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Why Paper Mills Clean Up

Determinants of Pollution Abatement in Four Asian Countries

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Clean production is not uncommon even in very poor countries such as Bangladesh. Even when there is no formal regulation of pollution, large, efficient, domestically owned plants operating near relatively affluent communities have demonstrated excellent environmental performance. The same cannot be said for manufacturing facilities near poor communities.

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Summary findings

Formal regulation of industrial pollution control standards has been hampered in some developing countries by the absence of a clear regulatory framework, by limited institutional capacity, and by limited information on emissions. For many manufacturing facilities in developing economies, the government-imposed "price of pollution" is zero.

Yet Hartman, Huq, and Wheeler find strong evidence that despite weak or nonexistent formal regulation and enforcement of environmental standards, many plants in South and Southeast Asia are clean. Of course, many plants are also among the world's worst polluters. To account for the extreme variation among plants, the authors review evidence from a survey of pollution abatement by 26 pulp and paper plants in four countries: Bangladesh, India, Indonesia, and Thailand.

They find that the level of pollution abatement is significantly affected by three factors. Abatement is:

- Positively associated with scale and competitiveness.
- Negatively associated with public ownership.
- Unaffected by foreign links (in ownership or financing).

A clear source of interplant differences is the level of community pressure, or informal regulation. Some communities successfully pressure plants to abate pollution even if they have little or no support from formal regulation. High local income is a powerful predictor of effective informal regulation.

The authors also find that policy matters. Privatization, to the extent that it increases plant efficiency, can significantly improve environmental performance. As private ownership, competitiveness, and per capital incomes rise, communities may be in a better position to exert strong local pressure on polluting facilities to clean up production.

The government may need to intervene to prevent environmental injustice in communities whose citizens are mostly poor, poorly educated, or members of marginalized minority groups (and hence less capable of applying local pressure on firms and less likely to be knowledgeable about pollution). To compensate, national regulators may want to consider strategies for improving participation in pollution control in those communities, and for targeting regulation to the problems of poor communities.

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WHY PAPER MILLS CLEAN UP: DETERMINANTS OF POLLUTION ABATEMENT IN FOUR ASIAN COUNTRIES

by

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EXECUTIVE SUMMARY

Developing countries, particularly those in Asia, are fast adopting industrial pollution control standards similar to those in developed countries. However, formal regulation has been greatly hampered by the absence of clear and legally binding rules; limited institutional capacity; lack of appropriate equipment and trained personnel; and inadequate information on emissions. At present, the government-imposed 'price of pollution' is nearly zero for many manufacturing facilities in these economies.

A conventional analysis would predict highly pollution-intensive production under such conditions. However, our research has uncovered strongly contradictory evidence. Despite weak or nonexistent formal regulation and enforcement, there are many clean plants in the developing countries of South and Southeast Asia. Of course, there are also many plants which are among the world's most serious polluters. What explains such extreme interplant variation? This paper reviews the evidence from a survey of pollution abatement by 26 pulp and paper plants in four countries: Bangladesh, India, Indonesia and Thailand.

Our analysis incorporates three sets of factors which may affect the pollution intensity of an industrial process: Relevant **plant characteristics** may include choice of technology, vintage, ownership, management quality, available human resources and technical expertise. Firms' responsiveness to pressure for abatement may also vary significantly with **economic considerations:** input prices, profitability, market characteristics, availability of information on abatement technology, and financing possibilities. Finally, plants may adapt to **external pressure** from government regulators, buyers or investors, and neighboring communities which suffer damage from pollution.

Our results show that all three factors play significant roles. Abatement is positively associated with scale and competitiveness; negatively associated with pubic ownership; and unaffected by foreign links (in ownership or financing). Community pressure, or informal regulation, emerges as a clear source of interplant differences. Under some circumstances, communities successfully pressure plants to abate even if little or no support is available from formal regulation. Our results suggest that local income is a powerful predictor of effective informal regulation. We also find that existing formal regulation has measurably beneficial effects, even when it is weakly-developed.

The main message of our results is a hopeful one for sustainable development. Clean production is not uncommon in very poor countries such as Bangladesh. Even in the absence of formal regulation, large, efficient, domestically-owned plants operating near relatively affluent communities have proven capable of excellent environmental performance. There is clearly no insurmountable barrier to clean production in poor countries.

Our strong results on ownership, competitiveness and income also show that policy matters a great deal for clean production. The current wave of privatization implies declining significance for the pollution intensity of public enterprises. Deregulation during the 1980's has presumably increased plant-level efficiency in the private sector, with significant improvements in environmental performance. Per capita incomes are now advancing steadily in many Asian and Latin American countries, raising the possibility of stronger local pressure on many polluting facilities.

In the latter context, however, we must introduce a cautionary note. Our results suggest that communities whose citizens are mostly poor, poorly educated or members of marginalized minority groups may have little ability to use the available channels of informal regulation. Significance for these factors would establish a clear case of 'environmental injustice.' To compensate, national regulators may want to consider strategies for enhancing community participation in pollution control, as well as targeting of regulation on the problems of poor communities.

1. INTRODUCTION

Industrial pollution has become a serious problem in many developing countries. Its costs include serious damage to human health and ecosystems, and direct economic costs for households and businesses.[1] During the past decade, many governments have begun responding by setting up regulatory institutions and standards for air and water quality.[2] Existing regulatory systems have used (singly or in combination): pollution charges; tradable and nontradable permits; concentration- and volume-based effluent standards;[3] technology standards;[4] and environmental provisions in investment licensing.[5]

Such systems have often been plagued by monitoring and

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[1] Calkins et al. (1994) estimate the *yearly* health damage from air and water pollution in Jakarta, Indonesia alone to be in excess of $500 million. Margulis (1992) documents a probable IQ loss of several points for thousands of children exposed to airborne lead in Mexico City, and similar findings for Bangkok have prompted the government of Thailand to mandate an immediate switch to unleaded gasoline.

[2] See Wheeler (1992) for a summary of the 'stages of regulatory development,' as suggested by the history of several industrial and developing countries. Dasgupta et. al. (1995) have recently attempted to quantify international differences in environmental policy and performance.

[3] A concentration standard is specified as an intensity in the medium of release (e.g., allowable kilograms of biological oxygen demand per kiloliter of waste water). A volume standard is specified as an intensity per unit of output (e.g., allowable kilograms of biological oxygen demand per ton of wood pulp).

[4] These specify actual pollution control equipment to be installed.

[5] These have included concentration, volume and technology standards.

enforcement problems in developing countries. Resource scarcity may prevent policy makers from establishing comprehensive monitoring procedures. Moreover, the enforcement of environmental standards generally remains very weak.[6] Under such conditions, a conventional analysis would predict high pollution loads from plants in pollution-intensive sectors.

In fact, a small but growing body of empirical work suggests that this proposition is not correct. In a small survey exercise, Huq and Wheeler (1992) found that some fertilizer and pulp mills in Bangladesh are quite clean by international standards, while others are very heavy polluters. Plant-level emissions inventories in Philippines, Thailand and Indonesia have suggested similar disparities.

