Chongqing, 1998

Source: *Katrinka Ebbe*

Chapter One

Is Industrial Pollution the Price of Development?

In China, a generation of economic growth has given millions a lifestyle beyond the dreams of their grandparents. China's urban consumers celebrate their new prosperity by strolling through downtown malls in cities like Chongqing. But as China's cities have boomed, the simple pleasures of sunshine and clear air have been lost. Pollution from motor vehicles, smokestacks, and home hearths is so thick that Chongqing consumers can't see the tops of office towers a few blocks away. The most dangerous pollutants are particulates—tiny airborne particles that lodge deep in the lungs, causing severe and sometimes fatal respiratory problems. In four Chinese cities alone—Chongqing, Beijing, Shanghai, and Shenyang—10,000 people will die prematurely this year from exposure to particulates.

In the filthy clouds hanging over China's cities and the smog plaguing other poor countries, unspoken questions lurk: Is pollution simply the price of development? Does this generation have to endure an environmental tragedy for the sake of future generations? Many people in both developed and developing countries believe the answer is yes, as stories in the popular media often reinforce the idea that pollution control is limited to the industrial economies. After all, the proof is right before our eyes . . . or is it?

In fact, recent evidence shows that many developing countries have already turned the corner in the fight against industrial pollution. Factories are running cleaner than a decade ago, and total emissions are starting to fall even in areas where industry continues to grow rapidly. The cleanup has begun because developing countries have decided that the benefits of pollution control outweigh the costs.

This realization has prompted many countries to adopt innovative strategies that enlist local communities, consumers, investors, and economic policy reformers in the struggle against industrial pollution. Polluters, in turn, are discovering that they have no place to hide—and showing that they can reduce pollution quickly while producing profitably if regulators provide the right incentives. Industrial pollution is still exacting a heavy price in developing countries, but there is no longer any reason to accept it as the price of development.

1.1 Kuznets Revisited

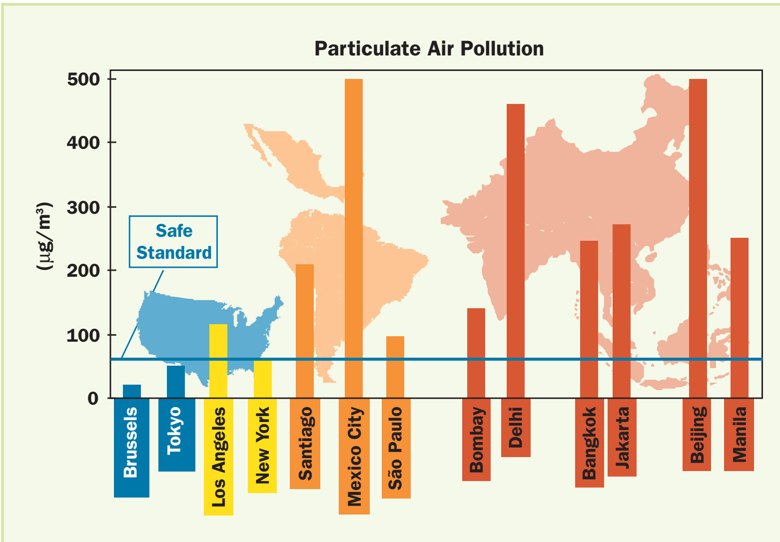
A generation ago, the U.S. economist Simon Kuznets proposed that income inequality generally rises as development proceeds, falling only after the rewards of growth accumulate. Similarly, some researchers have claimed to identify an environmental Kuznets curve, in which pollution from industry, motor vehicles, and households increases until development generates enough wealth to promote significant pollution control. Whether the turning point occurs when countries reach per capita incomes of $5,000 or $15,000 per year has never been clear. But the implication is that for highly polluted cities in poor countries (Figure 1.1), another generation of growth will create nightmarish conditions.

Fortunately, the evidence doesn't support such a bleak vision. São Paulo, for example, has lower particulate air pollution than Los Angeles (Figure 1.1), and Bombay's level is scarcely higher. Present-day Jakarta and Santiago have air quality comparable to that of many developed-country cities in the 1950s—yet the former have much lower incomes.

China's growth experience casts further doubt on the environmental Kuznets curve, which would predict rapidly increasing pollution in such a poor country. Recent data suggest that average urban air quality in that country has stabilized or improved since the mid-1980s (Fig. 1.2).

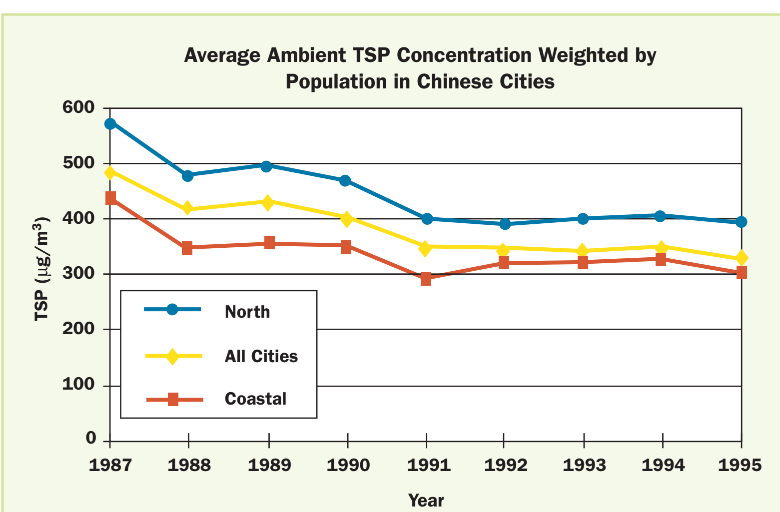
At best, environmental Kuznets curves provide snapshots of a dynamic relationship between pollution and development that is evolving in response to experience. To understand the forces underlying this evolution, we need to pay closer attention to the complex factors driving environmental progress in developing countries.

