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What Kinds of Firms Are More Sensitive to Public Disclosure Programs for Pollution Control?

The Case of Indonesia's PROPER Program

Jorge H. García, Shakeb Afsah, and Thomas Sterner

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Abstract

This paper analyzes differences in firms' responsiveness to PROPER, Indonesia's public disclosure program for industrial pollution control. The overall effectiveness of this program at achieving emissions reductions and its low regulatory costs earned it a good reputation around the world. PROPER had no deterrents or incentives other than those that arose indirectly from publicly disclosing information about the environmental performances of firms. We analyzed plant-level data to relate short- and longer-term environmental responses to facility characteristics. The results revealed that foreign-owned firms were consistently more likely to respond to the environmental rating scheme, compared to private domestic firms. This is a clear and important insight with consequences for a number of issues, such as understanding the pollution haven debate. Also, firms located in densely populated regions, particularly in Java, responded more positively to the public disclosure of PROPER ratings. The main observed effect, however, occurred at the initial level of environmental performance of firms. Those firms that had bad environmental performance records felt pressure to improve, but once the initial abatement steps had been taken, the incentives to improve further appeared to diminish.

Key Words: Environmental policy, pollution control, public disclosure, developing country, Asia, Indonesia

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Contents

List of Tables

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Introduction

Indonesia's Program for Pollution Control Evaluation and Rating (PROPER) was the first major initiative in the developing world that used information disclosure to reduce industrial pollution. Its apparent effectiveness at achieving emissions reductions and its low regulatory costs earned it a good reputation. The program was viewed as an inspiring experiment and a number of countries set out to emulate it (World Bank 2000; Dasgupta et al. 2007).[1] The early success of the program has been challenged, however, by the possible presence of other factors not related to PROPER that could have been responsible for the observed reductions in emissions. Recently, García et al. (2007) addressed this issue and studied the change in emissions before and after the program, using treatment and control groups of firms that did and did not participate in the program. The authors concluded that there was indeed a strong, positive response to PROPER, particularly among firms with poor environmental compliance histories.

In this study, we took a further step and attempted to uncover some of the characteristics of those firms with better responsiveness to PROPER. More broadly, we sought to contribute to the understanding of regulatory programs based on public provision of information about

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[1] The U.S. Toxics Release Inventory Program (TRI), active since 1988, was the first and most notable public disclosure program in the world. However, until PROPER, it was not realized that programs that provided information about industrial polluters could be successfully implemented in countries with relatively weak governmental institutions and imperfect markets.

polluters and the mechanisms through which they work.[2] It has been argued that disclosure triggers or intensifies interactions among firms, workers, community groups, consumers, and investors, increasing the expected costs of polluting activities through channels that do not directly involve the regulator (Tietenberg 1998; Sterner 2003). The empirical literature has so far only reported a determining role of financial markets in these programs that disclose information. A number of studies found negative effects on stock prices for heavy polluters following a release of information. Khanna et al. (1998), Hamilton (1995), and Konar and Cohen (1997) analyzed the U.S. Toxics Release Inventory (TRI) Program; Lanoie et al. (1998) studied the effects of the list of polluters published by British Columbia's Ministry of Environment, Canada. Dasgupta et al. (2001) showed that stock markets in Argentina, Chile, Mexico, and the Philippines reacted to announcements of information on environmental events.

Among the above-mentioned studies, only Konar and Cohen (1997) considered the possible effects on emissions and found that bad publicity was not only followed by falling stock prices but also by emissions reductions; further, the greater the fall in stock price, the larger the observed emissions reduction. It is important to note that stock prices are not just a proxy for the reaction of investors—they actually reflect the value of a firm and, in principle, contain information concerning the reaction of all other agents, such as communities. Despite the somewhat robust evidence of the links between financial markets and environmental disclosure, there is an apparent lack of research testing the influence of other mechanisms. Arora and Cason (1999) looked at the links between communities and environmental outcomes in the context of the U.S. TRI program, but they did not disentangle the effects of information availability itself on emissions.

The imbalance in the current empirical evidence on regulation through disclosure may reflect the difficulties of obtaining certain types of data rather than the relative importance of the different channels though which disclosure may work. Also, although public disclosure appears to be a promising strategy to tackle industrial pollution problems in third world countries, our understanding of the mechanisms at work in this context is still very limited. Under the presumption that the (latent) demand for environmental quality in poor societies is relatively low,

[2] Tietenberg (1998) refered to information disclosure as the third wave of instrument choice (after regulation and market-based instruments). Portney (2000) identified public dissemination of information as one of the three enduring changes in environmental policy over the 2000–2050 period. The other two changes are increased use of market-oriented approaches, such as emission fees and tradable emission permits, and increased decentralization of environmental institutions.

the findings on the success of disclosure programs at achieving emissions reductions in such contexts is, to some extent, puzzling. We know that symmetric information is a necessary but not a sufficient condition for markets and other types of interactions to emerge.[3]

In our study, we analyzed differences in firms' responsiveness to PROPER during the period 1995–98. We used a data set collected from PROPER that contained information on facility characteristics and environmental outcomes before and after the disclosure of information. In June 1995, the plants that were selected to participate were given prior, private notification of their ratings as of that date. They were also informed that updated ratings would be publicly disclosed in December 1995 and at regular intervals thereafter. We used the first *evaluation* round as a baseline to analyze the changes in environmental performance observed in the two subsequent *evaluation and disclosure* rounds. We constructed two response indices for the June–December 1995 period and the June 1995–July 1997 period, and used them as dependent variables in ordered logit models. Lagged firms' characteristics that were correlated with the channels through which disclosure works were used as regressors.

The paper proceeds as follows: section 2 describes information disclosure as a policy instrument in Indonesia and presents an overview of the program to be evaluated. Section 3 presents the empirical approach, section 4 reports the data, and section 5 discusses the results. Section 6 concludes.

