How Do Public Disclosure Pollution Control Programs Work? Evidence from Indonesia

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Abstract

Although a growing body of evidence suggests that publicly disclosing information about plants' environmental performance can motivate emissions reductions, this phenomenon remains poorly understood. To help fill this gap, this paper presents original data from a survey of plants participating in the Program for Pollution Control, Evaluation and Rating (PROPER), Indonesia's widely acclaimed public disclosure program. The data suggest that a key means by which PROPER spurs abatement is improving factory managers' information about their own plants' emissions and abatement opportunities. These finding contrast with the prevailing view in the literature that public disclosure enhances pressures to abate placed on firms by external agents such as community groups and shareholders. But our data also suggest that PROPER's "environmental audit" effect operates in concert with external pressures. Therefore, simply supplying new information to plant managers without making that information public may not be sufficient to motivate significant abatement.

Keywords: *Public disclosure, environment, PROPER, informal regulation, Indonesia, Asia*

Introduction

Public disclosure — the regular collection and dissemination of information about firms' environmental performance — has been characterized as the "third wave" in environmental regulation, after command-and-control and market-based approaches (Tietenberg 1998). Its growing popularity is partly due to evidence that pioneering programs like the United States' Toxic Release Inventory (TRI) have had a significant impact on pollution abatement. Just as important, public disclosure imposes a minimal burden on regulators. It does not necessarily require an effective enforcement capability or even a well-defined set of environmental regulations. The costs of the administrative activities it does require — data collection and dissemination — appear to be falling due to new information technologies. As a result, public disclosure holds particular promise for developing countries where environmental regulatory institutions are chronically short of funding, expertise and political support. It is also attractive as a complement to conventional regulatory instruments in industrialized countries, especially for types of pollution (like toxics) that have yet to be strictly controlled.

Although policy makers are increasingly embracing public disclosure, we still know relatively little about how it motivates firms to cut emissions. The thin literature on the topic suggests that public disclosure enhances pressures placed on firms by a variety of private- and public sector agents including community groups, consumers, financial markets, and state regulators. But little research has been done to identify which of these — or other — factors drive improvements in environmental performance. Such research could help policy makers design more efficient and effective public disclosure programs.

To help fill this gap, this paper presents original data from a survey of plants participating in the Program for Pollution Control, Evaluation and Rating (PROPER), Indonesia's widely acclaimed public disclosure pollution control program. The survey data suggest that a key means by which PROPER spurs abatement is improving factory managers' information about their own plants' pollution and abatement opportunities. But our data also suggest that this "environmental audit effect" operates in concert with external pressures. Therefore, simply supplying new information to plant managers without making that information public may not be sufficient to motivate significant abatement.

The paper is organized as follows. The second section reviews the literature. The third and fourth sections provide background on PROPER and discuss its impact on pollution abatement. The fifth section presents the survey data and the last section concludes. The appendix presents a simple analytical model to demonstrate how public disclosure can affect a firm's abatement decisions.

Literature

Tietenberg (1998) reviews the thin but quickly growing literature on public disclosure. He writes that public disclosure programs entail four elements:

- detecting environmental risks;
- assuring reliable information;
- disseminating the information to those at risk from the pollution; and
- allowing public- and private-sector agents to act on the information to create pressures for pollution control.

Furthermore, Tietenberg identifies seven "channels" through which public disclosure of reliable information about firms' environmental performance can affect their behavior. Specifically, public disclosure may:

- affect the demand for firms' goods;
- affect the demand for firms' securities;
- affect firms' ability to hire and retain employees;
- convince private citizens to initiate tort law actions against polluters;
- build support for new pollution control legislation;
- motivate private suits to force firms to undertake abatement; and
- give rise to judicial actions in countries like Colombia, Ecuador and Chile where the constitution guarantees citizens the right to a healthy environment.

The empirical literature on public disclosure has mainly focused on the second channel — capital markets. While this research clearly shows that public disclosure can affect stock prices (e.g., Arora 2000; Laplante and Lanoie1994), it is less clear that changes in stock prices can, in turn, affect firms' pollution control activities. However, Konar and Cohen (1997) and Khanna, Quimio and Bojilova (1998) suggest that they can.