Figure 1.1 Air Pollution In World Megacities



Source: UNEP/WHO, 1992

Figure 1.2 Air Pollution in Urban China, 1987–1995



Source: China Environmental Yearbooks (SEPA)

1.2 Focusing on Pollution from Industry

In many cities, a large share of air pollution comes from motor vehicles and home hearths, while household sewage is a major contributor to water pollution. Emissions from industry are also pervasive, although they vary considerably in relative importance. At one extreme, China's State Environmental Protection Agency estimates that pollution from factories accounts for over 70 percent of the national total, including 70 percent of organic water pollution, 72 percent of sulfur dioxide emissions, and 75 percent of flue dust, a major component of suspended particulates. Many polluting industries are located in China's densely populated metropolitan areas, where emissions exposure can cause particularly serious damage to human health and economic activity.

In many Brazilian cities, by contrast, households and motor vehicles emit the lion's share of serious air and water pollution. These major pollution sources deserve serious attention. However, this report will focus on emissions from factories rather than attempting a comprehensive analysis of urban pollution. We have chosen to work on emissions from industry for two main reasons besides their significant contribution to overall pollution. First, we are following the lead of our colleagues in developing-country environmental agencies. During their first phase of development, they have focused their limited resources on major industrial polluters. Such polluters are feasible to regulate because they are stationary, relatively easy to identify, and more amenable to pollution control than smaller polluters such as households, informal-sector enterprises, and motor vehicles.

Emissions from industry also provide an excellent domain for comparative analysis because they are more highly varied than those from other sources. Industry emits hundreds of air, water, and solid pollutants, contributing to smog, buildup of heavy metals, organic water pollution, hazardous solid waste, and many other sources of damage to communities and ecosystems. Investigating these highly varied emissions has generated a wealth of new information for sound environmental policy making: on the sources of pollution, their relative contributions to environmental damage, and differences in the costs of controlling them.

Rather than providing an exhaustive treatment of the issues surrounding control of industrial pollution, we highlight recent experiences with regulatory and economic policy reforms whose impacts have been documented. Rich sources of complementary social and economic data from standard national surveys facilitate this study.

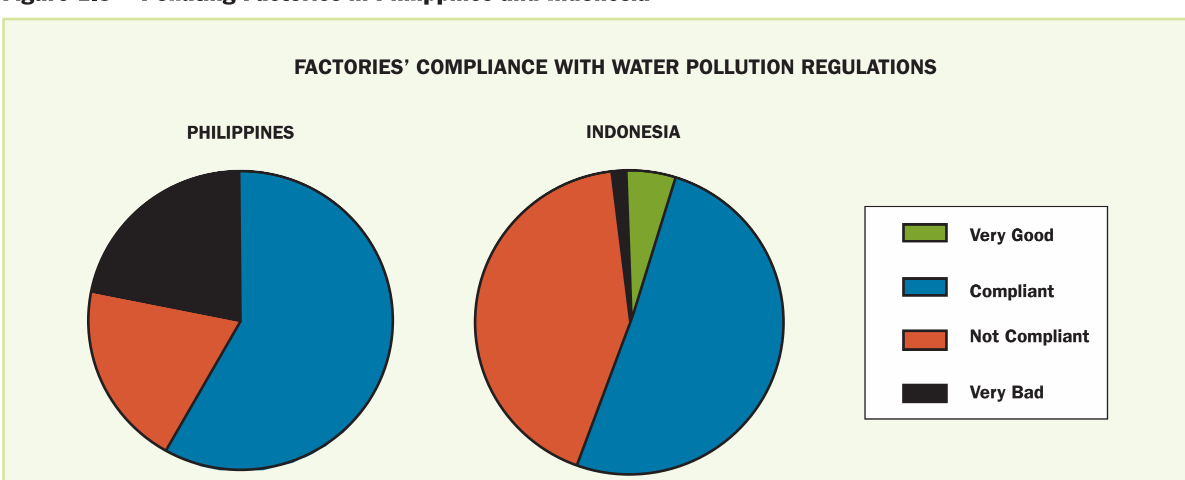
Equipped with such data, we have been able to investigate the role of many factors in promoting pollution reduction.

1.3 How Economic Development Affects Pollution and Regulation

Because regulatory institutions in many poor countries are weak, we might expect factories to pollute with no restraint. However, consider the record of three Asian developing countries: Bangladesh, Indonesia, and Philippines. The poorest is Bangladesh: In a flood- and cyclone-prone area the size of an average U.S. state, 115 million Bangladeshis subsist on an average income of US$270 per year. The country is just beginning to regulate pollution, and industrial sectors such as paper, chemicals, and fertilizer nearly always discharge wastes into rivers that serve downstream populations. However, a study of fertilizer plants in Bangladesh finds wide variation in their environmental performance. Some are serious polluters, while others have made major efforts to control their emissions (Box 1.1).