2. Disclosure as a Policy Instrument in Indonesia

Garvie and Keeler (1994) argued that the environmental regulator can be viewed as an institution that solves an information asymmetry between polluters and the judiciary. This not only refers to the command and control of standards but also to market based instruments, since a reliable monitoring system is a necessary pre-condition for their successful implementation. Typically, the "classical" regulator would allocate the budget in two different activities: monitoring and enforcement (the actual process of prosecuting firms). The initial steps taken toward the establishment of an environmental regulatory regime in Indonesia, as in many other

[3] Blackman et al. (2004) presented results of a manager survey carried out within the context of PROPER in 1998. Managers were asked to rank mechanisms that could have been influential in the program. Among the mechanisms most frequently ranked first or second were that the program aroused managers' awareness of environmental problems, and that bad ratings increased pressure from communities and from the news media. Pressure from shareholders also appeared to be important.

countries, followed this model. Against the backdrop of increasing environmental problems, the national environmental regulator (BAPEDAL) was created in 1989.[4] Effluent discharge standards for a number of industrial sectors were set in 1991.[5]

Indonesia was well known for the authoritarian government of President Suharto (1967–1998). The sharp decline in international oil prices in the 1980s, however, ended the period of a natural resource-driven economy that had allowed a relatively high degree of government intervention. The new circumstances required a change in policy, and the government engaged in market reform (Farrukh and James 2002). The outward-oriented development strategy resulted in an export boom of manufacturing products. Industrial growth rates frequently surpassed 10 percent per annum in the 1980s and early 1990s, and the country was part of what came to be known as the East Asian Miracle (World Bank 1993).[6]

Despite the existence of a regulatory regime in the early 1990s, the attempts by BAPEDAL to regulate an expanding industrial sector were not very successful. No fines were ever assessed and the authorities lost 90 percent of the environmental and health court cases. BAPEDAL was relatively weak and lacked bargaining power to face the industry (MacAndrews 1994).[7] Estimates in 1994 indicated that industrial pollution accounted for 25–50 percent of the total pollution load in the rivers of Java, Indonesia's main island (World Bank 1994). Industrial contamination had become a serious health problem in the fourth most populated country in the world (the population in the mid-1990s was around 200 million). Also, water pollution, along with over-fishing, was threatening the coral reef diversity of the archipelago. As a result, BAPEDAL was under constant pressure from communities affected by environmental degradation, non-governmental organizations (NGOs), and the media (Makarim 2007).[8]

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[4] BAPEDAL was conceived at Indonesia's Ministry of Environment in 1978. It had a small budget and no enforcement functions and has had to rely heavily on advocacy since its creation (MacAndrews 1994).

[5] Ministerial decree (KEP/MEN/03/1991) set effluent discharge standards in terms of concentration (mg/L) for a number of industrial sectors.

[6] The manufacturing's share of gross domestic product tripled from about 10% in the 1967–73 period to an average of 29% in the 1987–92 period.

[7] The Clean River Program was an early initiative that targeted water pollution. It consisted of a series of semi-voluntary agreements between local governments and polluting firms under the supervision of the Ministry of Environment. Although this program produced some positive results, such as the creation of an inventory of industrial pollution sources, it was clear that coercive actions were required (Afsah et al. 1995).

[8] Nabiel Makarim was the director of the PROPER program during the period studied in this paper and was later appointed Indonesia's minister of environment.

Faced with its own lack of resources and an ineffective and often corrupt judiciary system, BAPEDAL decided to use an alternative approach to address the industrial pollution control problem—PROPER, the Program for Pollution Control Evaluation and Rating. The basic idea of PROPER was to use public disclosure of firms' environmental indicators as a substitute for enforcement. BAPEDAL officials understood that firms face many other costs of pollution, costs that may be much more important than the environmental fees or fines associated with traditional regulations. Firms have relations with surrounding communities and participate in inputs and output markets, labor markets, and financial markets. These interactions could in fact be intensified if different stakeholders became aware of the environmental performances of the firms.[9]

2.1 PROPER

PROPER[10] was launched in June 1995 to reduce water pollution at minimum regulatory costs. To achieve the greatest impact on environmental quality, BAPEDAL handpicked the major contributors to river pollution loads to participate in the program. A distinctive feature of PROPER was the disclosure of information via a five-color scale, in which each participating firm was assigned a color according to its environmental rating. The scale built primarily on compliance with existing pollution standards. The environmental authority understood that disclosing raw data could create interpretation problems among the public. Yet, a simple binary index—in compliance or not in compliance—would not do justice to all firms, especially not to those that had an excellent performance record and those that missed compliance by a narrow margin.

A *black* rating meant that a firm did not meet the legal standards and had made virtually no effort to control pollution. *Red*-graded firms had made some effort to reduce emissions, but failed to meet legal emissions standards and had insufficient reporting. *Blue* was given to those that met legal emissions standards and had reasonably frequent reporting. *Green* was intended for "proactive" companies and was awarded if pollution was 50 percent or less than the required standards and if the firm maintained its equipment well, complied with reporting, and conducted

[9] It is a well-established fact that information plays a determining role in the development of institutions, such as markets. (See, e.g., Stiglitz 2002).

[10] This is a brief description of PROPER. For a more detailed account of the program and the Indonesian regulatory regime in the 1980s and 1990s, see Afsah et al. (1997) and Afsah and Vincent (2000).

environmental work. *Gold* was reserved for firms that were below 5 percent of the legal standard and met international standards for environmental excellence, use of clean production technology, waste minimization, and pollution prevention activities.[11]

BAPEDAL identified 1,500–2,000 firms that accounted for about 80 percent of total pollution. The plan was to rate all of these firms gradually, and BAPEDAL wanted to move cautiously in order to maintain the quality and integrity of the program. It carefully selected firms the first year, choosing of course the most significant polluters. But, another important criterion at this stage was that the firms had to be located in regional clusters to minimize the travel cost for the inspectors and thus keep within the limited initial budget. In June 1995, 187 large polluting plants were notified of their initial ratings and were told that full disclosure of the ratings would be made in December 1995. New firms were slowly and deliberately included in the program until it reached 324 facilities by June 1998. (The program collapsed in 1998 with the Asian financial crisis, but was revived in 2002 with broader rating criteria.) Participation was compulsory for the selected firms, but "opt-ins" were rated as well, and a small number of additional firms joined the program voluntarily.