Although research on public disclosure *per se* is limited, the more extensive literatures on "voluntary regulation" and "informal regulation" are quite relevant. Both literatures focus on explaining why firms voluntarily overcomply with regulatory standards: the literature on voluntary regulation concerns over-compliance with *de jure* regulatory standards in industrialized countries (see Lyon and Maxwell 1999 and Harrison 1999 for reviews), while the literature on informal regulation mainly concerns over-compliance with lax *de facto* regulatory standards in developing countries (see World Bank 1999 for a review).[4] For the most part, explanations proposed in these literatures concern the same pressures discussed in the literature on public disclosure including pressures generated by consumer demand, capital markets, and labor markets.

A common theme in the literature on voluntary regulation is that firms over-comply with existing regulations to weaken future regulation and enforcement. For example, Maxwell, Lyon and Hackett (2000) construct a model in which citizen lobbying spurs new environmental regulation. When the cost citizens pay to acquire information about environmental issues is low, they can lobby more effectively for new regulation. In such situations, firms try to pre-empt new regulation by voluntarily undertaking abatement. Hence, in this paradigm, public disclosure spurs abatement by enhancing pressures placed on firms by lobby groups. Maxwell and Decker (1998) develop a model in which firms voluntarily cut emissions, not to pre-empt future legislation, but to reduce how intensely existing regulations are enforced.

Regarding the link between consumers and environmental performance, Arora and Gangopadhayay (1995) show that firms may overcomply with environmental regulations to attract "green consumers." Some empirical evidence supports this proposition. For example, Arora and Cason (1996) and Khanna and Damon (1998) show that firms selling directly to final consumers are more likely to participate in a voluntary program to reduce TRI emissions (the 33/50 program).

As for the link between judicial action and environmental performance, Khanna and Anton (2002) find a significant relationship between the threat of future liability (measured by the number of Superfund sites for which a firm is the potentially responsible party) and voluntary environmental performance (measured by the number of corporate environmental practices it adopts). Khanna and Damon (1998) investigate the impact of industry associations on environmental performance — a channel for non-regulatory pressure not discussed by Tietenberg (1998). They find that firms belong-

ing to the Chemical Manufacturers Association are more likely to join the 33/50 program, all other things equal.

The literature on informal regulation focuses on pressures to abate generated by private-sector agents in developing countries where state regulators are weak. Most of this research entails cross-sectional, plant-level econometric analysis of the determinants of environmental performance. For example, Pargal and Wheeler (1996) examine the relationship between Indonesian plants' emissions of water pollutants and the characteristics of the surrounding community. They find that, all other things equal, plants have lower emissions when they are located in communities with higher per capita income and higher levels of education, implying that such communities effectively pressure plants to abate. Dasgupta, Hettige and Wheeler (2000) find that, all other things equal, Mexican firms are more likely to be in compliance with environmental regulations if they are publicly traded, have more highly educated workers, and have adopted ISO14001-type internal management procedures. These findings imply that shareholders, employees, and international certification programs pressure firms to cut emissions. Finally, using data on small-scale Mexican brick kilns, Blackman and Bannister (1998) find that lower emissions are correlated with, among other things, pressure applied by industry and neighborhood organizations.

While the studies cited thus far all suggest public disclosure works by strengthening external pressures to cut emissions, some management and economics research suggests factors *inside* the firm may be just as important. Specifically, public disclosure may work in part by enhancing managers' information about, and their attitudes towards pollution control and environmental regulation. For example, empirical studies have repeatedly found that firms are slow to adopt profitable clean technologies (especially energy efficient technologies) either because managers assign environmentally friendly technological change a low priority, or because they simply do not know much about it (Blackman and Kildegaard 2003; Boyd 2001; DeCanio 1994 and 1998). Presumably, public disclosure could work by enhancing managers' information about, and changing their attitudes toward, clean technologies. Empirical research has also demonstrated that managers sometimes lack information about even the most basic regulatory requirements. For example, April and Greiner (2000) review Massachusetts' Environmental Results Program, an initiative premised on the hypothesis that small businesses in certain sectors tend to be relatively dirty because managers' are ill-informed about environmental matters. They find this program has significantly improved such firms' environmental performance partly by providing user-friendly workbooks on regulatory requirements and abatement technologies. Presumably, public disclosure could have a similar effect. Finally, management research has demonstrated that general environmental attitudes of plant managers often affect their firms' environmental performance (e.g., Cordano and Frieze 2000). Hence, public disclosure might motivate emissions reductions by changing such attitudes.