Traditionally, Indonesia and Philippines have also lacked a strong commitment to enforcing pollution control regulations. During the past few years, however, both countries have begun programs for rating and publicly disclosing factories' compliance with regulations (see Chapter 3). The programs have rated several hundred factories for over two years, and at least half now adhere to organic water pollution regulations in each country (Figure 1.3).[1]

Figure 1.3 Polluting Factories in Philippines and Indonesia



Sources: DENR (Philippines); BAPEDAL (Indonesia)

Box 1.1 Four Fertilizer Plants in Bangladesh

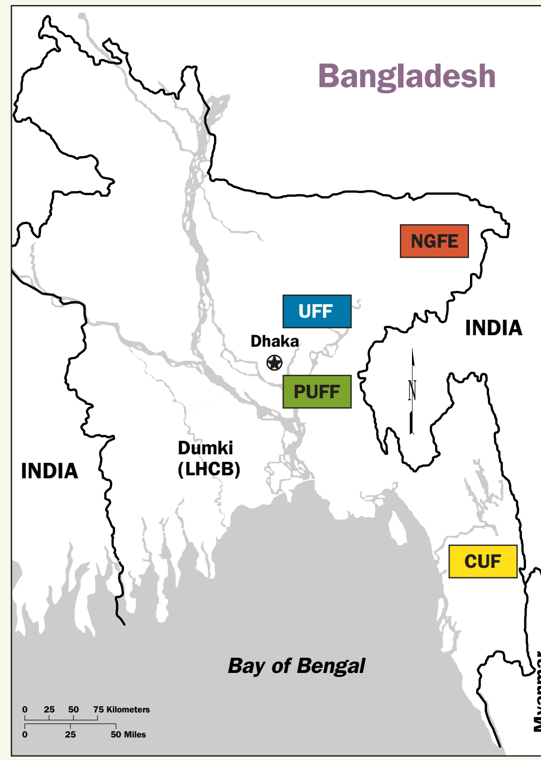
In 1992, a World Bank team surveyed four of the five urea fertilizer plants in Bangladesh (Huq and Wheeler, 1992). All of these plants were public enterprises managed by the Bangladesh Chemical Industries Corp. (BCIC), but their ages varied widely, and they were scattered in urban and rural locations throughout the country. All the plants were located on rivers into which they discharged their wastewater. All used natural gas as the basic feedstock, included both ammonia and urea facilities, and operated on self-generated electricity.

Our survey investigated process technologies, end-of-pipe treatment efforts, and the efficiency of general waste management. At that time, Bangladesh had no regulation-based incentives for end-of-pipe (EOP) waste treatment, so we expected the enterprises to have invested little in such efforts. We were wrong.

Despite their operational similarities, the factories' EOP treatment and pollution varied widely.

NGFF (Natural Gas Fertilizer Factory, Sylhet) was Bangladesh's oldest urea fertilizer plant, built with Japanese assistance in 1961. Downstream villages had clearly identified the plant's discharges as the cause of fish kills, paddy-field damage, and health threats. Yet community pressure for change was only moderate, as the area is primarily nonindustrial and offers few other factory jobs. BCIC, too, regarded the facility as obsolete and kept it open only to preserve the local employment base. Everyone recognized that the age and technology of the plant precluded cleanup to a high standard, so nearby communities settled for some compensation and a first-level cleanup effort.

Figure B1.1 Plants in Bangladesh



UFF and **PUFF** (Urea and Potash Urea Fertilizer Factories, Narsingdi) were built in different eras: UFF with Japanese assistance in 1968, and PUFF with Chinese assistance in 1985. Technologically, however, they were roughly at parity because the Chinese design closely reflected the two-decades-old Japanese design. Both plants were clearly identifiable polluters whose damage intensity fell in the mid range of our survey. Downstream fish kills and paddy damage from polluted irrigation water were common, and the community exerted strong

Box 1.1 *(continued)*

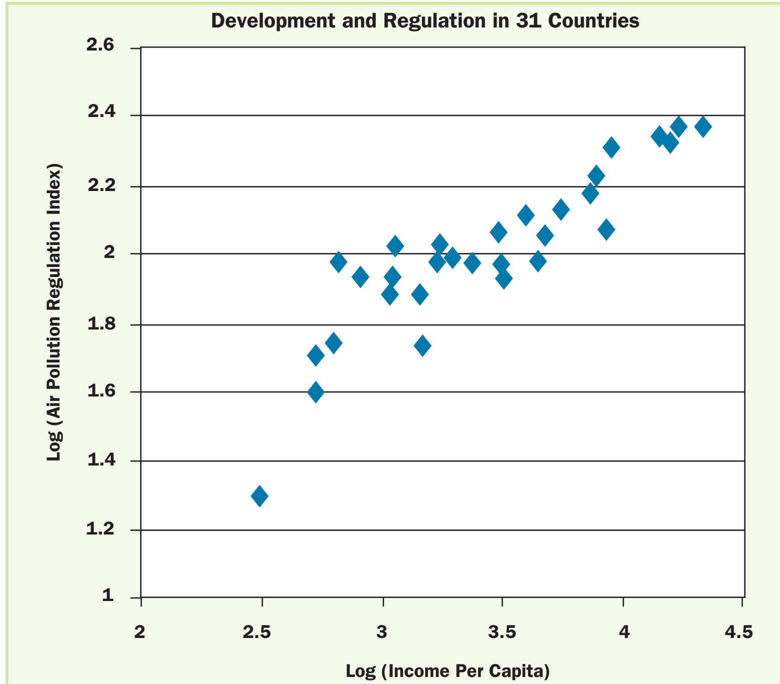
pressure for cleanup in the 1980s, emboldened by the relative abundance of other local jobs. In response, UFF increased the number of employees working on pollution control, and both plants paid some compensation for damage claims. The two plants also shared a first-stage treatment lagoon, constructed by UFF in 1980. Both factories used the lagoon to dilute the effluent with wastewater from their employee housing complexes. UFF also used urea hydrolysis, an ion exchange facility, and an oil/grease separation plant to clean up its effluent. PUFF, in turn, reduced the ammonia load in its effluent with a steam stripping method, and spread a simple cloth barrier over the outfall to capture some of the oil and grease.