For example, Figures 1 and 2 compare a sample of approximately 100 plants from the Metro Manila area in Philippines with a similar-sized sample from two industrial areas in the Bangkok industrial region. The bar charts depict the relative frequency of biological oxygen demand (BOD) removal

[6] O'Connor (1994) notes: "In several of the [Asian] countries studied here, the monitoring problem is compounded by weak enforcement. In short, when violators of standards are detected, if penalised at all they often face only weak sanctions. In other instances, polluters are exempted from fines either on grounds of financial hardship or because the violators wield undue political influence. Perhaps the most pervasive problem is that, even when fines are levied, they are frequently so low in real terms that they have little if any deterrent value." (p. 94)

Figure 1 THAILAND MANUFACTURING

BOD REMOVAL RATES

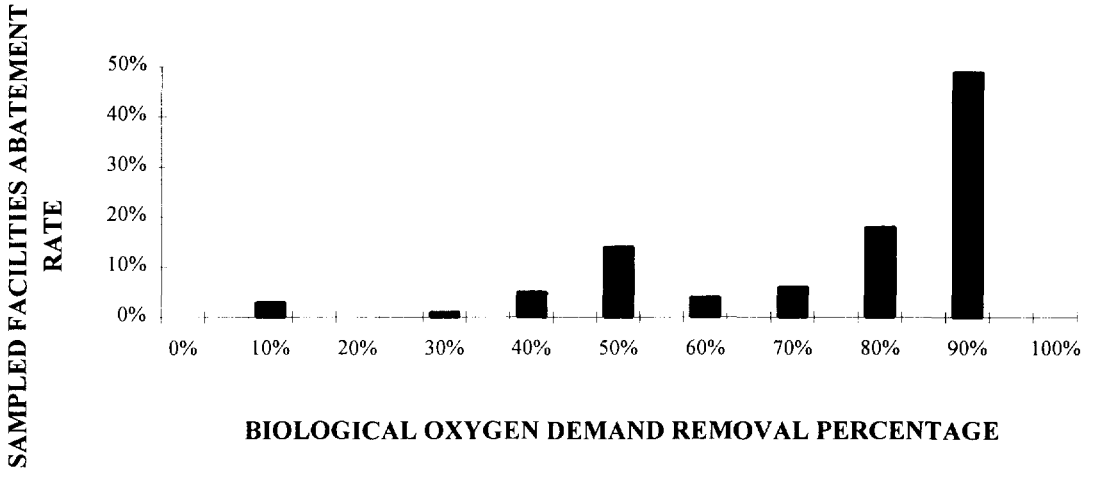
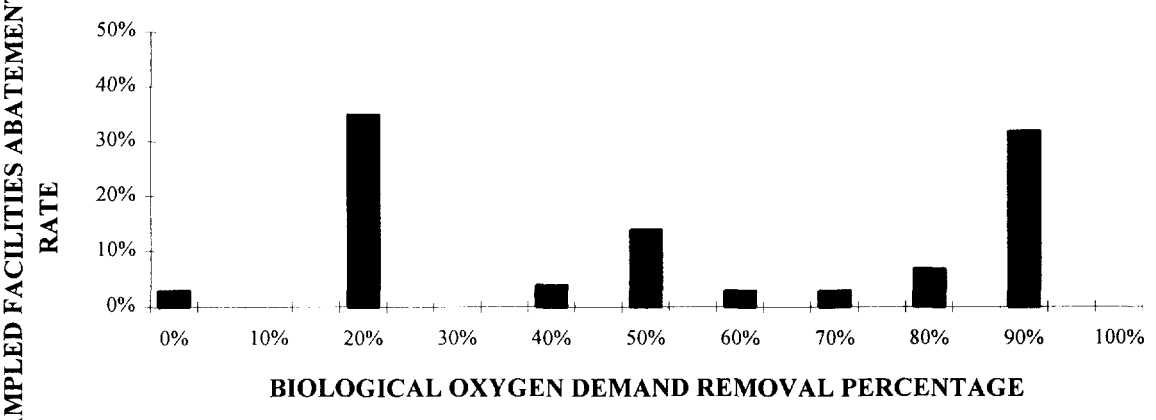


Figure 2 PHILIPPINES MANUFACTURING
BOD REMOVAL RATES



rates in the two plant samples.[7] Clearly, these results contradict the stereotype. At least one-third of the plants in the Manila sample are removing BOD at high rates, and many Thai plants seem to be running near OECD standards. Approximately 50% of the Thai factories in the sample are removing over 90% of their BOD from the waste stream, and 70-80% are removing 70% or more.[8]

Indonesia is another Southeast Asian economy with historically weak regulation. Nonetheless, recently-gathered data reveal the same pattern (Afsah, 1995). Figures 3 and 4 present distributions of BOD concentrations relative to U.S. and Indonesian standards for large samples of Indonesian pulp/paper and textile mills. In each case, the Indonesian standard is several times that of its U.S. equivalent. While the U.S. Environmental Protection Agency is well-staffed and has operated for over twenty years, the Indonesian national regulatory agency (BAPEDAL) is quite new, operates with a small staff, and has little power to punish plants which are not in compliance with existing regulations. Nevertheless, the actual distribution of

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[7] Organic water pollutants are oxidized by naturally-occuring micro-organisms. Biological oxygen demand (BOD) removes dissolved oxygen from the water and can seriously damage some fish species which have adapted to the previous dissolved oxygen level. Organic water pollutants can also accelerate the growth of algae, which will crowd out other plant species. The eventual death and decomposition of the algae is another source of oxygen depletion as well as noxious smells and unsightly scum. The most common measure for BOD is the amount (kg.) of oxygen used by micro-organisms to oxidize the organic waste in a standard sample of pollutant during a five-day period (hence, '5-day BOD').

[8] Sources: World Bank consultant reports.