Initial ratings indicated that two-thirds of the companies were non-compliant and were given red or black ratings. In December 1995, full disclosure of all the ratings started, industry by industry, to attract maximum press coverage during a fairly extended time period. The changes in rankings for the 145 firms used in the empirical exercise of this paper, from June 1995 to December 1995 to July 1997, are shown in table 1. No gold ratings were awarded during these periods. The 6-month period, June 1995–December 1995 (top section of table 1), shows that there was an immediate, positive response during the first six months of the program, particularly among black- and red-rated firms. All but one of the black rated firms improved and moved up. The 25-month period, June 1995–July 1997 (lower section of table 1), shows that more firms adjusted and improved over the longer period. Note that a fairly similar number of firms declined in their environmental performance in both the short and longer terms.[12]

[11] See Afsah and Ratunanda (1999) for more details on the rankings.

[12] As mentioned earlier, PROPER has been considered a reasonably inexpensive experiment. The average annual budget of the program during the 1995–98 period was US$ 200,000, which translates into a cost of $740 per firm per year. Sixty-five percent of the budget was allocated to monitoring and inspection activities, 15% to laboratory tests, and 20% to information processing and administration. During the 1995–98 period, the budget increased by a factor of 2.2, whereas the number of firms in the program increased by a factor of 1.7.

Table 1 Changes in Ratings: June 1995–December 1995, and June 1995–July 1997

Rating June 1995	Declined	No change	Improved	Total
Change in ratings June 1995–December 1995				
Black	-	1	4 (1)	5
Red	1	66	23	90
Blue	13	32	1	47
Green	1 (1)	2	0	3
Gold	0	0	-	0
Total	16	101	28	145
Change in ratings June 1995–July 1997				
Black	-	0	5 (4)	5
Red	3	50	37 (1)	90
Blue	13	29	5	47
Green	2	1	0	3
Gold	0	0	-	0
Total	18	80	47	145

Notes: This table includes the 145 firms that were used in the empirical analysis in this paper. The numbers in parentheses indicate the number of firms that improved or declined two ratings with respect to their initial rating in June 1995. For instance, in December 1995, four firms improved from black to red and one from black to blue.

As mentioned earlier, García et al. (2007) clarified that the general improvements in ratings were in fact due to the program and not to natural trends in emissions or other factors. For this paper, we were interested in uncovering the types of firms that were most responsive to the program.

2.2 Possible Drivers of Improvements

We identified two variables that had a crucial role in forming and structuring the relationship between a polluting plant on one hand and the set of different stakeholders on the other. These two variables are ownership structure and location. Indonesia, like many other countries, is characterized by a certain degree of nationalism. There are three basic categories of

ownership: state, national, and foreign. The state-run firms obviously are well connected politically, which generally applied to domestic business as well.[13] Foreign-owned firms, however, lack these links and, furthermore, have been subject to intense public scrutiny in a way that is distinct from national companies. The economic power of enterprises controlled by foreigners is still limited in some sectors and these firms have still been rather vulnerable to changes in regulations (Treverton et al. 1998). In the socio-political structure build up under Suharto, the most powerful firms were the local private firms, which according to Treverton belonged to two different groups: the Sino-Indonesians (ethnic Chinese) and the Suharto family. The second most powerful group included the stated-owned enterprises—which had many links to the local private groups—and finally, with somewhat less influence in local political arenas, the foreign-owned.

If an environmental NGO suspects environmental dumping by a state or private Indonesian company, it often faces internal opposition from its managers who have well-developed strategic contacts with politicians, media, and trade unions.[14] If the NGO wants to attack a multinational company, however, it will often get strong support from politicians, media, and local businesses. NGOs also have an added channel of influence via the worldwide web and international press—and not least the media in the country of origin of the multinational company concerned.

Some studies have assessed possible technological differences between local and foreign-owned firms in Indonesia. Takii (2004) found that foreign-owned firms had more modern technology than local-owned firms in 1995. Bernard and Sjöholm (2003) reported higher levels of (labor) productivity in foreign firms, compared to local enterprises in the country in 1975–89. Apparently this gap in productivity increased over time. The technological advantages of foreign-owned firms and their relatively easy access to credit can make them more responsive to external shocks (such as new environmental demands).

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[13] Much of the growth of the state-owned enterprises during the Suharto era was due to the protection they received from the sector ministries. Despite the structural changes towards economic liberalization in the mid 1980s, local firms still enjoyed the protection of sector ministries and the central government during the 1990s (Treverton et al. 1998).

[14] Under the Suharto regime, environmental activism was legal as long as it did not have a political motivation. In fact, the NGO movement has played an important role in environmental management in Indonesia. The Environmental Management Act of 1982 (which provided the environmental legislation framework for over 15 years) endorsed and legitimatized community institutions (such as NGOs) to actively participate and support the management of the environment.

An additional fact is that information disclosure by the authorities can actually help foreign owners learn about the performance of local subsidiaries and their managers. Due to asymmetric information, it is often hard for international companies to monitor their local subsidiaries. In many cases, the parent company itself has strict environmental standards because of intense pressure in its own country. As mentioned above, these companies typically have good access to the necessary know-how, technology, input markets, and so forth, to be environmentally responsible, and they may actually desire this in order to avoid expensive damage to their trademarks and reputations. However, monitoring local performance can be difficult, so at the margin a disclosure and rating program can provide them with an important additional instrument.

