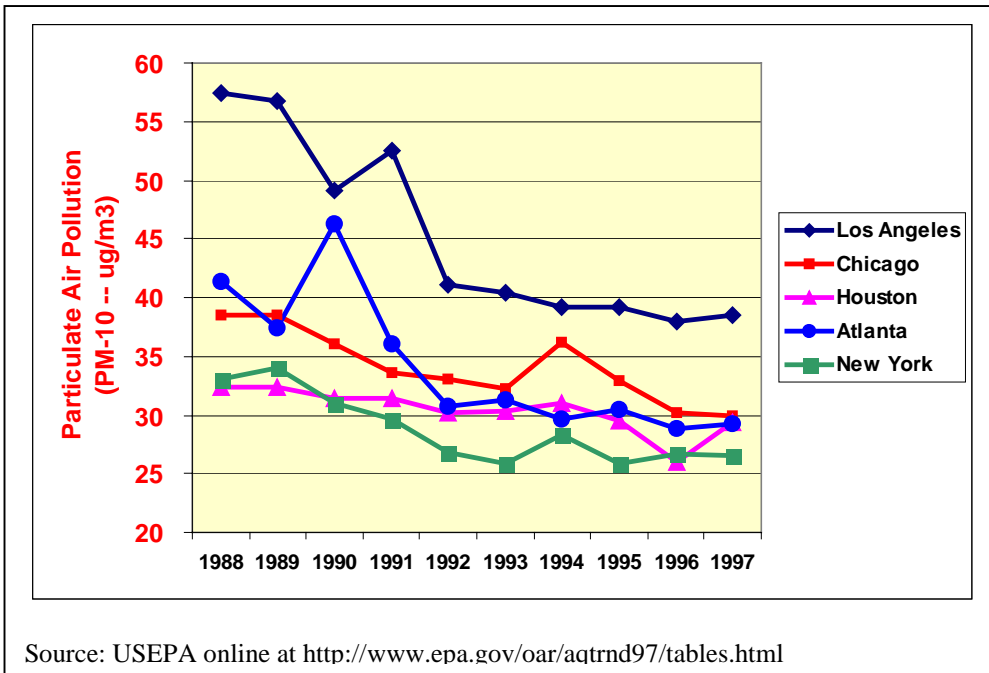


Figure 6: Air Pollution Control Costs in China

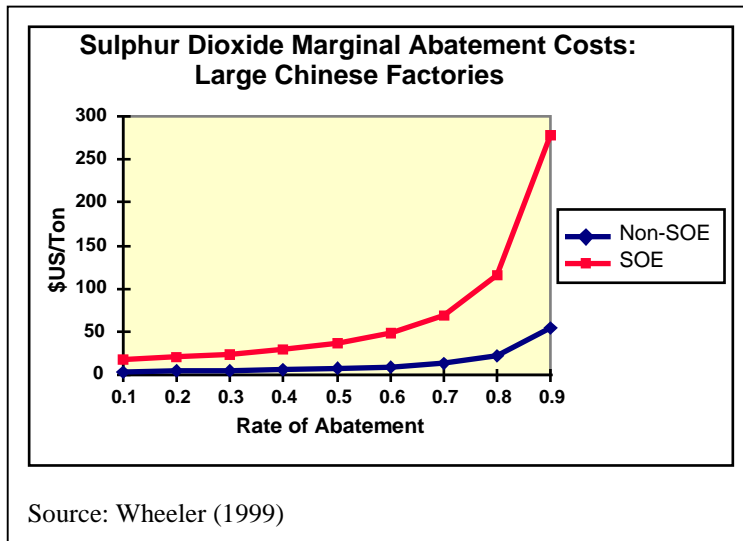


Figure 7: Air Pollution Regulation and Income Per Capita