CUF (Chittagong Urea Factory, Chittagong) was the country's newest, largest, and most advanced urea fertilizer factory. Because it was constructed in 1989 with Japanese assistance and incorporated modern Japanese technology, CUF was a very clean plant. A treatment lagoon had been excavated, but the effluent load was so low that the plant discharged wastewater directly into the Karnaphuli River. Although local employment alternatives were plentiful, neighboring communities had put no pressure on CUF, as they considered its environmental controls acceptable. These controls surpassed any regulatory standards that the Government of Bangladesh was likely to enforce in the coming decade.

These findings suggest that an intriguing and hopeful story is unfolding in the developing world. Long before reaching middle-income status, countries like Indonesia, Philippines, and Bangladesh have begun an environmental transition in which some factories are demonstrating high levels of environmental performance.

The role of economic development in this transition is clearly revealed by a study based on reports submitted to the 1992 U.N. Conference on Environment and Development held in Rio de Janeiro (Dasgupta, Mody, Roy, and Wheeler, 1995). The research shows a continuous relationship between national income per capita and the strictness of environmental regulation (Figure 1.4, Box 1.2). According to a recent World Bank study, the result is a 1 percent decline in the intensity of organic water pollution—the amount per unit of industrial output—for each 1 percent increase in income per capita. The study is based on extensive data from environmental agencies in Brazil, China, Finland, India, Indonesia, Korea, Mexico, the Netherlands, Philippines, Sri Lanka, Taiwan (China), Thailand, and the United States.[2] Overall, the data reveal that pollution intensity falls by 90 percent as per capita income rises from $500 to $20,000 (Figure 1.5). Most important, the fastest decline occurs *before* countries reach middle-income status.

Figure 1.4 Regulation vs. Income



Source: Dasgupta, Mody, Roy, and Wheeler (1995)

Table 1.1 Sectoral Indices of Organic Water Pollution Intensity

Sector	*Index*
Food	100
Pulp and Paper	87
Chemicals	29
Textiles	26
Wood Products	13
Metal Products	8
Metals	3
Nonmetallic Minerals	2

Source: Hettige, Mani, and Wheeler (1998)

However, total pollution in developing countries could still rise if industrial output grows faster than pollution intensity declines. This is especially true because development affects the share of an economy's polluting industries. An economy that depends largely on food and paper production, for example, poses a much greater threat of organic water pollution than one based on metals and nonmetallic minerals (Table 1.1). Yet an analysis of data from more than one hundred countries reveals that development shifts production to sectors that produce *less* organic water pollution per unit of output. This shift toward cleaner sectors reduces overall water pollution intensity by 30 percent as income rises to around $5,000 per capita (Figure 1.6).

We still need to estimate total organic water pollution in each sector of growing economies, to determine whether industrial expansion yields more waste. Such estimates are difficult to find, so to produce them we have used another result from the 12-country study cited above. In those countries, we found that for each 1 percent rise in per capita income (and wages), labor intensity also

Box 1.2 Environmental Regulation and Economic Development

We have analyzed international differences in environmental regulation using reports presented to the United Nations Conference on Environment and Development (UNCED, 1992) by 145 countries. The UNCED reports are similar in form as well as coverage, and permit cross-country comparisons. To an impressive degree, they seem to reflect real environmental conditions and issues.

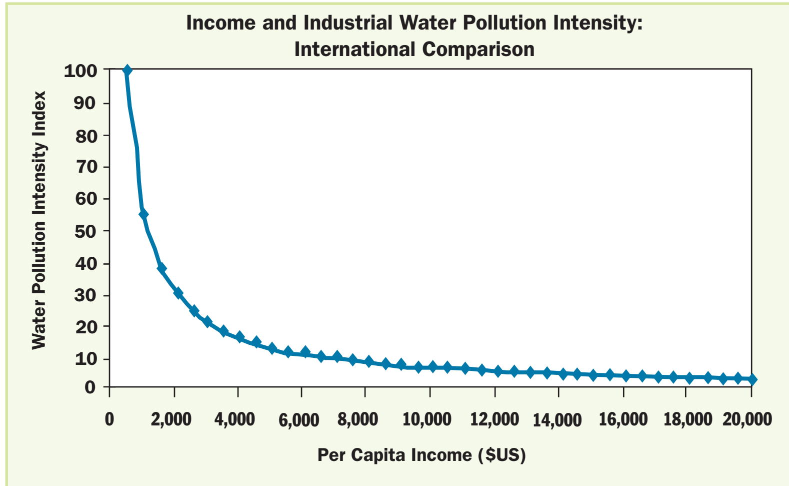
From the information in these reports, we have developed a set of indicators that measure the status of pollution control policy and performance in 31 randomly selected countries. Our survey assessment uses a variety of questions to categorize the (i) scope of policies adopted; (ii) scope of legislation enacted; (iii) control mechanisms in place; and (iv) degree of success in implementation. The status in each category is graded “high, medium, or low,” with assigned values of 2, 1, and 0 respectively. We have developed over 500 assessment scores for each country and computed separate composite indices of regulations for air and water pollution. The resulting index values increase continuously with national income per capita.