Location can be key since the pressure from various interest groups—such as communities—reacting to commercial polluters varies significantly. In densely populated and more affluent regions, the pressure will be stronger, whereas in areas that are less populated, are poorer economically, and have fewer effective media and political connections, this pressure will inevitably be weaker. The natural starting point for an analysis of the relations between polluters and communities is the Coase theorem (Coase 1960). Providing information about polluters can reduce transaction costs between communities and neighboring plants, placing the former in a better position to negotiate pollution reductions. This mechanism can be quite relevant in the developing world where ill-functioning official institutions and informal mechanisms are more likely to be found. The public-good nature of information also helps disclosure reach social and economic spheres that stretch beyond neighboring communities (Tietenberg 1998).[15]

In the presence of disclosure, environmentally aware consumers are able to identify and, if preferred, purchase "greener" products. This mechanism applies directly when the industries produce consumer products, but reputation can be important to firms producing inputs for other enterprises as well. Employees may be encouraged to negotiate higher workplace standards after learning the environmental standing of firms. Investors make decisions based on previous issues and other sensitivities, and will, for instance, worry about hidden liabilities of polluters and loss of goodwill associated with pollution. They may also view excess pollution as a signal of inefficiency.

[15] Pargal and Wheeler (1996) provided some evidence on the possible existence of some forms of informal control of polluting firms in Indonesia. Their study suggested that wealthier and more educated surrounding communities could impose greater pressure on polluting firms.

In the context of Indonesia, as in many developing countries, pressure from workers and consumers related to the environmental performance may often be latent rather than overt. Unemployment was still high in the mid-1990s and the economy, although invigorated in the 1980s and 1990s, remained rather poor. Without the possibility of participating in a more competitive job market, workers could not afford to make high demands.[16] Pressure from consumers might not necessarily occur either, as most firms participating in PROPER produced intermediate goods. Furthermore, green consumerism is not very developed in poorer countries.

3. Empirical Approach

We used the first round of PROPER in June 1995, where facilities were evaluated but information was not disclosed, as a benchmark. The changes in the environmental performance of firms after implementation of the program could be analyzed in a number of different ways. One way is to focus on emissions only, which we did in García et al. (2007). However, for the firms operating under this labeling scheme, and for most other stakeholders, it is reasonable to think that their main focus of attention was related to the rating itself. Therefore, our empirical approach concentrated on these ratings. The ratings were of course based on emissions as well as on the implementation of some environmental management practices. Note that the ratings were based on wide emission intervals, which meant that the goal of the firm might not be so much a general reduction of emissions but rather a level just below a certain limit that corresponded to the desired rating (perhaps with some margin to hedge against any uncertainty of emission metering). Due to these considerations, we believed that we could get a deeper understanding of the compliance incentives and behavior by studying changes in rating rather than emission levels.

Let E_{it} be a continuous variable that measures the environmental performance of firm i at time t. Higher values of E_{it} indicate better performance. We were primarily interested in changes of this variable that could be attributed to information disclosure. Thus, the change in environmental performance between $t = 0$ without disclosure, and $t = 1$ some time later with disclosure, can be represented as $\Delta E_i = E_{i1} - E_{i0}$. Note that this can be positive or negative. Some firms might actually increase emissions and decrease their environmental performance as a

[16] Although the official rate of unemployment was 3% in 1994, the underemployment rate was estimated to be 40%. The latter includes the unemployed and those involuntarily working part time for economic reasons or working for poverty-level pay.

response to other (unobserved) factors. Let R_{it} be a PROPER rating variable that takes discrete consecutive values for each color category: 1 for black, 2 for red, up to 5 for gold. R_{it} is a reflection of the underlying variable E_{it}, but the latter may change without a change in rating. There will be a change in rating only if the change in emissions is sufficiently large. Our empirical model assumed that the response to the policy ΔE_i depended on a number of exogenous variables X_i related to firm characteristics and the different channels through which disclosure works. Also, we included the initial environmental performance E_{i0} in order to control for increasing marginal abatement costs effects.

The structural model in our specification is thus given by:

$$\Delta E_i = \beta' X_i + \gamma E_{i0} + \varepsilon_i \ , \qquad (1)$$

where the vector β and the scalar γ represent the parameters, and ε_i is the error term.

A model that is sometimes used in the context of public disclosure programs is:

$E_{i1} = \beta' X_i + \varepsilon_i$. (See, for instance, Arora and Cason 1999.)

Note that the dependent variable is given by the absolute level of emissions in period *t = 1*, when information has already been disclosed. This specification, although useful for several purposes, does not permit inferring the incremental contributions of the different factors associated with information provision. Disentangling the informational effects requires data on the environmental performance of firms under non-disclosure.

We devised the change in rating ΔR_i as a reflection of the change in environmental performance ΔE_i. As discussed in the previous section, facilities participating in PROPER could typically be classified into three groups: those that improved their ratings, those that did not change them, and those whose ratings declined. We maintained this classification to define the dependent variable of our econometric specification.

Thus:

$$\Delta R_i = \begin{cases} -1 & -\infty \le \Delta E_i \le \mu_1 \\ 0 \quad \text{if} & \mu_1 < \Delta E_i \le \mu_2 \\ +1 & \mu_2 < \Delta E_i \le \infty \end{cases} \ , \qquad (2)$$

where μ_1 and μ_2 are threshold parameters to be estimated along with β and γ in equation (1). Note that the coding of ΔR_i is irrelevant as long as the order of the three outcomes is preserved. The coding we used in equation (2) is meant to remind the reader of the directions of the changes

in ratings. The error term is assumed to have a standard logistic distribution across observations. The probabilities of observing the three different outcomes are given by:

$$\begin{aligned}
\Pr(\Delta R_i = -1 \mid X_i, E_{i0}) &= F(-\beta' X_i - \gamma E_{i0}) \\
\Pr(\Delta R_i = \ \ 0 \mid X_i, E_{i0}) &= F(\mu_1 - \beta' X_i - \gamma E_{i0}) - F(-\beta' X_i - \gamma E_{i0}) \ , \\
\Pr(\Delta R_i = +1 \mid X_i, E_{i0}) &= 1 - F(\mu_2 - \beta' X_i - \gamma E_{i0})
\end{aligned} \qquad (3)$$

where F is the cumulative logistic distribution function. These probabilities are used to construct the likelihood function and carry out the estimation.