Figure 3 Distribution of BOD Load Intensity Indonesian Paper Plants

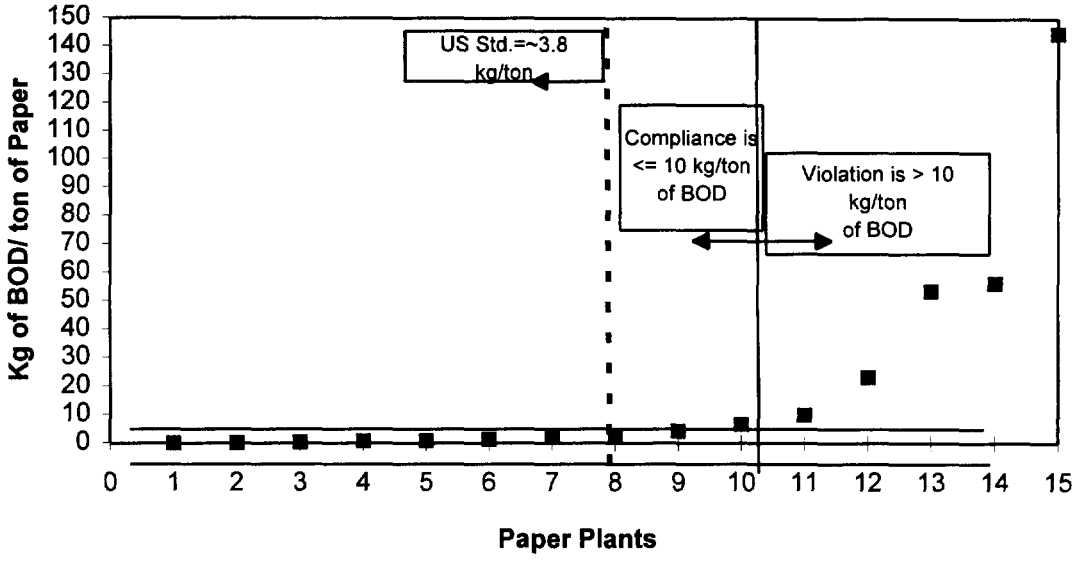
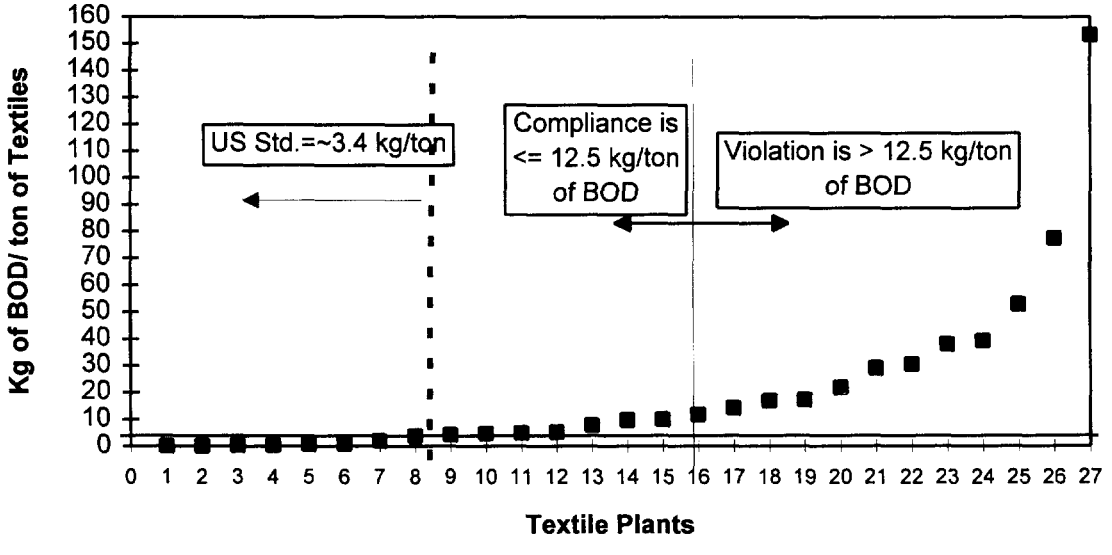


Figure 4 Distribution of BOD Load Intensity Indonesian Textile Plants



effluent concentrations in Indonesian plants is extremely broad, overlapping both U.S. and Indonesian standards. Approximately two-thirds of the plants are in compliance with Indonesian standards, and one-third would be in compliance with U.S. standards.

Thus, evidence from South and Southeast Asia indicates great variation in plants' environmental performance regardless of the state of formal regulation. In Brazil, Seroa da Motta, et al. (1993) have found a similarly broad pattern of variation in BOD removal across Brazilian states. Even in North America, relatively high average performance masks a surprising degree of variation.[9]

Why should such broad variations exist, even in countries where regulation is weak? Most explanations have relied on anecdotes (Birdsall and Wheeler, 1993) or on work which relates national policies to changes in the balance between "dirty" and "clean" sectors or technologies across countries (Birdsall and Wheeler, 1993; Martin and Wheeler, 1992; Huq et al., 1993). The latter work, however, relies on sector- and technology-specific pollution intensities estimated from U.S. data and does not reflect actual emissions in other countries. More systematic evidence for developing countries is just beginning to emerge.

In a recent econometric analysis of BOD emissions from

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[9] Three years ago, a California coastal pulp mill was fined and forced to install abatement equipment after local surfers developed skin lesions from contact with its **untreated** raw effluent in the Pacific. Laplante and Rilstone (1994) note that BOD and SS (suspended solids) pollution from pulp and paper mills in Québec violates environmental standards at least 38% of the time.

Indonesian factories, Pargal and Wheeler (1995) find that several plant characteristics significantly affect pollution intensity. These include operating scale, vintage, efficiency and ownership. Their results are also consistent with widespread 'informal regulation:' Where the state functions poorly as a regulatory agent, local communities, under some circumstances, have struck their own Coasian bargains with neighboring factories. Leverage in negotiations is provided by social pressure on workers and managers; adverse publicity; the threat (or use) of violence; or recourse to civil law.

While the Pargal/Wheeler results are certainly suggestive, they are subject to some important caveats. First, the sample is limited to one country (albeit spread across a highly varied set of provinces). Second, the sample plants are spread across many sectors; sector controls are limited to dummy variables for a few well-represented activities. Third, only end-of-pipe emissions are observed. Thus, it is not clear how much of the variation in BOD is due to actual abatement and how much is due to subsectoral variation in product lines. This is particularly important for evaluation of the informal regulation hypothesis. Higher pollution intensity might simply reflect the differential location of highly polluting facilities in poor communities, not explicit abatement efforts. This would certainly reflect differential community power, but would not imply that such power provides important leverage for pollution control.

In this paper, we reverse the Pargal/Wheeler approach.

Rather than estimating emissions equations across many sectors in one country, we analyze explicitly-observed abatement activity in one sector -- pulp and paper -- across several countries. We also distinguish between possible Pigouvian and Coasion interpretations of abatement. In Section 2 of the paper, we review the Pigouvian and Coasian approaches and introduce the distinction between 'formal' and 'informal' regulation. Section 3 presents our analysis of the plant-level data. Section 4 summarizes the paper.

2. PIGOUVIAN vs. COASIAN REGULATION

The Pigouvian approach places responsibility for an externality on its generator (the polluter) and imposes a pollution tax (effluent fee) as the policy prescription. Its optimality rests on a set of restrictive neoclassical assumptions.[10] Most importantly, the Pigouvian approach does not address the reciprocal nature of externalities. Nor does it analyze the abatement behavior that will be induced by the Pigouvian tax.