Income and Environmental Regulation

Country	GNP Per Capita ($1990)	Air Regulation Index	Water Regulation Index	Country	GNP Per Capita ($1990)	Air Regulation Index	Water Regulation Index
Mozambique	80	56	98	Paraguay	1,110	84	117
Tanzania	110	50	90	Jordan	1,240	95	131
Ethiopia	120	20	56	Thailand	1,420	98	113
Bhutan	190	39	54	Tunisia	1,440	128	158
Malawi	200	93	116	Jamaica	1,500	114	168
Bangladesh	210	77	89	Bulgaria	2,250	168	198
Nigeria	290	75	106	South Africa	2,530	136	165
India	350	105	132	Brazil	2,680	113	127
China	370	98	127	Trinidad	3,610	118	149
Kenya	370	85	127	Korea	5,400	150	170
Pakistan	380	105	131	Ireland	9,550	203	223
Ghana	390	93	124	Netherlands	17,320	219	226
Zambia	420	87	115	Germany	22,320	236	242
Egypt	600	92	134	Finland	26,040	214	229
Philippines	730	93	113	Switzerland	32,680	231	240
Papua New Guinea	860	54	91				

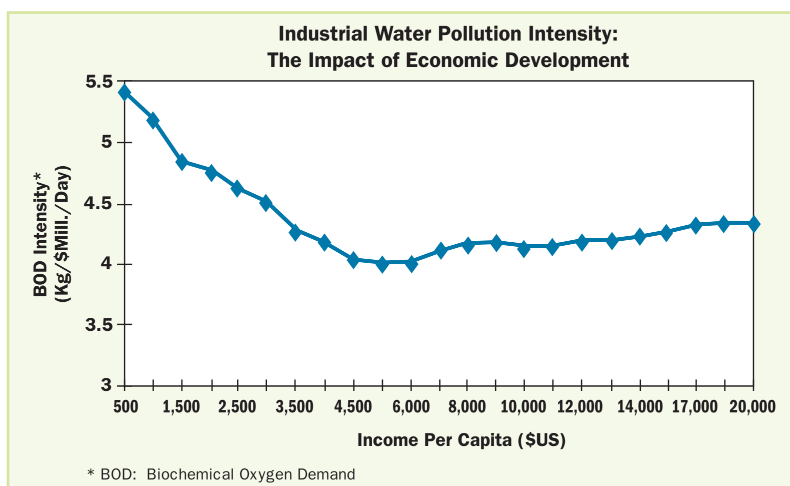
Source: Dasgupta, Mody, Roy, and Wheeler (1995)

Figure 1.5 Per Capita Income and Industrial Pollution



Source: Hettige, Mani, and Wheeler (1998)

Figure 1.6 Economic Development and Sectoral Change



Source: World Bank BESD Database; Hettige, Mani, and Wheeler (1998)

declines by approximately 1 percent. As countries grow richer, rising wages lead to lower demand for labor per unit of output.

The study shows that economic development has a parallel impact on organic water pollution intensity: Stricter regulation and greater productive efficiency lead to lower pollution per unit of output. As a result, an average Indian paper mill employs far more workers and generates far more pollution than a U.S. mill with the same capacity. But because labor and water pollution intensities decline at about the same rate with development, the two mills have similar pollution/labor ratios.

We can use these results to estimate total industrial water pollution loads for a variety of countries, using a U.N. database that provides annual employment figures for each industry sector and country. For example, to estimate organic water pollution from paper production in each country, we multiply that country's paper-sector employment by our estimated (constant) pollution/labor ratio for the paper sector. We multiply employment in the metals sector by its pollution/labor ratio, and similarly for all other industry sectors. Then we add across sectors to obtain total estimated organic water pollution for each country.

To determine the relationship between economic development and total organic water pollution during the 1970s and 1980s, we have selected 15 countries within four major economic groups: the Organisation for Economic Co-operation and Development (or OECD), represented by the United States, Japan, France, and Germany; the newly industrialized economies (or NIEs), represented by Mexico, Brazil, Taiwan (China), Korea, South Africa, and Turkey; the less-developed countries of Asia (or LDCs), represented by China, India, and Indonesia; and the ex-COMECON countries, represented by Poland and the former Soviet Union.

In the OECD countries, despite continued economic growth, we estimate that total organic water pollution declined by 4 percent from 1977 to 1989 (Table 1.2), reflecting rising per capita income and more regulation. Organic water pollution in the NIEs increased by about 40 percent, while in the poorer Asian countries it grew at a slightly higher rate—49 percent. Since the latter three countries are very large, we estimate that they generated most of the pollution growth in our international sample (Table 1.2). The OECD and ex-COMECON countries dropped significantly in their share of pollution, while the NIEs increased their share only marginally.

Perhaps most impressive is our estimate that total organic water pollution from industry grew by only 16 percent in these 15 major industrial countries. Although economic growth sparked fears of skyrocketing pollution in the 1970s and 1980s, development was setting the stage for real improvements in environmental performance.

Table 1.2 Trends in Organic Water Pollution: Selected Countries, 1977–1989

	Emissions ('000 Kg/Day)					
Region	**1977**	**1980**	**1983**	**1986**	**1989**	**% Ch. 1977–89**
OECD	5,776	5,847	5,501	5,403	5,523	–4
COMECON	4,127	4,218	4,302	4,228	4,039	–2
NIEs	1,565	1,917	1,848	2,197	2,188	40
ASIAN LDCs	4,617	5,030	5,566	6,183	6,883	49
TOTAL	**16,085**	**17,012**	**17,217**	**18,011**	**18,633**	16
	% of Total Pollution					
	1977	**1980**	**1983**	**1986**	**1989**	
OECD	36	34	32	30	30	
COMECON	26	25	25	23	22	
NIEs	10	11	11	12	12	
ASIAN LDCs	29	30	32	34	37	