To briefly summarize the foregoing discussion, the literature suggests that public disclosure can motivate firms to cut emissions by enhancing pressures generated by external agents including: consumers who buy the firm's products, international certification bodies, various institutions providing financial capital, the firm's employees, regulators, legislators, community groups, non-governmental organizations, industry associations, and the judiciary. In addition, the literature suggests public disclosure may spur abatement by improving firms' internal information about, and attitudes towards, pollution control. The Appendix presents an heuristic analytical model that formalizes the discussion of the channels through which public disclosure operates.

PROPER

In Indonesia, rapid industrialization, population growth, and urbanization have created severe pollution problems. Although the country has had a command-and-control regulatory system in place since the early 1980s, compliance has been limited, mainly because enforcement has been virtually nonexistent (Afsah and Vincent 1997). In 1995, Indonesia's Environmental Impact and Management Agency (BAPEDAL) established PROPER to overcome pervasive institutional barriers to enforcement. The idea was to "create incentives for compliance through honor and shame" (Afsah and Ratunanda 1999). Although relatively new, PROPER is already being widely imitated.[5]

PROPER employs a color-based single-index rating system. Individual plants are assigned one of five ratings-black, red, blue, green and gold-based on their compliance or over-compliance with command-and-control emissions standards (Table 1). This rating system was designed to be simple enough to be easily understood by the public but precise enough to provide incentives for firms to move from one category to the next. The exact criteria for each rating are well defined and relatively simple (see Afsah and Ratunanda 1999). To minimize both error and discretion, BAPEDAL uses a computerized management and information system to determine ratings.

In developing its first set of ratings, BAPEDAL relied on plant-level data from pre-existing voluntary pollution control programs, self-reported survey data, and inspection data. Subsequently, ratings have been based on monthly emissions reports filed by participating plants. Emissions reports are checked against past reports and against current reports of

Table 1. PROPER ratings criteria.

Rating	Criteria
Gold	Levels of pollution control for air and hazardous waste similar to those for water; extensive use of clean technology, pollution prevention; recycling, etc.
Green	Emissions 50% below regulatory standards; proper disposal of wastes; good housekeeping; accurate emissions records; reasonable maintenance of waste water treatment system.
Blue	Emissions below regulatory standards.
Red	Some pollution control effort but emissions exceed regulatory standards.
Black	No control pollution effort or serious environmental damages.

similar plants. When discrepancies arise, BAPEDAL conducts inspections to resolve them. In 1995, 1996 and 1997, BAPEDAL conducted approximately 200 inspections of PROPER plants per year (Afsah, Dasgupta, and Ratunanda 1998).

Participation in PROPER is limited to several hundred relatively large water polluters. BAPEDAL chose to focus on water pollution because it has much less experience with air emissions and hazardous waste, pollutants for which implementing regulations were only introduced in the mid-1990s.[6]

BAPEDAL's first round of ratings, in June 1995, was carefully orchestrated. To enhance transparency and credibility, ratings were screened by an advisory committee that included representatives of environmental non-governmental organizations and other stakeholders. Also, to give firms an opportunity to improve their performance prior to public disclosure, the names of plants rated black, red, and blue were not released to the public until December 1995.

BAPEDAL attempts to ensure that both participating firms and the public have easy access to ratings. Typically, ratings are released at a formal press conference and posted on the internet.[7] In addition, for each participating plant, BAPEDEL issues a one-page report on environmental performance. This report serves as an information resource for the plant's managers and environmental engineers. Despite BAPEDAL's efforts to publicize ratings, so far only about 5% of the participants have been named in the press.

One hundred and eighty-seven plants were selected to participate in the first two rounds of PROPER ratings in June and December 1995. On hundred and seventy-six of these plants were selected because they had participated in the Clean River Management Program (PROKASIH), a semi-voluntary pollution control program established in 1989.[8] The 11 remaining plants volunteered to participate in PROPER. Between December 1995 and the fall of 1998 when our survey data were collected, PROPER conducted two additional ratings — in October 1996 and July 1997. Seventy-five plants joined the program during this time.[9,10]

PROPER's Impact

To assess PROPER's impact on environmental performance, we observe how participating plants' performance ratings changed over time. Our sample is a subset of the 233 plants that were participating in PROPER in July 1997 at the time of the fourth rating. Since we require at least two ratings to assess PROPER's impact, we eliminated 42 plants that joined the program in July 1997 and, therefore, were only rated once. In addition, for the sake of consistency with the analysis in the next section, we eliminated 12 plants that returned incomplete survey responses and 33 plants that returned inconsistent survey responses (we return to the issue of the consistency of survey responses in the next section). Thus, 146 plants comprise our sample.