In contrast, the Coasian approach assumes that an externality is reciprocal (i.e., *both* polluter and pollutee cause

[10] See Baumol [1972]. This optimality of the Pigouvian tax holds whether participants merge or operate independently. Buchanan [1969] and Davis and Whinston [1973] question this optimality in the case of monopoly and/or oligopoly. However, for a workably large number of participants, the Pigouvian results are unassailable.

the externality[11]); that legal rules and institutions should change to efficiently internalize the externality; and that policy makers should focus upon the dynamic issue of eliminating (abating) the externality. By incorporating these issues into the analysis, the Coasian approach arrives at optimal policy prescriptions which generally dominate the Pigouvian results.[12]

Because formal regulation is often weak, we hypothesize that abatement efforts in developing countries may have significant Coasian elements. At the core of this issue lies the question of effective political constituency: Have centralized governmental regulations and statutes (formal regulatory initiatives) or localized citizen pressure and negotiations (informal regulatory initiatives) been more important as inducements to observed abatement efforts?[13]

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[11] More specifically, the externality would not exist if the pollutee had located elsewhere. In the law, this is called "coming to the nuisance". See Cooter and Ulen [1988], p. 181.

[12] See Brown [1973]; Calabresi [1970]; Coelho [1975]; Coase [1960]; Demsetz [1963,1967,1972]; Diamond [1974]; Hartman [1982]; McKean [1970].

[13] In developed countries, we would expect to find that political and social pressure for pollution abatement are communicated through formal governing and regulating agencies. In developing countries, however, the formal political and regulatory infrastructure is less well-developed. In these situations, political constituencies must sometimes go directly to the source of the problem. See Huq and Wheeler (1993) for examples from Bangladesh.

3. EMPIRICAL ANALYSIS

Our empirical analysis makes use of data gathered as part of a 1992 World Bank field survey of 26 plants in the pulp and paper industry. The plants were distributed throughout Bangladesh, India, Indonesia and Thailand. The survey gathered the following information about each plant:

- The process technology in place. Four processes were in operation: stone ground; soda; kraft sulphate and sulphite; and waste-paper-based pollution. In our analysis, we characterize the stone ground process as "clean" because it does not use polluting chemicals.
- Ownership in three categories: state-owned enterprises (SOE), domestic privately-owned enterprises (POE) and multinational enterprises (MNC).
- Characterization of geographical location by degree of urbanization: Big city (population greater than 1 million), small city (population less than 1 million), or rural area.
- The size of the plant measured by total employment.
- Whether foreign financing and/or donor aid supported plant construction.
- The existence of local pressure to abate observed pollution.
- The cost competitiveness of the plant relative to other plants in the domestic market.
- The pollution abatement efforts undertaken by the plant. The focus of this measure for the most part is end-of-pipe abatement.

To this data base, we have added the following information about the economic and regulatory environment in which each plant operated:

- The standard of living in the country, measured as per capita income at purchasing power parity;
- The extent of formal emissions regulation;
- Indices of informal regulatory pressure.

The available information set does not include the pollution abatement efforts undertaken by *other* local parties in response to pollution at the plant. Thus, our results can only provide suggestive evidence about the significance of Coasian elements.

3.1 Model Variables

For this analysis, we have used the available information to develop indices of abatement efforts; formal regulatory pressures at the national and local levels; informal regulatory pressure; and other relevant factors. Variable definitions are provided in Box 1. The informal regulatory set has the following dimensions:

- Per capita income, a proxy for local valuation of pollution damage; political awareness; education; and citizen activism.
- The ease with which a given polluter can be identified and subjected to informal pressures, measured by the size of the city or rural area in which the plant operates.
- The competitiveness and profitability of the plant, measuring its willingness to accept abatement responsibility; its ability to abate; and its bargaining strength in localized Coasian negotiations.
- The size of the aggregate social willingness to pay to eliminate the externality, measured as the size of the

BOX 1: VARIABLE DEFINITIONS

ABATEMENT EFFORT

An integer score that summarizes both the number of abatement actions undertaken by the plant and the relative costliness of those actions. Ten actions are possible, including installation of electrostatic precipitators or filter bags, lagoon facilities, aerobic treatment, anaerobic treatment, clarifier, chemical treatment of wastes (coagulant/focculin), water recycling, liquor recovery, compaction of solid waste and general housekeeping procedures. The score can range in value from 1 to 36. In the data, the score actually ranges from 0 to 32. We describe the development of this variable in greater detail in Appendix A.

INFORMAL REGULATORY PRESSURES

LOC1 = 1 if plant location is within a city of more than 1 million residents; 0 otherwise.
LOC2 = 1 if plant location is within a city or town of less than 1 million residents; 0 otherwise.
LOC1 = LOC2 = 0 if plant location is rural.
EMP = total employment at plant.
PCI = per capita income in the country.
COMPETE = 2 if the firm is above average in terms of competitiveness; 1 if the firm is average; 0 if the firm is below average.
PRESSURE = 1 if the plant was subjected to localized pressure to abate observed pollution; 0 otherwise.

FORMAL REGULATORY PRESSURES

NATREG = an index summarizing the degree of formal regulation at the national level in the home country of the survey plant: 0 if no environmental regulations; 1 if some generalized enabling statutes but no real effluent guidelines or technology standards; 2 if mandated standards but no monitoring or enforcement; 3 if mandated standards, ambient monitoring and no enforcement; 4 if mandated standards, ambient and some site monitoring, and some enforcement; 5 if mandated standards, systematic ambient and site monitoring, and systematic enforcement.

PROVREG = an index summarizing the degree of formal regulation affecting the surveyed plant at the provincial level: -1 if provincial regulations are less stringent than national regulations; 0 if provincial regulations are no more stringent than national regulations; 1 if provincial regulations are more stringent than national regulations.

FORMREG = an index summarizing the strength of formal regulatory pressures affecting the surveyed plant, including both national and provincial regulations and defined as NATREG + PROVREG.

OTHER FACTORS

SOE = 1 if the plant is a state-owned enterprise; 0 otherwise.
MNC = 1 if the plant is a joint venture with foreign investment; 0 otherwise.
SOE = MNC = 0 if the plant is domestic and a privately owned-enterprise (POE)
FORFIN = 1 if any foreign donor financing was used for the installation, where donors include the World Bank and OECD countries; 0 otherwise.
AGE = Age of the plant.
CLEAN = 1 if the manufacturing process at the plant is either waste paper or some stone-ground process; 0 otherwise (the process is either soda, kraft or sulphite).

city in which the plant is located.

More detailed descriptions of the abatement index and selected independent variables are provided in the Appendix.

3.2 Survey Results

3.2.1 Ownership

Prior to the survey, we believed that plant ownership would be an important determinant of abatement effort. Everything else being equal, we expected state-owned enterprises (SOEs) to be larger than private-sector counterparts (certainly relative to local privately-owned enterprises -- POEs) and less efficient in material use. We hypothesized that both of these factors would increase pollution, *ceteris paribus*, and the need for abatement efforts.[14] On the other hand, we also recognized that state-owned enterprises have frequently been more insulated from regulatory pressures than their private-sector counterparts.

The decomposition of our sample by ownership (and country) is presented in Table 1A. Roughly 50% of our plants are domestic, privately-owned enterprises (POEs); only four are owned by multinational corporations (MNCs); and about 38% are SOEs. In Table 1B, we present the average size of these plants. In India and Bangladesh the SOEs are larger, on average, than the POEs. In Thailand, however, they are not.