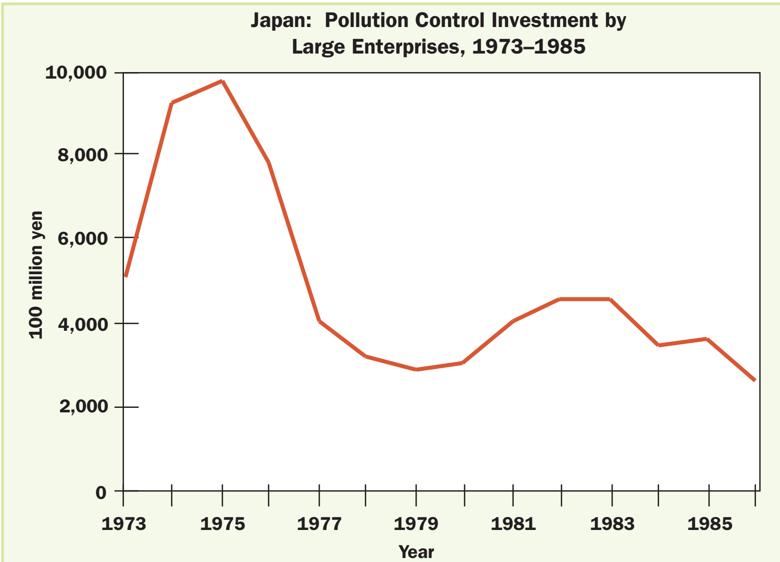
Source: Hettige, Mani, and Wheeler (1998)

1.4 The Rise and Fall of Pollution Havens

The pattern of international trade provides another measure of this record. Northern environmental groups have long expressed the concern that poor countries will become pollution havens, attracting industries that relocate from richer countries to avoid strict regulations, and siphoning away jobs in the process. Yet a look at overall trade statistics shows that permanent pollution havens have not emerged.

Concern about pollution havens began in the early 1970s, when developed countries rapidly tightened pollution controls and most developing countries had not yet begun formal regulation. Business investment in pollution controls skyrocketed in Japan during that time (Figure 1.7), and companies in North America and Western Europe made similar investments. If such costs gave an edge to polluting industries in developing countries, the effect should have appeared in international trade patterns: Developing countries' exports of the products of dirty industries should have risen faster than their imports, lowering their import/export ratios for these products. The converse should have been true for developed countries.

Figure 1.7 Pollution Control Investment in Japan



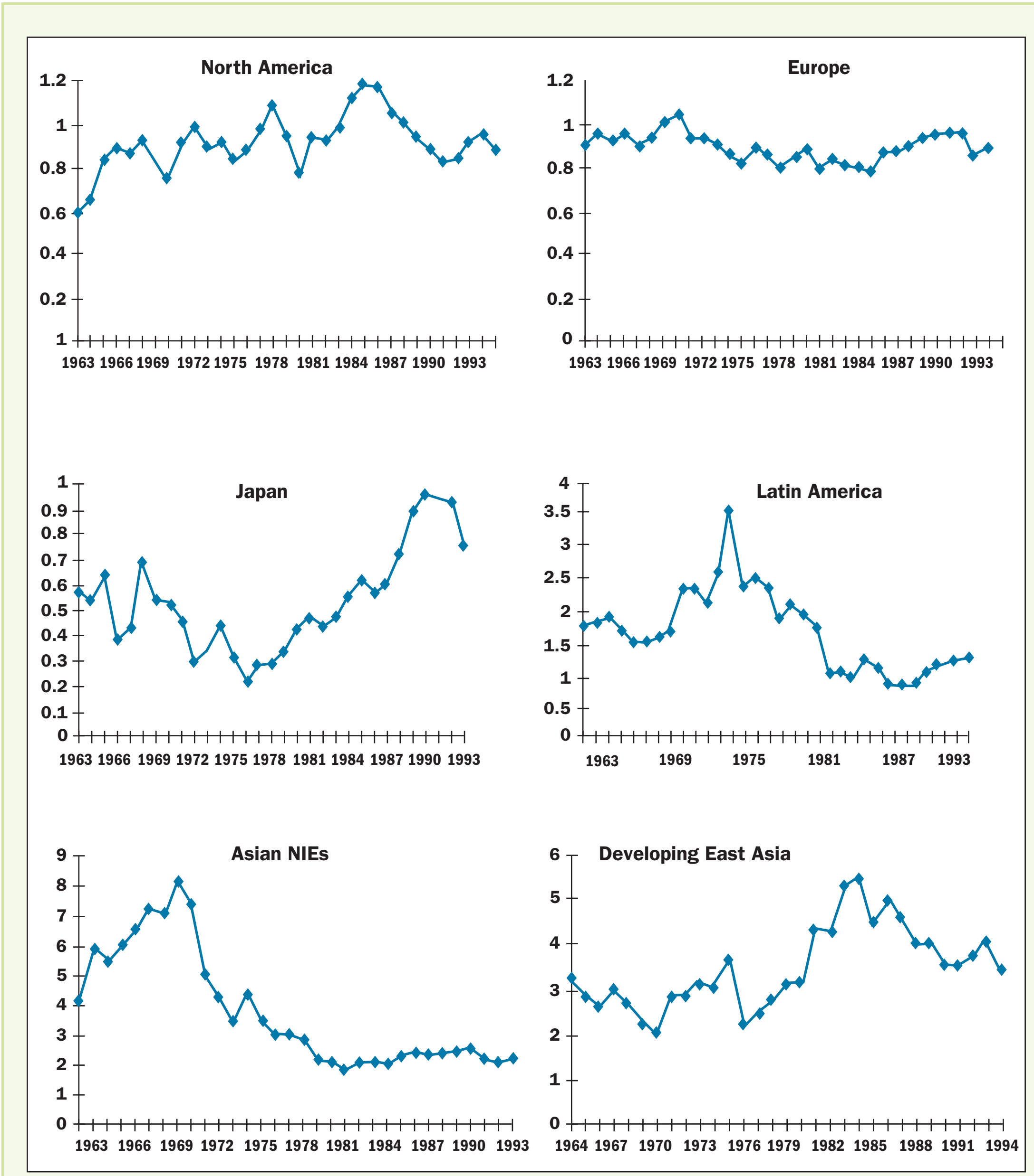
Source: Mani and Wheeler (1998)