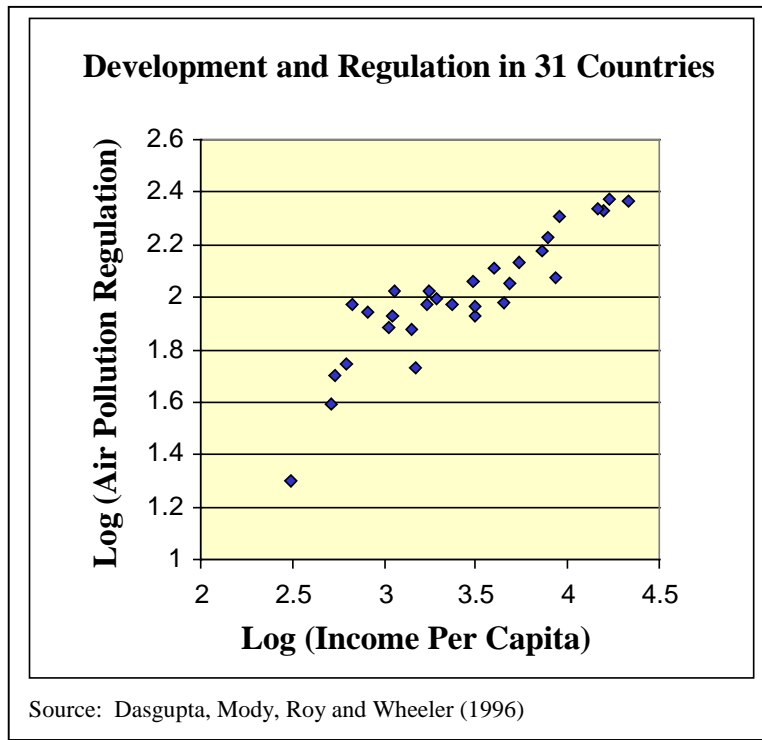


Figure 8: Indonesia: Plant Ownership and Compliance with Pollution Regulations

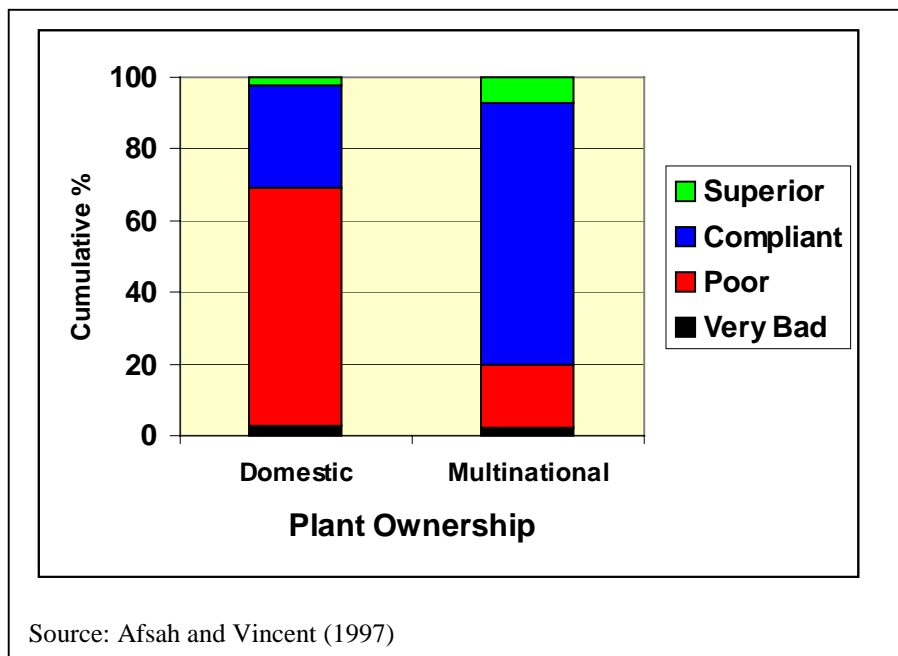


Figure 9: Industrial Pollution Intensity and Economic Development