Table 2 gives the first rating (June or December, 1995) and the last rating (July, 1997) for these 146 plants. Ratings improved for over a third of the plants.[11] The percentage of plants whose rating improved — hereafter "improvers" — was much higher among plants initially rated black and red than among plants initially rated blue and green. Both of the two plants initially rated black improved, and 46% of the 90 plants initially rated red improved. However, only 11% of the 47 plants initially rated blue improved, and none of the plants initially rated green improved (BAPEDAL has yet to assign a gold rating). The reason that plants initially rated black and red were more likely to have improved is straightforward: for such plants, marginal abatement costs were relatively low and the marginal benefits of improvement were relatively high.

Table 2. 1995 and 1997 PROPER ratings.

		Black	Red	Blue	Green	Gold	All
1995 rating		2	90	47	7	0	146
1997 rating	**Gold**	0	0	0	0	0	0
	Green	0	1	5	3	0	9
	Blue	1	40	35	4	0	80
	Red	1	46	7	0	0	54
	Black	0	3	0	0	0	3
% improvers		100	46	11	0	0	34

Hence, these data strongly suggest that for plants that are not in compliance with regulatory standards — i.e., those initially rated black or red — PROPER motivated significant emissions reductions. The next section presents survey data that indicates which of the channels discussed in Section 2 were responsible.

Survey Results

In the winter and spring of 1998, the authors developed a plant-level survey aimed at identifying the key factors dri-

ving PROPER participants' improvements in environmental performance. The survey's design was based on focus groups of PROPER participants as well as open-ended pilot surveys — both informed by a review of the literature. The survey elicited participating firms' responses to the question, "How do PROPER ratings create incentives for your firm to improve its environmental performance?" Specifically, the survey asked respondents to rank the importance of 18 different types of incentives for improved performance which, following Tietenberg (1998), we will call "channels" (see Table 3-note that the second column indicates the correspondence between each channel and the variables in the analytical model in the Appendix). Respondents were asked to rank the importance of each channel on a scale of zero (no importance) to five (extreme importance) and then to identify the first, second and third most important channels among the group of 18. The purpose of the first ranking was simply to encourage respondents to think about each channel before comparing them to each other, and also to provide a means of checking the consistency of survey responses.[12]

In the fall of 1998, BAPEDAL mailed the survey to managers of all 324 plants then participating in PROPER, almost a third or which had joined the program *after* the fourth rating in July 1997 (in anticipation of a fifth rating planed for the summer of 1998).[13] Of these 324 plants, 264 (73%) responded. All responses were in writing. We eliminated records for 78 plants that had not been rated at least two times. As discussed above, it impossible to evaluate PROPER's impact on the environmental performance of such plants. We also eliminated records for 40 plants that returned incomplete or inconsistent survey responses. Thus, 146 plants comprise our final sample.

The survey results are somewhat surprising. While the existing literature on public disclosure and related topics has focused on sources of pressure to improve environmental performance that are external to the firm (e.g., capital markets, the threat of future regulation, discretionary enforcement of existing laws, and product markets), most of our respondents did not view such channels as most important. Rather, the majority indicated that the critical means by which PROPER ratings spur improved performance is providing information to plant managers and owners about their own plant's emissions and abatement opportunities via the one-page performance reports mentioned above. Sixty percent of the re-

Table 3. How do PROPER ratings create incentives for improved environmental performance? Survey responses and environmental performance for full sample (n = 146).