Figure 1.8 shows that the shadow of pollution havens did emerge in five particularly polluting sectors: iron and steel, nonferrous metals, industrial chemicals, pulp and paper, and nonmetallic mineral products.[3] After the early 1970s, Japan's import/export ratio in these industries rose rapidly, while the ratio declined steeply in the newly industrialized economies (NIEs) of the Republic of Korea, Taiwan (China), Singapore, and Hong Kong (China). And the same pattern occurred in mainland China and the other developing countries of East Asia a decade later. However, in each region the pollution haven story was markedly short. Both sets of Asian economies have stabilized their import/export ratios at levels greater than one, and remain net importers of pollution-intensive products from industrial countries.

The story in the Western Hemisphere is similar. In North America, the United States and Canada witnessed a steady climb in import/export ratios for polluting industries from the beginning of the environmental era to the late 1980s, while Latin America experienced the opposite after 1973. However, as in developing Asia, the Latin American ratio leveled off near one by the 1990s.

Why didn't polluting industries continue to shift to developing countries? Economic growth—accompanied by more regulation—provides the best answer. Along with greater prosperity in the newly

Figure 1.8 Import/Export Ratio Trends for Polluting Industries



Source: Mani and Wheeler (1998)

industrialized countries came increased demands for environmental quality and better institutional capacity to regulate. The same process occurred in the Asian developing countries after a decade's delay. Faced with rising costs from environmental damage, they stabilized the terms of trade through measures to control their own pollution.

1.5 Controlling Pollution: Benefits and Costs

Poor countries are taking more steps to control pollution, but they must carefully justify such efforts because resources used to curb emissions could also be used to build schools or train doctors. Yet environmental policymakers in developing countries who look closely at the benefits and costs of controlling pollution are moving toward even stronger support for regulation.

China provides an excellent case in point. Output from the country's 10 million industrial enterprises grew by more than 15 percent annually during the 1990s, and industry is China's largest productive sector, accounting for 47 percent of its gross domestic product and employing 17 percent of the country's labor force. Despite the country's progress in controlling pollution, serious environmental damage has undeniably accompanied this rapid growth. As we have noted, China's State Environmental Protection Agency (SEPA) estimates that industry accounts for over 70 percent of the nation's organic water pollution, sulfur dioxide (SO_2) emissions, and flue dust. Atmospheric concentrations of suspended particulates and SO_2 in urban areas routinely exceed World Health Organization safety standards by large margins.

China's pollution problem is clearly compelling, but how much more pollution control can the Chinese afford to undertake? To begin to weigh benefits and costs, a team of Chinese researchers has estimated the link between air pollution and mortality from respiratory disease in Beijing.[4] Their analysis shows that a "statistical life" could be saved by removing 100 tons of SO_2 annually from Beijing's atmosphere (Box 1.3).

But how much would it cost to abate those 100 tons of SO_2? To find out, we estimated abatement costs for large and small plants in China: Figure 1.9 shows the incremental cost per ton of pollutant removed as the degree of abatement rises. The scales on the vertical axes of the two graphs indicate that small plants have much higher marginal abatement costs than large plants, and that state-owned

Box 1.3 Controlling Air Pollution and Saving Lives in Beijing

Xu et al. (1994) have estimated dose-response relationships linking atmospheric pollution to respiratory disease in Beijing. Their study shows that atmospheric sulfur dioxide (SO_2) concentration is highly correlated with damage from respiratory disease. Recent scientific evidence provides some insight into the nature of this relationship. 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. These acid mists can irritate the respiratory systems of humans and animals. Therefore, a high concentration of SO_2 can affect breathing, and may aggravate existing respiratory and cardiovascular diseases. Sensitive populations include asthmatics, individuals with bronchitis or emphysema, children, and the elderly.

The second, and probably more significant, effect of SO_2 is traceable to the impact of fine particulates on mortality and morbidity. A review of recent evidence by the U.S. Environmental Protection Agency suggests that fine particulates are the source of the worst health damage from air pollution. In the case of China, there is reason to believe that 30 to 40 percent of fine particulates are in the form of sulfates from SO_2 emissions.

In 1993, Beijing had a population of about 11,120,000; the mortality rate was about 0.611 percent; total deaths were about 68,000; and total SO_2 emissions were about 366 thousand tons (of which 204 thousand were from industry). From this base, a decrease of 1,000 tons in SO_2 emissions decreases total emissions by $1/366 \times 100$ percent. An independent econometric analysis of the relationship between emissions and air pollution in China's cities predicts an associated decrease of $0.51 \times 1/366 \times 100$ percent in Beijing's ambient SO_2 concentration. Applying the Beijing dose-response result of Xu et al. to the new concentration, we obtain an estimated saving of 10.4 lives per year. Dividing both elements by 10 yields a useful round number for policy discussion: 1 life saved per 100 tons abated annually.