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[14] While size may increase the need for abatement efforts overall, it can also reduce the average cost of abatement because of scale economies in waste treatment.

TABLE 1A
DISTRIBUTION (NUMBER) OF PLANTS BY OWNERSHIP AND COUNTRY

Country	Public	Private Domestic	Foreign	TOTAL
Bangladesh	3	1		4
India	3	4	2	9
Indonesia	4	5	1	10
Thailand		2	1	3
TOTAL	10	12	4	26

TABLE 1B
AVERAGE SIZE OF PLANTS (MEASURED BY EMPLOYMENT)
BY OWNERSHIP AND COUNTRY

	Ownership			
Country	Public	Private	Multinational	TOTAL
Indonesia	1504.5	2225.4	3081	2022.6
Thailand	-	385	400	390
India	1330	289.5	945	922.7
Bangladesh	2737	250	-	1908
TOTAL	1720.2	1272.6	1342.7	1459.9

TABLE 2
ABATEMENT ACTIVITY (MEAN, MEDIAN, MAXIMUM AND
MINIMUM SCORE) BY OWNERSHIP

Ownership	Minimum	Median	Maximum	Mean	No. of Obs.
Public	0	7.5	32	10.2	10
Private	1	13.5	31	16.2	12
Foreign	13	20	28	20.3	4

During the survey, the management of the POEs seemed more aware of and responsive to existing and expected environmental regulations than did their SOE counterparts. The largest, most competitive and profitable POE plants, such as those of the Sinar Mas group in Indonesia and Thai Paper in Thailand, have aggressively controlled water and air pollution. In fact, these particular POEs appeared to abate more aggressively than many MNCs. However, our results suggest very active abatement efforts by MNCs. Certainly, local regulation has something to do with this. It also reflects the MNCs' attempts to standardize their operations across the globe. Their production techniques must often meet developed-country environmental standards.[15]

Table 2 summarizes our findings, presenting the abatement scores of the three groups of plants by ownership class. Based on both median and mean scores, state-owned enterprises (SOEs) have been least aggressive in abating pollution, in spite of the fact that the SOEs are, on average, the largest plants. The strength of this result is compounded by the fact that average abatement costs are generally lower for larger plants. The mean POE has undertaken approximately 60% more abatement effort than the mean SOE, while the mean MNC (in an admittedly tiny sample)

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[15] In our sample, we should note that MNCs are cleaner only in end-of-pipe abatement, not in original choice of production technique. We have classified alternative manufacturing processes as "clean" if the process is either waste paper or some stone-ground process and "dirty" if the process is either soda, kraft or sulphite. Using these categories, we find the following distribution of plants by ownership and manufacturing process: SOEs (1 clean and 9 dirty); POEs (5 clean and 7 dirty); MNCs (1 clean and 3 dirty). In this small sample, at least, the POEs have more consistently selected clean processes than have the MNCs.

has undertaken approximately 25% more abatement effort than the mean POE.

3.2.2 Indices of Informal Regulation

Section 3.1 identifies several factors that we believe affect the strength of informal regulatory pressures on polluting facilities. These factors include per capita income (proxying political awareness, literacy, activism and political power); the size of the city in which the plant is located (measuring *both* the ease with which the polluter can be identified and subjected to informal pressures *and* the size of the aggregate social willingness to pay to eliminate the externality); and the competitiveness and profitability of the plant (measuring *both* its willingness and ability to accept and undertake abatement responsibility *and* its bargaining strength in localized Coasian negotiations[16]).

Tables 3 and 4 summarize the abatement scores of plants grouped by national per capita income (in purchasing power parity), location, plant competitiveness and degree of past pressure from local communities.

- Income: There is a strong positive relationship between per capita income and abatement effort in our sample.

- Location: We find an inverse relationship between city size and abatement efforts; plants in rural areas undertake significantly more abatement than plants in small and large cities. To the extent that abatement is induced by regulatory

[16] Thus, both size and competitiveness have countervailing elements.

TABLE 3
ABATEMENT EFFORTS, BY INCOME, LOCATION AND COMPETITIVENESS

Country (Per Capita Income)		Min	Med	Max	Mean	No. of Obs.
Bangladesh ($700)		3	6	8	5.8	4
India ($786)		0	13	30	14.3	9
Indonesia ($1714)		1	10.5	32	14.6	10
Thailand ($2800)		19	29	31	26.3	3
Location	Rural area	0	23	32	19.1	13
	Small town	9	16	19	15	4
	Big city	1	5	14	5.7	7
Compet-itiveness	Below average	0	7.5	32	8.9	8
	Average	1	13	28	12	9
	Above average	4	26	31	23.8	8

TABLE 4
ABATEMENT ACTIVITY BY COUNTRY AND PRESENCE OF LOCAL PRESSURE (INFORMAL REGULATION)

	Country				
Pressure	Indonesia	Thailand	India	Bangladesh	TOTAL
0	12.7	19	11.2	5	11.1
1	19	30	18.2	8	19.8
TOTAL	14.6	26.3	14.3	5.7	14.5

response to perceived aggregate willingness to pay, we would have expected the opposite result. That is, abatement efforts would be greatest in the largest cities, *ceteris paribus*. Our finding therefore suggests a strong effect for ease of identification: in rural areas polluting activities are more obvious, while they are lost among all the other polluters in large cities. Significant power for informal regulation is implied by this finding, but we should also note a parallel result which reveals a weakness of partially-informed community action. Local communities can pressure plants to abate once they have been installed, but they have little ability to compare processes before installation. We find an apparently powerful countervailing effect in process technology selection: 'dirty' processes are far more common in rural areas. The distribution is as follows: rural location (0 clean, 13 dirty); small city (2 clean; 2 dirty); large city (5 clean; 2 dirty).

- Competitiveness: The more competitive (i.e., profitable) plants undertake more aggressive abatement, apparently because they can afford it.[17]

- Pressure: While we have used per capita income and location to proxy the existence of informal regulatory pressure, we have also been able to obtain a more direct measure of localized pressure. Specifically, 9 of our 26 plants reported that they had experienced pressure and complaints from local

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[17] We had originally hypothesized that export-oriented plants might abate more because of sensitivity to 'green consumerism' in richer importing economies. However, we found no such effect.

citizen groups concerning plant pollution. We use a dummy variable (PRESSURE) to identify these plants. Table 4 summarizes the abatement activities of the sample plants differentiated by PRESSURE and country. In all cases, those plants experiencing localized pressure undertook significantly more abatement activities afterward.

3.2.3 Indices of Formal Regulation

Finally, we present summaries of abatement efforts for plants facing alternative levels of formal regulatory pressure, which we differentiate at the national and provincial levels. Table 5 summarizes our findings. In Table 5A, we present average scores for our national regulatory index. As national regulatory pressure increases from level 1 to level 3, we find that the average abatement score rises from 5.75 to 16.09. In Table 5B, we examine the scores of plants within each country differentiated by the relative strength of provincial environmental regulation.