Channel	Var.	Description of channel in survey	% respondents ranking each channel as 1st or 2nd most important	% respondents ranking each channel as 1st or 2nd whose PROPER rating improved
Consumers	g_1	Bad PROPER ratings make our firm less competitive in international markets	6	38
	g_2	Bad PROPER ratings make our firm less competitive in domestic markets	1	0
	g_3	Good PROPER ratings help to differentiate our product from our competitors	7	20
	g_4	Good PROPER ratings will help in obtaining ISO 14001 certification	11	63***
Information	t_1	PROPER ratings provide clear information about how to improve environmental performance	22	28
	t_2	PROPER ratings make owners and managers aware of the factory's environment performance	38	29
Financial capital	k_1	Bad PROPER ratings increase pressure from the shareholders	8	73***
	k_2	Bad PROPER ratings make it difficult to obtain credit from banks	2	0
	k_3	Bad PROPER ratings make it harder to get capital from the International Finance Corporation	0	-
	k_4	Bad PROPER ratings reduce the market value of the company	4	67**
Human capital	k_5	Bad PROPER ratings increase pressure from our firm's employees	7	30
Regulators	r_1	Good PROPER ratings improve our firm's relationship with BAPEDAL	4	67**
	r_2	Good PROPER ratings will facilitate compliance with future more strict regulations	8	27
Communities	c	Bad PROPER ratings increase pressure from communities living around the factories	36	30
NGOs	n	Bad PROPER ratings increase pressure from non-governmental organizations	10	27
News media	m	Bad PROPER ratings increase pressure from the news media	25	27
Industry assns.	a	Bad PROPER ratings increase pressure from industry associations	2	33
Courts	j	Bad PROPER ratings increase the chances of court action by the government	8	42

***significantly different from sample proportion (34%) at 1% level
**significantly different from sample proportion (34%) at 5% level

spondents ranked channel t_1 (PROPER ratings provide clear information about how to improve environmental performance) or channel t_2 (PROPER ratings make owners and senior managers aware of the environmental performance of the factory) as most important or second most important. Thus, in the eyes of most of our survey respondents, PROPER ratings serve principally as an environmental audit.

This is not to say that our survey respondents did not perceive factors external to the firm to be important as well. Channels ranked as first or second most important by more than 10% of the respondents included: c (bad PROPER ratings increase pressure from communities living around the factories) which was ranked as first or second most important by 36% of the respondents; m (PROPER ratings increase pressure from the news media) which was ranked as first or second most important by a quarter of the respondents; and g_4 (good PROPER ratings will help in obtaining ISO 14001 certification) which was ranked as first or second most important by 11% of the respondents. The last channel concerns certification of the plant's environmental management system by the International Standards Organization (ISO). This endorsement is highly valued by firms that participate — or that seek to participate — in international markets (Wotruba 1997; Dasgupta, Hettige and Wheeler 2000).[14] Often downstream buyers in international production chains favor upstream suppliers that are ISO 14001 certified. Anecdotal evidence suggests that survey respondents tied to such downstream buyers feared bad PROPER ratings would make it difficult for them to obtain or maintain ISO 14001 certification. Hence, this result likely reflects external pressures placed upon the firm by downstream buyers.

While these data indicate which channels PROPER participants as a group perceive to be important, they do not tell us whether these channels actually drove a third of the plants in our sample to improve their environmental performance. Did these plants reduce their emissions because they obtained better information about their emissions and abatement opportunities via PROPER reports? Or did they reduce their emissions because of external factors such as community pressure? Ideally, multiple regression analysis could be used to address this question. But such analysis would require plant-specific measures of changes in the intensity of each of the 18 channels due to public disclosure, i.e., for each plant, measures of the intensity of each channel before public disclosure and after it. Unfortunately, such data do not exist and our survey data are an inadequate proxy.[15]

However, when combined with regulatory data on changes in PROPER ratings over time, our survey responses can provide some clues as to which channels drove improvements in environmental performance. Using these two types of data, we calculate the percentage of plants that chose each channel as first or second most important whose PROPER rating improved during the course or their participation (see the last column in Table 3). We then test whether this percentage is significantly greater than the percentage of improvers in the entire sample — 34%. A statistically significant difference indicates a simple correlation between the channel and improved environmental performance. We would note that like all tests for simple correlations, this one does not control for correlations with other potential explanatory variables such as the type and size of the plant. Nor does it imply anything about the direction of causality.

We find statistically significant differences for four channels: g_4, k_1, k_4 and r_1. However, for three of these channels — k_1, k_4 and r_1 — the percentage of the sample that chose each as first or second most important is so small — 9%, 4% and 4% respectively — as to cast doubt on the import of this finding.[16] Eleven percent of the sample chose the remaining channel, g_4 (good PROPER ratings will help in obtaining ISO 14001 certification), as first or second most important. Almost two-thirds of these respondents were improvers. This suggests that there may be some synergy between public disclosure and international certification programs. Note that there is not a significant correlation between improved environmental performance and choosing either of the two information channels (t_1 and t_2).