4. Data

The local environmental authority BAPEDAL provided the information collected from PROPER. We used data on 145 firms that were rated in the first (June 1995), second (December 1995), and fourth (July 1997) rounds of the program. The third round of evaluation (June 1996) only included a small number of firms and we were not able to use the data in the analysis. Note also that the Asian financial crisis was reported to have started in July 1997. Since the information used to construct the ratings was typically collected in advance, the data set was not contaminated by this event.

Table 2 presents the specification and descriptive statistics of the variables included in the analysis. The upper and lower panels include information on the dependent and independent variables respectively. We constructed two dependent variables, ΔRating6 and ΔRating25, based on the reported changes in ratings in the first 6 and the first 25 months of the program (June 1995–December 1995 and June 1995–July 1997). The difference in means indicated a higher positive response in the longer term.

In the discussion in section 2.2, two factors—namely, community groups and ownership structure—were identified as potential drivers of the general positive response to the scheme. We used the population density in the provinces where the firms were located as a proxy to capture community pressure. This, we believed, was a reasonable way to look at the effects of this channel, since highly populated areas are usually the most affected by pollution. We built a set of three dummy variables. The first one accounted for provinces with more than 500 persons per square kilometer, which corresponds to provinces in Java, Indonesia's main island and one of the

Table 2 Variable Specification and Descriptive Statistics

Variable	Mean	Standard deviation	Description
Reaction to PROPER			
ΔRating6	0.08	0.548	Change in rating between June 1995 and December 1995. The coding is 1=improved, 0=no change, -1=declined.
ΔRating25	0.20	0.640	Change in rating between June 1995 and July 1997. The coding is 1=improved, 0=no change, -1=declined.
Explanatory variables			
Initial rating	0.655	0.477	1=black or red; 0=no
Employment	1299	1933	Number of employees
Ownership			
Public	0.176	0.382	1=yes; 0=no
Private	0.693	0.462	1=yes; 0=no
Foreign	0.129	0.336	1=yes (with foreign share), 0=no
Sector			
Sugar	0.102	0.303	1=yes; 0=no
Rubber	0.170	0.376	1=yes; 0=no
Plywood	0.149	0.357	1=yes; 0=no
Palm oil	0.081	0.274	1=yes; 0=no
Pulp paper	0.122	0.328	1=yes; 0=no
Textile	0.231	0.423	1=yes; 0=no
Other	0.142	0.351	1=yes; 0=no
Population density			
High (Java)	0.524	0.501	1=yes (high population density), 0=no
Medium	0.117	0.322	1=yes(medium population density), 0=no
Low	0.358	0.483	1=yes(low population density), 0=no
Number of firms = 145			

most densely populated places on earth.[17] The second and third dummy variables were for firms located in provinces with population densities between 100 and 500 persons per square kilometer and less than 100 persons per square kilometer, respectively.

As already mentioned, ownership was a crucial variable for a number of reasons. On one hand, foreign firms were more likely to have good access to international credit and technology markets, making abatement cheaper. On the other hand, ownership might also be related to different types of stakeholder pressure. The hypothesis was that firms that were, for instance, state-owned as opposed to private-owned, were less likely to face pressure from communities and the media. We constructed three dummy variables: one for state-owned firms, one for local privately owned firms, and one for firms with some share of foreign ownership.

Other explanatory variables were initial rating, employment, and industrial sector. The initial rating variable was a dummy variable that took the value of 1 if a firm was rated either black or red in the first PROPER round (June 1995). Tables 1 show that only three firms (2 percent) were given a black rating and five (3 percent) a green rating in that round; therefore, we decided to put them in the same categories with red-rated and blue-rated firms, respectively. This environmental performance dummy variable actually indicated whether a firm was initially in or out of compliance. The industrial sector dummy was included primarily to control for possible differences in abatement costs and reaction capabilities across sectors. Note that the need to control for such factors, although necessary, was less important in our model. The reason was that, in Indonesia, emission standards are stated in concentrations (mg/L) and differ across sectors in such a way that the difficulties in compliance are somewhat evened out. Employment was included as a measure of firm size. Larger firms could more likely be affected by bad publicity. It is difficult to argue that this variable measures possible economies of scale in abatement since pollution intensity (mg/L) is a measure that controls for firm size.

5. Results

Table 3 presents full-information maximum-likelihood estimates for both the 6- and 25-month-response ordered logit models. Using a threshold probability value of 0.5, the estimated

[17] Around 35% of the population lives in urban areas. The Indonesian archipelago comprises approximately 17,500 islands, of which only 6,000 are inhabited. The four major islands are Java, Sumatra, Kalimantan, and Sulawesi (Central Bureau of Statistics-Indonesia 1998).

Table 3 Ordered Logit Estimates

Variables	6-month response		25-month response	
	Coefficient	***SE***	***Coefficient***	***SE***
Initial rating	4.393 ***	0.861	2.608 ***	0.512
Log employment	0.044	0.202	0.019	0.186
Ownership				
Public	1.325	0.869	0.218	0.718
Foreign	1.894 ***	0.685	1.551 **	0.629
Density				
High (Java)	2.439 ***	0.950	0.219	0.819
Medium	1.676 **	0.837	-0.308	0.697
Sector				
Sugar	0.459	1.334	1.226	1.159
Rubber	1.833 *	1.088	1.724 **	0.852
Plywood	3.347 **	1.315	1.207	1.031
Pulp paper	0.031	1.306	0.699	1.101
Textile	0.779	1.236	-0.124	1.057
Other	1.079	1.092	0.662	0.909
U_1	2.802	1.584	0.290	1.338
U_2	8.682	1.918	3.936	1.388
Sample size	145		145	
Log likelihood	-84.54		-111.79	
Pseudo R2	0.283		0.190	

Notes: The omitted dummy variables are: Private (local) in the ownership set of variables, low in the population density variables, and palm oil in the sector variables. Pseudo R2 is the likelihood ratio index $1 - \ln L / \ln L_0$, where L and L_0 are the log likelihoods with and without regressors.