We find differences across provinces in Indonesia and India only. In Indonesia, those plants facing provincial regulations more stringent than the national regulations reveal greater abatement activities through considerably higher scores. In India, we find that plants facing below-average provincial regulations reveal less abatement effort. However, plants facing above-average pressure do not reveal greater abatement effort than plants at national average levels. Finally, Table 5C summarizes the average scores for plants grouped by our variable

TABLES 5A-5C:
ABATEMENT ACTIVITY BY MEASURES OF FORMAL REGULATION

TABLE 5A
VARIATION BY NATIONAL REGULATION

National Regulation	Mean Score
1	5.75
3	16.0
TOTAL	14.5

TABLE 5B
VARIATION DUE TO PROVINCIAL REGULATION

	Country				
Provincial Regulation	Indonesia	Thailand	India	Bangladesh	TOTAL
-1			7.3		7.3
0	12.8	26.3	18.3	5.7	14.6
1	17.2		17.3		17.2
TOTAL	14.6	26.3	14.3	5.7	14.5

TABLE 5C
VARIATION BY FORMAL REGULATION: NATIONAL AND PROVINCIAL

Formal Regulation	Mean Score
1	5.7
2	7.3
3	17.5
4	17.2
TOTAL	14.5

summarizing both national and provincial formal regulation. As formal regulations are strengthened from 1 to 3, we find that the average score rises from 5.75 to 17.58. However, the average scores for plants facing values of 3 and 4 are essentially the same. This latter result is due entirely to the non-responsiveness of plants in India.

3.3 Correlations

Table 6 presents the correlations among those independent variables that we have found to be important. The state-owned plants (SOEs) are the least competitive in the sample ($r = -0.5012$) and the most likely to be financed by donor aid[18] ($r = 0.5447$); plants with cleaner technologies are usually located in larger cities ($r = 0.5238$); our measure of formal regulation (FORMREG) is orthogonal ($r = 0.0000$) to our single measure of informal regulation (PRESSURE); correlated with per capita income (ln PCI: $r = 0.3987$) but only weakly correlated with our other proxies for informal regulation: LOC1, LOC2 and COMPETE ($r = 0.0000$, 0.2795 and -0.2004 respectively).

3.4 Regression Results

We have estimated two regressions to assess the partial

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[18] We introduced the variable FORFIN (see Box 1) to test the hypothesis that donor agencies attempt to encourage pollution abatement efforts through their lending policies, ceteris paribus. However, we found that FORFIN summarized lending activities that occurred over the lives of the plants, some of which predated the era of international environmental consciousness. Unfortunately then, FORFIN only provided a weak index of recent pressure by donors.

TABLE 6
CORRELATION MATRIX

	SCORE	COMPETE	Ln PCI	LOC1	LOC2	FORFIN	MNC
SCORE	1.00						
COMPETE	0.53	1.00					
Ln PCI	0.40	0.21	1.00				
LOC1	-0.59	-0.13	0.17	1.00			
LOC2	-0.01	-0.29	-0.16	-0.32	1.00		
FORFIN	-0.62	-0.55	-0.05	0.37	-0.28	1.00	
MNC	0.24	0.29	0.02	-0.32	0.06	-0.28	1.00
SOE	-0.17	-0.50	-0.25	-0.02	-0.10	0.54	-0.36
Ln EMP	0.31	0.06	-0.05	-0.29	-0.34	0.24	0.03
EMP	0.33	0.11	0.01	-0.30	-0.28	0.05	-0.04
CLEAN	-0.33	-0.00	0.11	0.52	0.21	-0.12	-0.05
FORMREG	0.25	-0.20	0.39	0.00	0.27	-0.12	-0.13
PRESSURE	0.45	0.12	0.17	-0.31	-0.15	-0.00	-0.40

	SOE	Ln EMP	EMP	CLEAN	FORMREG	PRESSURE	
SOE	1.00						
Ln EMP	0.38	1.00					
EMP	0.16	0.88	1.00				
CLEAN	-0.48	-0.39	-0.33	1.00			
FORMREG	-0.11	0.01	0.09	0.00	1.00		
PRESSURE	0.47	0.40	0.42	-0.53	0.00	1.00	

Notes:
1. Ln PCI and Ln EMP are the Natural Logs of PCI and EMP.
2. All variables are defined in Box 1.

effects of regulation and plant characteristics on abatement effort. The plant characteristics include EMP, MNC, SOE, CLEAN, FORFIN, COMPETE and AGE. (See Box 1.) The two versions differ in their treatment of informal regulatory pressure. In our first regression, we measure this as PRESSURE; in our second regression, we measure it as the vector of proxies <ln PCI, LOC1, and LOC2>. Using standard t and F tests, we eliminated those variables whose estimated parameters were not statistically different from zero. After hypothesis testing, we report the final estimates for both regressions in Table 7.

In the first regression, we find that both formal (FORMREG) and informal (PRESSURE) regulation have statistically important positive effects on abatement activity (SCORE). Given the scaling of the variables, the effects are about equal. Other factors affecting abatement activity include the size of the plant (which increases abatement activities at a decreasing rate); its relative competitiveness; state ownership (SOE = 1) and whether the process technology is 'clean.' However, MNC ownership has not proven to be significant in this multivariate analysis.[19] *Ceteris paribus*, more competitive plants are able to undertake more substantial abatement efforts; state-owned enterprises abate considerably less than privately-owned enterprises (whether local or multinational); and plants with "clean" technologies require less abatement.

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[19] Where the same variables are employed, these results are consistent with those reported in Pargal/Wheeler (1995).

TABLE 7
REGRESSION RESULTS

REGRESSION 1: DETERMINANTS OF ABATEMENT EFFORT				
Variable	Coefficent	Standard Error	t	P>|t|
PRESSURE	9.67	4.13	2.34	0.03**
FORMREG	3.36	.95	3.53	0.00**
EMP	.0069	.0028	2.49	0.02**
EMP^2	-1.04e-06	4.12e-07	-2.51	0.02**
COMPETE	3.48	2.02	1.72	0.10*
SOE	-12.79	4.57	-2.79	0.01**
CLEAN	-6.89	3.60	-1.91	0.07*

Number of observations = 22; adj R^2 square = 0.8

*Significant at 10% confidence level.
**Significant at 5% and 1% level.

REGRESSION 2: DETERMINANTS OF ABATEMENT EFFORT				
Variable	Coefficient	Standard Error	t	P>|t|
COMPETE	5.71	1.56	3.64	0.00**
Ln PCI	6.74	2.71	2.48	0.02**
LOC1	-11.94	2.73	-4.36	0.00**
EMP	.0041	.0021	1.95	0.07*
EMP^2	-5.69e-07	3.10e-07	-1.83	0.09*
FORMREG	2.99	1.55	1.92	0.07
CONS	-47.21	17.51	-2.69	0.01**

Number of observations = 20; adj R^2 = 0.7520: $F_{6,13}$ = 10.6

*Significant at 10% confidence level.
**Significant at 5% and 1% level.