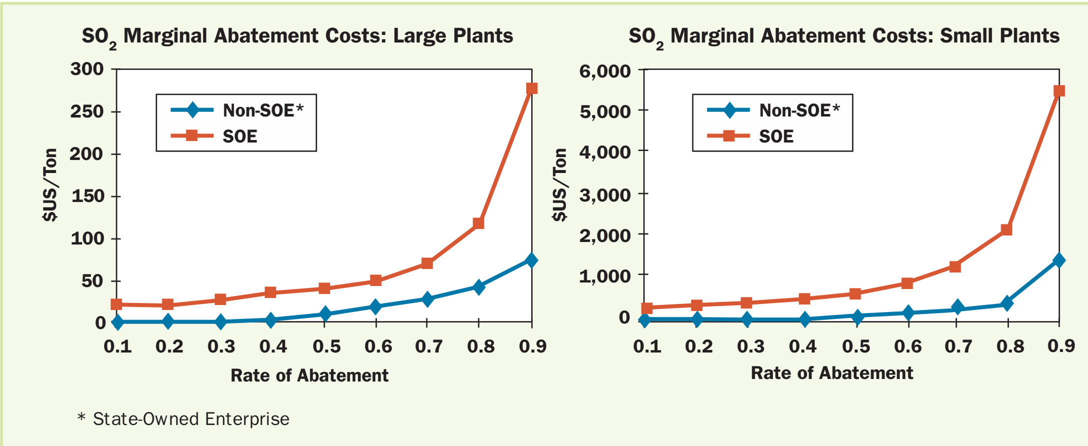
Source: Dasgupta, Wang, and Wheeler (1997)

enterprises (SOEs) have far higher marginal abatement costs than other plants.

As large plants are a major source of air pollution in cities like Beijing, the numbers for those facilities are particularly interesting. Our results show that abating one ton of SO_2, when 10 percent of emissions are controlled, would cost large plants about US$3. This is very low by international standards: U.S. environmental policymakers have been happy to discover that industry can abate SO_2 for less than $100 per ton. If abating 100 tons—at a cost of $300—will save a life, can anyone seriously argue that it shouldn't be done? In China, the numbers are clearly signaling that pollution control is far too lax.

To consider how much further pollution control should be tightened, a simple exercise in valuation is worthwhile. In the West, environmental agencies commonly use a value of at least $1,000,000 to

Figure 1.9 The Cost of Air Pollution Control in China



Source: Dasgupta, Wang, and Wheeler (1997)

assess the social benefit when pollution control saves one life. In Beijing, it costs only $300 to save a life by abating 100 tons of SO_2. Using the Western benefit standard, the implied benefit-cost ratio (1,000,000/300) is over 3,000 : 1. Some analysts have proposed much lower benefit estimates for China, but a figure as low as $8,000 would still yield a benefit-cost ratio of 24 : 1. In either case, the implied social rate of return for air pollution abatement is extremely high. China's regulators have reduced air pollution significantly by charging factories for their emissions (see Chapter 2). Yet even for a life-benefit value of only $8,000, we estimate that returns to further abatement are high enough to justify a 50-fold increase in the pollution charge rate.

Of course, environmental, social, and economic conditions will yield different conclusions in different countries and regions. But efforts to apply the same methods to countries as varied as Brazil and Indonesia have yielded similar results: When the benefits of reduced pollution are weighed against the costs of control, today's regulation appears far too lax.[5] Pollution control is a very attractive option for saving lives in the large cities of developing countries.

1.6 The New Agenda

The record shows that developing countries are not destined to be the world's environmental dumping grounds: Even the most polluted areas are moving away from the nightmare landscapes anticipated only a few years ago. In China, air pollution has been stable or dropping during the past decade despite a rapid increase in income, and we see strong evidence that economic development boosts pollution control elsewhere in the developing world. Regulation has grown steadily with income, and its impact has quickly reduced the pollution intensity of industrial production.

Yet benefit-cost studies in Asia and Latin America show that pollution damage remains unjustifiably heavy, given the low cost of abatement. More action is needed on three fronts: regulatory reform, economic policy reform, and better environmental management within factories. On the regulatory front, new, surprisingly low-cost strategies based on pollution charges and public information have reduced emissions from many factories. We take a detailed look at these strategies in Chapters 2, 3, and 4, drawing on new research and examples of imaginative and effective programs in developing countries. In addition, we explore the complex real-world decision making that these programs try to reflect. Chapter 4 also looks inside the factory gate for more clues to effective pollution fighting. Recent policy experiments suggest that pollution falls significantly when environmental agencies broaden their mandate to include technical assistance to plant managers in the private sector. Chapter 5 explores the effects of economic reforms, such as privatization, market liberalization, and curtailment of subsidies for materials and fuels, to determine which can best be used to prevent pollution.

Regulatory and economic policy reforms do not take place in a vacuum: in Chapter 6, we identify political and institutional changes needed to support such efforts. In-depth research on these changes is lacking, because most relevant knowledge is in the heads of the people who are leading the process of policy innovation in developing countries. We have been fortunate enough to work with many of them, and this chapter presents the lessons they have taught us.

Finally, in Chapter 7, we summarize the main findings of this report and highlight the keys to progress. We see an urgent need for expanding the pilot projects we describe and disseminating their lessons internationally, and we hope this report will contribute to such efforts. We also suggest useful roles for our own institution in promoting the new agenda. On balance, given the recent record, we remain optimistic about the prospect for continued progress in controlling industrial pollution.

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End Notes

1. Indonesia and Philippines have nearly identical color coding schemes, permitting direct comparison of results in Figure 1.3.

2. See Hettige, Mani, and Wheeler (1998).

3. See Mani and Wheeler (1998).

4. See Xu et al. (1994).

5. Similar case studies for Brazil and Indonesia, respectively, are available in Von Amsberg (1997) and Calkins (1994).