* Significant at the 10% level; ** significant at 5%; *** significant at 1%.

models correctly predicted 72 percent and 62 percent of the short- and longer-term responses, respectively. Explicitly, the observed actions and predicted actions were (prediction in brackets):

6-month response: declined 16 (9), no change 101 (126), and improved 28 (10).
25-month response: declined 18 (7), no change 80 (90), and improved 47 (48).

These predictions should be read with some reservation, given that a majority of the observations in our sample fell into the no-change category. In this case, prediction of the other

two outcomes was less likely than in a balanced data set. While the no-change outcome was fairly well predicted by the two models, as expected, the improvement category was much better predicted in the 25-month response model. The seemingly poor predictability of the declined (in rating) category in the two models might be related to unobserved factors and the randomness embedded in this outcome. Firms that had some financial or technological problems, or that had to meet a peak of demand for their product, might increase pollution intensity despite the incentives given by PROPER.

The ordinal regressions estimates of table 3 provided a general idea of the direction of the effects of the different variables. Positive estimates invariably indicated a higher likelihood of a positive response;[18] that is, a higher probability of improving, $\Delta R = +1$, and a lower probability of declining, $\Delta R = -1$. Some regularities can be identified between the two regressions.[19] Firms that were initially non-compliant and had foreign shares, as opposed to being national private firms, were more likely to respond positively. Also, most sector dummies were positive but rarely significant in our regressions. The two location variables were positive and significant in the first model, but not in the second model, signifying a stronger short-term positive response of those firms situated in densely populated areas. The two location dummy variables of the 6-month response model, although not significantly different from each other, suggested a larger effect of Java.[20]

Since we used a probability model, the sizes of the estimates of the ordinal regressions are difficult to interpret in terms of stimulus to the "unobserved" latent variables ΔE_{i6} and ΔE_{i25}. We thus turned to study estimated marginal effects which, ultimately, broke down the regression

[18] The signs of the coefficients of ordinal regression models only gave unambiguous information on the changes in probabilities in the two extreme categories (Greene 2003). No inference about the intermediate outcomes could be made. Note, however, that our model had only three categories and that the in-between category was, by construction, directly associated with the initial environmental states of the firms. This allowed us to read the estimates in terms of contributions to the likelihood of observing positive responses, as compared to the initial environmental state.

[19] Direct interpretation of the magnitude of the parameters across the two regressions was not possible due to probable differences in the variances of the latent variables, which might be represented as ΔE_{i6} and ΔE_{i25}.

[20] It should be acknowledged that the estimates of the longer-term response model were more likely to be affected by noise and unobservable factors. For instance, Garcia et al. (2007) found evidence of the existence of negative trends in industrial water emissions in Indonesia in the same period of analysis.

Table 4 Estimated Marginal Effects

Variable	6-month response model			25-month response model		
	Declined ($\Delta R = -1$)	***No change*** ($\Delta R = 0$)	***Improved*** ($\Delta R = 1$)	***Declined*** ($\Delta R = -1$)	***No change*** ($\Delta R = 0$)	***Improved*** ($\Delta R = 1$)
Initial rating	-0.340 ***	0.048	0.292 ***	-0.258 ***	-0.148 **	0.406 ***
Log employment	-0.001	-0.002	0.003	-0.001	-0.002	0.003
Ownership						
Public	-0.026	-0.122	0.148	-0.013 ***	-0.030	0.043
Foreign	-0.031	-0.227	0.258 *	-0.063	-0.289 **	0.353 **
High (Java)	-0.087	-0.116 *	0.204 **	-0.014	-0.028	0.042
Medium	-0.028 *	-0.191	0.219	0.021	0.034	-0.056
Sector						
Sugar	0.011	0.031	0.041	-0.052	-0.225	0.278
Rubber	-0.033 *	-0.202	0.234 **	-0.072 **	-0.316 *	0.388 **
Plywood	-0.045	-0.521 **	0.566	-0.054	-0.215	0.270
Pulp paper	-0.001	-0.002	0.002	-0.035	-0.114	0.150
Textile	-0.018	-0.055	0.073	0.008	0.015	-0.023
Other	-0.022	-0.094	0.116	-0.034	-0.106	0.141

Notes: Marginal effects are estimated at the means of other dependent variables. The omitted dummy variables are: Private (local) in the ownership set of variables, Low in the population density variables, and Palm Oil in the sector variables.

* Significant at the 10% level; ** significant at 5%; *** significant at 1%

estimates into contributions to each one of the response probabilities (see table 4). The marginal effects related to the improvement outcome[21] had the same signs as the ordinal regression estimates in table 3. Thus, a bad initial rating (non-compliant firms had a value of 1, while compliant firms had zero) implied not only a larger *probability* of change in rating but also a large expected *size* of the change. The same went for foreign ownership and location in the high density area of Java. For our only continuous variable, employment, the marginal estimate measured a partial increase in the "absolute" probability of observing a given outcome due to a

[21] The marginal effects for a "decline" (or no change) outcome typically had the opposite sign from those of the improved outcome.

percentage change in the number of employees. Employment, however, appeared non-significant throughout the analysis. For dummy variables, the marginal effects were calculated as differences in probabilities of a given outcome for the two possible values of the variables.

We thus found that the initial rating had a large and significant effect on both the probabilities of observing improvements and declines in ratings. Being rated black or red in June 1995, as opposed to blue or green, increased the likelihood of improvement by 29.2 percent in December 1995, and by 40.6 percent in July 1995. Accordingly, the probability of observing a decline was reduced by 34.0 percent and 25.5 percent, respectively.[22] As table 1 shows, both non-compliant firms (red and black) and compliant ones (blue and green) were more likely to improve in the longer time period. Non-compliant firms appeared to have been relatively more responsive as time passed.[23]

Foreign ownership, as opposed to private local ownership, explained the improvement but not the decline in the short- and longer-term models. The importance of ownership in explaining the improvement category was more significant and apparently stronger in the 25-month response model; being foreign-owned increased the probability of improvement by 25 percent in the June–December 1995 period, and by 35 percent in the June 1995–July 1997 period. Although these estimates were consistently higher than those of the public ownership dummy variable, no statistical difference between the two was found. Foreign ownership exhibited a large, negative, and significant effect for the no-change category in the 25-month response model, whereas no significance was reported in the 6-month response model. Also, public-owned firms appeared less likely to decline in their performance than private-owned firms in the longer term. However, the associated marginal effect was a negligible 1.3 percent.