When we use our proxy variables for informal regulatory pressures in Regression 2, we obtain similar results. Formal regulatory pressures are still quite important, and the measured size of the effect is similar to that found in Regression 1. "Other" factors that prove statistically important are size (which also increases abatement activities at a decreasing rate) and competitiveness. In this regression, both SOE and CLEAN are statistically insignificant. The two proxy measures for informal regulatory pressure that prove to be statistically significant are per capita income and location in a large city (LOC1). As discussed above, the measured effect of LOC1 supports our hypothesis that polluters in smaller cities and rural areas are more easily identified and subjected to localized informal pressure.[20]

4. SUMMARY AND CONCLUSIONS

In this paper, we have analyzed the results of a survey of pulp and paper plants in four Asian developing countries. We find that both informal and formal regulation have significant effects on abatement. While our results are consistent with a Coasian interpretation, we must defer any strong conclusions until more detailed survey work has been completed.

4.1 Determinants of abatement

The main message of our results is a hopeful one for

[20] However, it is important to note that many of the plants in LOC1 have CLEAN technologies. The fact that CLEAN is statistically insignificant in this regression may be due to its collinearity with LOC1.

sustainable development. Clean production is not uncommon, even in very poor countries such as Bangladesh. Why are some factories so much cleaner than others? Some plant characteristics clearly matter a lot, although several of our prior hypotheses have not survived this particular test. We find that abatement is positively associated with scale and competitiveness; negatively associated with pubic ownership; and unaffected by foreign links (in ownership, financing or export-orientation). Age of plant is not associated with greater abatement in this four-country study, although it has been significant in other studies (e.g., Pargal and Wheeler, 1995).

Community pressure, or informal regulation, emerges as a clear source of interplant differences. Under some circumstances, communities successfully pressure plants to abate even if little or no support is available from formal regulation. Our results suggest that local income is a powerful predictor of effective informal regulation. We also find that existing formal regulation has measurably beneficial effects, even when it is weakly-developed.

4.2 General Policy Implications

Our results suggest that several trends in developing countries will encourage pollution abatement. The current wave of privatization implies declining significance for pollution-intensive state-owned enterprises. Deregulation during the 1980's has presumably increased plant-level efficiency in the

private sector, with significant improvements in environmental performance. Per capita incomes are also advancing steadily in many Asian and Latin American countries, raising the likelihood of stronger local pressure on many polluting facilities.

If cross-section results can be extrapolated to time series, continuation of such trends should be associated with a significant increase in abatement activity, no matter what happens in the formal regulatory sector. Furthermore, this predicted effect does not depend on any increased presence of foreign, putatively 'green,' firms. More multinational plants will certainly open in the developing world, but our evidence suggests that their environmental performance will be matched by domestic firms which are otherwise comparable.

Our findings on the strength of informal regulation seem particularly significant. An important role for this factor would have several implications for environmental policy in developing countries. First, widespread informal regulation represents a promising foundation for decentralized regulatory policy. In the textbook paradigm of environmental economics, optimal pollution loads and emissions charges should vary across communities because local conditions create different marginal benefit and cost schedules for abatement.

Our results suggest that this is true of informal regulation as well. New formal regulatory systems may be able to build on such local arrangements rather than replacing them at unnecessarily high cost. The imposition of a national system of

uniform standards might, in fact, create enough deviation from locally-optimal standards to reduce welfare in some communities. Second, and arguably more important, our results suggest that community income is a key determinant of informal regulatory outcomes. Communities whose citizens are mostly poor, poorly educated or members of marginalized minority groups may have little ability to use the available channels of informal regulation. Thus, our results imply that 'environmental injustice' may be an important problem in developing countries. To compensate, formal regulation could be targeted particularly on pollution control problems of poor communities.

5. REFERENCES

Afsah, S. and B. Laplante, 1995, *Are Voluntary Pollution Reduction Programs Effective? The Case of PROKASIH in Indonesia*, Policy Research Department Working Paper, World Bank, Washington, D.C. (forthcoming)

Baumol, W.J., 1972, "On Taxation and the Control of Externalities", 62 American Economic Review 307-322

Birdsall, Nancy and David Wheeler, 1993, "Trade Policy and Industrial Pollution in Latin America: Where Are the Pollution Havens?", Journal of Environment and Development, 2, 1, Winter, 137-149

Brown, J.P., 1973, "Toward an Economic Theory of Liability", Journal of Legal Studies 332-349

Buchanan, J., 1969, "External Diseconomies, Corrective Taxes and Market Structure", 59 American Economic Review 174-177

Calabresi, G., 1970, *The Costs of Accidents*, Yale University Press, New Haven

Calkins, Richard S., et. al., 1994, Indonesia - Environment and Development: Challenges for the Future (Washington: World Bank)

Coase, R.H., 1960, "The Problem of Social Cost", Journal of Law and Economics 1-44

Coelho, P.R.P., 1975, "Externalities, Liability, Separability and Resource Allocation: Comment", 65 American Economic Review 721-723

Cooter, R. and T. Ulen, 1988, *Law and Economics*, Scott, Foresman and Company

Dasgupta, S., A. Mody, S. Roy and D. Wheeler, 1995 *Environmental Regulation and Development: A Cross-Country Empirical Analysis*, Policy Research Department Working Paper No. 1448, World Bank, Washington, D.C.

Davis, O. and A. Whinston, 1962, "Externalities, Welfare and the Theory of Games", Journal of Political Economy 241-262

Demsetz, H., 1963, "The Exchange and Enforcement of Property Rights", Journal of Law and Economics 11-26

Demsetz, H., 1967, "Toward a Theory of Property Rights", *American Economic Association Papers and Proceedings* 347-359

Demsetz, H., 1972, "When Does the Rule of Liability Matter", 13 Journal of Legal Studies

Diamond, P., 1974, "Single Activity Accidents", 3 (1) Journal of Legal Studies 107-164

Grossman, G. and A. Kreuger, 1992, "Environmental Impacts of a North American Free Trade Agreement", Peter Garber, ed., *The U.S.-Mexico Free Trade Agreement.* Cambridge, Massachusetts: The MIT Press

Hartman, R.S., 1982, "A Note on Externalities and the Placement of Property Rights: An Alternative Formulation to the Standard Pigouvian Results," International Review of Law and Economics, Volume 2

Hartman, R.S., D. Wheeler and M. Singh, 1994, *The Cost of Air Pollution Abatement*, Policy Research Department Working Paper 1398, World Bank, Washington, D.C.

Hartman, R.S. and D. Wheeler, 1994, "Incentive Regulation for Environmental Protection in Developing Countries", World Bank, Washington, D.C.

Huq, M. and D. Wheeler, 1993, *Pollution Reduction without Formal Regulation: Evidence from Bangladesh*, World Bank Working Paper 1993-39, World Bank, Washington, D.C.