But our analysis of the correlation between our respondents' survey responses and their environmental performance may be biased by the fact that the sample contains both plants initially rated blue and green as well as plants initially rated black and red. As discussed above, fewer than 10% of the plants in the first group improved while almost half of the plants in the second group did. Both the marginal costs of improvement and the expected marginal benefits of improvement may be different for these two groups of plants, and therefore, the drivers of improved environmental performance may also be different. To control for this, we split the sample into plants initially rated red or black (n = 92) and those initially rated blue (n = 47). We omit from the sample plants initially rated green since no plants have ever improved from green to gold.

For the sample of 92 plants initially rated red or black, the results are qualitatively the same as those for the full sample: the lion's share of plants chose as first or second most important those channels having to do with information, community pressure, the media and ISO 14001 certification, and (discounting channels selected by fewer than 6% of the sample) there clearly is a simple correlation between environmental performance and concern about ISO 14001 certification. For the sample of 47 plants initially rated blue, the survey results are slightly different. Most notably, there is not a significant correlation between improved environmental

performance and concern about ISO 14001 certification, but there is a significant correlation between improved environmental performance and concern about shareholders. In neither subsample is there a significant correlation between improved environmental performance and choosing either of the two information channels (t_1 and t_2).

In summary, our survey results show that in the eyes of the majority of the plants in our sample, the most important means by which PROPER encourages emissions reductions is enhancing factory owners' and managers' information about their plant's emissions and abatement opportunities — the environmental audit effect. But the perception that this effect is critical is not correlated with improved environmental performance: non-improvers are more or less just as likely to have this view as improvers. Rather, for plants not in compliance with regulatory standards, improved environmental performance is correlated with concern about ISO-14001 certification, and for firms that are in compliance, it is correlated with concern about shareholders. These results suggest that although the environmental audit effect may be an important component of the explanation for PROPER's success, it is only one component. This effect probably has an impact by operating in concert with external pressures heightened by public disclosure.

Conclusion

This paper reviewed the literature to develop a list of channels through which public disclosure may motivate emissions reductions and presented data that suggest which of these channels are important. Although it runs counter to the emphasis in much of the literature on channels external to the firm, our finding that program participants perceive PROPER's environmental audit role to be a critical driver of improved environmental performance seems quite logical. Firms in industrialized countries typically pay consultants to perform environmental audits, a practice that implies it is costly to collect environmental performance data. Therefore, in countries like Indonesia where formal regulatory pressure is virtually nonexistent and factories have little incentive to pay these costs, one would expect public disclosure programs to provide new information about environmental perfor-

Table 4. How do PROPER ratings create incentives for improved environmental performance? Survey responses and environmental performance for split sample.

			A: % respondents ranking each channel as 1st or 2nd most important **B:** % respondents ranking each channel as 1st or 2nd whose PROPER rating improved			
			initial rating = red + black (n = 92)		**initial rating = blue** (n = 47)	
Channel	**Var.**	**Description of channel in survey**	**A**	**B**	**A**	**B**
Consumers	g_1	Bad PROPER ratings make our firm less competitive in international markets	5	40	6	33
	g_2	Bad PROPER ratings make our firm less competitive in domestic markets	1	0	0	-
	g_3	Good PROPER ratings help to differentiate our product from our competitors	7	33	6	0
	g_4	Good PROPER ratings will help in obtaining ISO 14001 certification	13	75**	6	33
Information	t_1	PROPER ratings provide clear information about how to improve enviro. performance	23	38	19	0
	t_2	PROPER ratings make owners and managers aware of the factory's enviro. performance	44	40	32	0*
Financial capital	k_1	Bad PROPER ratings increase pressure from the shareholders	5	80*	13	67***
	k_2	Bad PROPER ratings make it difficult to obtain credit from banks	2	0*	0	-
	k_3	Bad PROPER ratings make it harder to get capital from the Intl. Finance Corp.	0	-	0	-
	k_4	Bad PROPER ratings reduce the market value of the company	3	33	6	100***
Human capital	k_5	Bad PROPER ratings increase pressure from our firm's employees	4	75	13	0
Regulators	r_1	Good PROPER ratings improve our firm's relationship with BAPEDAL	3	100**	9	-
	r_2	Good PROPER ratings will facilitate compliance with future more strict regulations	7	50	6	0
Communities	c	Bad PROPER ratings increase pressure from communities living around the factories	39	42	34	6
NGOs	n	Bad PROPER ratings increase pressure from non-governmental organizations	10	44	11	0
News media	m	Bad PROPER ratings increase pressure from the news media	25	43	21	0
Industry assns.	a	Bad PROPER ratings increase pressure from industry associations	3	33	0	-
Courts	j	Bad PROPER ratings increase the chances of court action by the government	5	100***	15	0