Table 5 illustrates these effects with the simple number of firms changing, and it is clear that the improvements came mainly in the red- or black-rated companies, while the smaller number of worsened ratings came in the green or blue categories. We also saw that the only category of firms with the largest share of improvements was actually the one for companies

[22] The initial rating also had a negative significant effect on the probability of observing the no-change outcome at least in the 25-month period. It seemed the inertia that tended to keep firms at their initial performance levels became less pressing over time.

[23] The declined outcome was not observable for firms with initial black ratings. Note that the proportion of black firms in our sample was very small (5.02% of total firms were rated black or red). Their inclusion in the analysis did not bias the econometric results

with some foreign shareholders. The econometric analysis showed that ownership was a determinant factor after controlling for a number of other variables.

Table 5 Details of Improvement/Decline of Ratings by Owner and Original Rating

June 1995 vs. December 95				June 1995 vs. July 1997			
State-owned				***State-owned***			
-	Declined	No change	Improved	-	Declined	No change	Improved
Red	0	5	5	Red	0	5	5
Blue	5	10	0	Blue	3	12	0
Green	0	1	0	Green	1	0	0
Private				***Private***			
-	Declined	No change	Improved	-	Declined	No change	Improved
Black	-	1	3	Black	-	0	4
Red	1	58	13	Red	3	44	25
Blue	8	15	1	Blue	8	13	3
With foreign share of ownership				***With foreign share of ownership***			
-	Declined	No change	Improved	-	Declined	No change	Improved
Black	-	0	1	Black	-	0	1
Red	0	3	5	Red	0	1	7
Blue	1	7	0	Blue	2	4	2
Green	1	1	0	Green	1	1	0

As for the location variables, significant effects were only found in the 6-month period model. The significant results showed that being located on Java increased the probability of observing an improved outcome by 20 percent (and reduced the probability of a no-change outcome by 12 percent), whereas being located on less populated islands decreased the probability of declined outcomes by 4 percent. The reported loss in significance of these variables in the 25-month response model could be due to either a drop in the performance of those firms located in the most densely populated provinces or to improvements made by firms located in less densely populated provinces. Since environmental performances improved over time, the most likely explanation was that firms located in the more populated provinces felt

more intense pressure to improve rapidly, whereas it took longer for pressure to build against firms in other areas.

6. Conclusions and Discussion

The reported success of public disclosure programs at inducing industrial pollution reductions has made this approach increasingly popular among policy makers around the world. Our understanding of the different mechanisms through which provision of information works is, however, still limited. In this paper, we set out to unveil some of the characteristics of those firms that showed higher susceptibility to informational regulation in the context of Indonesia's PROPER program, 1995–1998, which sought to reduce industrial water pollution by environmental rating. It had few instruments other than the mere public disclosure of the environmental ratings of firms. The program lasted only a few years before the Asian crisis temporarily halted it. However, in that brief interlude, it was rather successful and a number of countries emulated its design. (PROPER was re-instated in Indonesia in 2002, using broader rating criteria.)

The data set used in this paper is one of the most comprehensive data sets available in the developing world: it included both firm characteristics and environmental performance under disclosure and non-disclosure regimes, and a number of interesting findings were identified. First, foreign-owned firms were consistently more responsive to the program than local private firms, which could be due to several factors. In Indonesia, as in many other developing countries, foreign firms are not only more sensitive to local and foreign media attention and subject to stricter public scrutiny but also lack the connections that local firms have. In fact, under the socio-political structure built up under Suharto, the most powerful firms were the local private firms, which placed foreign-owned firms at a disadvantage. Apart from being subject to higher external pressure, foreign-owned firms were possibly more responsive to disclosure due to lower emissions-abatement costs from better access to credit and better technology. PROPER could have also provided a means by which corporate offices in home countries could learn about possible hidden liabilities of their subsidiaries.

The result of the higher responsiveness by foreign-owned firms to public disclosure adds to the debate on the pollution haven hypothesis. This hypothesis states that firms that produce more pollution have migrated from developed countries to developing countries, attracted by lax environmental regulatory regimes. Although (seemingly) sound, empirical studies have not found consistent support for this idea. (See, e.g., Eskeland and Harrison [2003] and Millinete and

List [2005].) On the other hand, our analysis emphasized the importance of the local socio-economic structure in determining the pressure foreign firms are subject to, in a developing country context. In particular, our results highlighted the role of information in mediating the relation between foreign-owned plants and the different local and foreign stakeholders.

We also found that, in the short term, firms located in the most densely populated areas responded better to the program. In particular, being located on Java, Indonesia's main island, seemed to be important in determining the extent of the response. Java is the most densely populated island on earth and has higher incomes than the other Indonesian islands, better media coverage, better access to the political arena, and a greater potential for community pressure.

Our results provided deeper insight into the mechanisms at work in programs such as PROPER than earlier studies. However, future research may want to probe farther to provide a more compelling picture of the role of different channels in disclosure programs, and for this more detailed data would be required. For instance, from a policy perspective, it is important to identify which of the various mechanisms made foreign firms more sensitive to PROPER (better access to technology and other markets, better monitoring of local managers, or greater sensitivity to bad publicity). Finally, it would also be interesting to have more concrete information to analyze whether legal or informal actions undertaken by communities against polluters were intensified following information releases and, most importantly, whether these actions translated into emission reductions.

References

Afsah, S., B. Laplante, and N. Makarim. 1995. "Programme-Based Pollution Control Management: The Indonesian PROKASIH Programme." Policy Research Working Paper, no. 1602. Washington, DC: World Bank.