Huq, M., D. Wheeler and P. Martin, 1993, "Process Change, Economic Policy and Industrial Pollution," World Bank, Washington, D.C.

Marchand, J.R. and K.P. Russell, 1973, "Externalities, Liability, Separability and Resource Allocation", American Economic Review 611-620

Margulis, Sergio, 1992, "Back-of-the-Envelope Estimates of the Environmental Damage Costs in Mexico," (Washington: World Bank), Working Paper Series No. 824

Martin, Paul and David Wheeler, 1992, "Prices, Policies, and the International Diffusion of Clean Technology: The Case of Wood Pulp Production," in Patrick Low, ed., International Trade and the Environment, (Washington, World Bank)

McKean, R., 1970, "Products Liability: Implications of Some Changing Property Rights", Quarterly Journal of Economics

O'Connor, D., 1994, "Managing the Environment with Rapid Industrialisation: Lessons from the East Asian Experience", Development Centre Studies, OECD, Paris

Pargal, S. and D. Wheeler, 1995, *Informal Regulation of Industrial Pollution in Developing Countries: Evidence from Indonesia*, Policy Research Department Working Paper 1416, World Bank, Washington, D.C.

Seroa da Motta, Ronaldo, Guilhermino Oliveira Filho, Francisco Mendes, Cynthia Nascimento, 1993, "Current Status of Water Pollution Control in Brazil," Instituto de Pesquisa Economica Aplicada (IPEA), Discussion Paper No. 289

Wheeler, David, 1992, *The Economics of Industrial Pollution Control: An International Perspective*, World Bank, Industry and Energy Department Working Paper, Industry Series Paper No. 60

APPENDIX A: Variable Construction

The Dependent Variable: Abatement Effort Score

For this study we have constructed an index of relative effort and financial resources committed to pollution abatement. The index summarizes both the quality of the abatement technique employed and the installation cost of the relevant plant and equipment. The index does not account for the possibility that the abatement facilities may not be properly or efficiently used. Nor does it include variable costs of operation (labor, materials and replacement parts).

The ten abatement techniques included in our index, which are all end-of-pipe, are the following:

- Air pollution abatement methods

  1. Electrostatic precipitator (EP) or filter bag

- Water pollution abatement methods

  2. Lagoon treatment
  3. Clarifier
  4. Aerobic treatment
  5. Anaerobic treatment
  6. Chemical treatment (coagulant/flocculin)
  7. Water recycling
  8. Liquor recovery

- Solid waste disposal methods

  9. Compaction of solid residuals

- General abatement efforts

  10. Good housekeeping practices for resource recovery and recycling

We characterized each of these ten techniques or practices by the following two criteria (with their appropriate score):

- Relative costliness of the abatement method and/or facility

  - Low cost (Score = 1)
  - Moderate cost (Score = 2)

- High cost (Score = 3)

- Relative quality of abatement facility installation

  - Standard installation (Score = 2)
  - Inferior installation (Score = 1)
  - No installation (Score = 0)

The grading of the ten abatement methods by degree of costliness is as follows:

Abatement Method	Score
Electrostatic precipitator (EP)	3
Filter bag	2
Lagoon treatment	1
Clarifier	2
Aerobic treatment	3
Anaerobic treatment	1
Chemical treatment	3
Water recycling	1
Liquor recovery	1
Compaction or pressing of solids	2
Good housekeeping practices	1

If a given facility uses inferior implementation procedures, it will incur lower costs. For example, standard aerobic treatment involves concrete holding tanks and sufficient aerating equipment. Inferior implementation procedures make use of earthen holding ponds and minimal aerating equipment.

We reflect this relative quality by multiplying the score for the expense of the abatement technique by the score for relative quality of implementation. Thus, aerobic treatment facilities are generally expensive (Score = 3). If a particular installation reflects standard installation criteria, we give it an overall Score of 3*2 = 6. Sub-standard installation of aerobic facilities receives a Score = 3*1 = 3, while the absence of aerobic facilities generates a Score of 0*3 = 0.

The total score given each plant is the sum of the scores for each possible abatement method. If a surveyed plant had implemented all abatement methods using standard installation procedures, the score for that plant would be 36: the maximum score attainable. The minimum score is obviously 0.

Table A1 summarizes the scores for each of our 26 survey plants. The plants are listed in ascending order of abatement effort. While there may be some disagreement about whether a

plant with a score of 9 had implemented more extensive and more costly abatement procedures than a plant with a score of 8, we think the scores provide a reasonable grouping of plants according to relative abatement investment.

Selected Independent Variables

The variable COMPETE is used to identify relative cost competitiveness (0, 1 or 2; see Box 1 in the text) of each plant. We ascertained this value by asking each survey respondent to rank the competitiveness of his/her own plant and all other plants in the region. Since there were usually only a few paper producers in any given country, each plant manager could respond. To avoid any strategic response bias, we corroborated the response of each manager concerning his/her own plant using the responses of the managers of other plants.

As noted in the paper, NATREG AND PROVREG are measures of relative strictness for national and provincial regulation. Table 2A summarizes the plant sample and scores by country and province.

TABLE A1
THE CONSTRUCTED INDEX SCORE OF THE SURVEYED PAPER PLANTS

Plant Number	EP or filter bag	Lagoon	Clarifier	Aerobic Treatment	Anaerobic Treatment	Coagulant/ flocculin	Water Recycling	House keeping	Liquor Recovery	Press for Solids	Score
1											
2											
3		1									1
4									1		1
5								1	2		3
6		1						1	2		4
7							2	1	2		5
8							2	2	2		6
9	6	1									7
10		2		3				1	2		8
11	6								2		8
12		2	2	3	1				1		9
13		1	4	6	1				1		13
14	4					6		1	2		13
15			4			6		2	2		14
16	4		4	6	2			1	2		19
17	6	1	2	6					2	2	19
18	6	1	4	6						4	21
19	6	1	2	6		6			2		23
20	6	1	4	6	1	3	2		1		24

Plant Number	EP or filter bag	Lagoon	Clarifier	Aerobic Treatment	Anaerobic Treatment	Coagulant/ flocculin	Water Recycling	House keeping	Liquor Recovery	Press for Solids	Score
21	6	2	4	6	2		2		2	4	26
22	6	2	4	6	2		2		2	4	28
23	6	2	4	6	2	6		1	2		29
24	4	2	4	6	2	6		1	1	4	30
25	6	2	4	6	2	6	2	1	2		31
26	6	2	4	6	2	6		1	1	4	32
Highest Possible Score	6	2	4	6	2	6	2	2	2	4	36

TABLE A2
NATREG, PROVREG, FORMREG By Country and Region

Country	NATREG	PROVREG	FORMREG	No. of Plants
INDONESIA				
Surabaya	3	1	4	4
Rest of Indonesia	3	0	3	6
INDIA				
Maharashtra	3	1	4	3
Kerala	3	0	3	1
Karnataka	3	0	3	2
West Bengal	3	-1	2	3
THAILAND	3	0	3	3
BANGLADESH	1	0	1	4

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