Afsah, S., B. Laplante, and D. Wheeler. 1997. "Regulation in the Information Age: Indonesian Public Information Program for Environmental Management." Research paper. Washington, DC: World Bank.

Afsah, S., and J. Vincent. 2000. "Putting Pressure on Polluters: Indonesia's PROPER Program." In *Asia's Clean Revolution: Industry Growth and the Environment*, edited by D. Angel and M.T. Rock, 157–72. Sheffield, UK: Greenleaf Publishing Ltd.

Afsah, S., and D. Ratunanda. 1999. "Environmental Performance Measurement and Reporting in Developing Countries: The Case of Indonesia's Program for Pollution Control Evaluation and Rating (PROPER). In *Sustainable Measures: Evaluation and Reporting of Environmental and Social Performance*, edited by M. Bennett and P. James. Sheffield, UK: Greenleaf Publishing Ltd.

Arora, S., and T. Cason. 1999. "Do Community Characteristics Influence Environmental Outcomes? Evidence from the Toxics Release Inventory," *Southern Economic Journal* 65: 691–716.

Bernard, A., and F. Sjöholm. 2003. "Foreign Owners and Plant Survival." Working Paper 10039. Cambridge, MA: National Bureau of Economic Research.

Blackman, A., S. Afsah, and D. Ratunda. 2004. "How Do Public Disclosure Pollution Control Programs Work? Evidence from Indonesia," *Human Ecology Review* 11: 235–46.

Central Bureau of Statistics-Indonesia (CBS), State Ministry of Population, Ministry of Health, and Macro International, Inc. (MI). 1998. "Indonesia Demographic and Health Survey 1997." Calverton, MD: CBS and MI.

Coase, R. 1960. "The Problem of Social Cost," *Journal of Law and Economics* 3: 1–44.

Dasgupta, S., B. Laplante, and N. Mamingi. 2001. "Pollution and Capital Markets in Developing Countries," *Journal of Environmental Economics and Management* 42: 310–35.

Dasgupta, S., H. Wang, and D. Wheeler. 2006. "Disclosure Strategies for Pollution Control." In *The International Yearbook of Environmental and Resource Economics 2006–2007: A*

Survey of Current Issues, edited by T. Tietenberg and H. Folmer. Northampton, MA: Edward Elgar Publishing.

Eskeland, G., and A. Harrison. 2003. "Moving to Greener Pastures? Multinationals and the Pollution Haven Hypothesis," *Journal of Development Economics* 70: 1–24.

Farrukh, I., and W.E. James. 2002. *Deregulation and Development in Indonesia*. Westport, CT: Praeger.

Foulon, J., P. Lanoie, and B. Laplante. 2002. "Incentives for Pollution Control: Regulation or Information?" *Journal of Environmental Economics and Management* 44: 169–87.

García, J.H., T. Sterner, and S. Afsah. 2007. "Public Disclosure of Industrial Pollution: The PROPER Approach for Indonesia?*" Environment and Development Economics* 12: 739–56.

Garvie, D., and A. Keeler. 1994. "Incomplete Enforcement with Endogenous Regulatory Choice," *Journal of Public Economics* 55(1): 141–62.

Greene, W. 2003. *Econometric Analysis.* Upper Saddle River, NJ: Prentice Hall.

Hamilton, J. 1995. "Pollution as News: Media and Stock Market Reaction to the Toxics Release Inventory Data," *Journal of Environmental Economics and Management* 28: 98–113.

Khanna, M., W. Rose, H. Quimio, and D. Bojilova. 1998. "Toxic Release Information: A Policy Tool for Environmental Protection," *Journal of Environmental Economics and Management* 36: 243–66.

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* 32: 109–24.

Lanoie, P., B. Laplante, and M. Roy. 1998. "Can Capital Markets Create Incentives for Pollution Control?" *Ecological Economics* 26: 31–41.

MacAndrews, C. 1994. "The Indonesian Environmental Impact Management Agency (BAPEDA): Its Role, Development, and Future," *Bulletin of Indonesian Economic Studies* 30: 85–103.

Makarim, N. 2007. Interviews by Jorge H. García and Shakeb Afsah. April 8–12, Jakarta, Indonesia.

Millimet, D.L., and J.A. List. 2005. "The Case of the Missing Pollution Haven Hypothesis," *Journal of Regulatory Economics* 26: 239–62.

Pargal, S., and D. Wheeler. 1996. "Informal Regulation of Industrial Pollution Control in Developing Countries: Evidence from Indonesia," *Journal of Political Economy* 104: 1314–26.

Portney, P. 2000. "Environmental Problems and Policy, 2000–2050," *Journal of Economic Perspectives* 14: 199–206.

PROPER. Program Penilaian Peringkat Kinerja Perusahaan Dalam Pengelolaan Lingkungan Hidup [Program for pollution control evaluation and rating]. http://www.menlh.go.id/proper/. Accessed January 29, 2008.

Sterner, T. 2003. *Policy Instruments for Environmental and Natural Resource Management.* Washington, DC: RFF Press.

Stiglitz, J.E. 2002. "Information and the Change in the Paradigm in Economics," *American Economic Review* 92: 460–501.

Takii, S. 2004. "Productivity Differentials between Local and Foreign Plants in Indonesian Manufacturing," *World Development* 32: 1957–69.

Tietenberg, T.H. 1998. "Disclosure Strategies for Pollution Control," *Environmental and Resource Economics* 11: 587–602.

Treverton, G.F., H.P. Levaux, and C. Wolf. 1998. "Commercial Power Centers in Emerging Markets." Rand Monograph Report. Washington, DC: Rand.

World Bank. 1993. *The East Asian Miracle: Economic Growth and Public Policy*. World Bank Policy Research Report. Washington, DC: World Bank.

———. 1994. *Indonesia: Environment and Development.* World Bank Country Study. Washington, DC: World Bank.

———. 2000. *Greening Industry: New Roles for Communities, Markets, and Governments*. New York: Oxford University Press.