***significantly different from sample proportion at 1% level
**significantly different from sample proportion at 5% level
*significantly different from sample proportion at 10% level

mance to ill-informed polluters as well as to the public. What are the policy implications of this finding?

Our survey data suggest that, in addition to the four elements of public disclosure programs that Tietenberg (1998) identifies (detecting environmental risks; assuring reliable information; disseminating the information to those at risk from the pollution; and allowing various agents to act on the information), a fifth element — disseminating the information to polluters — also plays an important role in generating emissions reductions and, therefore, should be promoted by program administrators.

Should policy makers disseminate information to polluters *instead of* disseminating it to those at risk from pollution? This approach would have the distinct advantage of reducing industry resistance to information-based programs. But our results do not unambiguously support the conclusion that simply collecting reliable information on environmental performance and providing it in confidence to polluters would spur significant emissions reductions. As discussed above, we hypothesize that the environmental audit effect has an impact on environmental performance by operating in concert with external pressures generated by public disclosure.

It is important to point out that the sociopolitical context of our case study may partly explain why many of our survey respondents assigned the environmental audit effect a higher ranking than external pressures. This study focuses on the first three years of the PROPER program (1995-1998), a period that coincided with the final three years of the repressive Suharto dictatorship. A number of characteristics of Indonesia during this period would tend to weaken external pressures placed on polluters by media, NGOs, courts and communities. These characteristics include the lack of a free press, relatively weak NGOs and courts, and limited experience with free public debate (Eldridge 2002; Sen and Hill 2000). In more open and democratic societies, external pressures generated by public disclosure may play a more important role. Indeed, to the extent Indonesia today is evolving into a free and democratic society, such pressures may be becoming increasingly important.

Thus, our broad point is not that external pressures are never likely to be important in public disclosure programs. Rather, our argument is that the environmental audit effect is more important than previously recognized, especially in developing countries where firms typically have limited information about their emissions and abatement opportunities, and where institutions (like NGOs) that generate external pressures are weak. Further research is needed to gauge the relative importance of the environmental audit effect and external pressures in public disclosure programs. As more plants join existing public disclosure programs and as new programs are set up, researchers have an opportunity to collect the data that might best address this question — *ex ante* and *ex post* firm-specific data on the intensity of various pressures to abate.

Finally, we note that our finding that ISO 14001 certification bodies and shareholders may have exerted significant pressures to cut emissions suggests that public disclosure programs may be particularly effective when targeted at firms that seek to participate in international certification programs as well as those that are publicly owned.

Endnotes

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4. See Khanna (2001) and Gunnignham and Rees (1997) for additional reviews of the literature on voluntary regulation — the former focuses on the economics literature and the later on alternative perspectives.
5. The Philippines introduced a similar program called EcoWatch in 1997 and China has introduced pilot programs called GreenWatch in several cities in the late 1990s, see Wang et al. (2003). Preparations for PROPER-like programs are also underway in Mexico, India, Bangladesh, and Thailand.
6. Plans call for PROPER to eventually be extended to cover both industrial air pollution and hazardous waste.
7. www.bapedal.go.id
8. For history and analysis of PROKASIH see Afsah, Laplante, and Makarim (1996).
9. Of the 233 plants that were participating in PROPER when our data were collected in the fall of 1998, 158 were rated in the first period, 187 were rated in the second period (154 of the 158 plants rated in the first period plus 33 new plants), 102 plants were rated in the third period (all were plants that were rated in the second period), and all 233 plants were rated in the fourth period (all of the 191 plants that were rated in any of the three previous periods plus 42 new plants).
10. After a fifth (June 1998) rating which was not publicly disclosed, PROPER was temporarily shuttered, a casualty of the political instability that accompanied the fall of the Suharto regime. However, the program was restarted in 2003 and a new rating process is scheduled for April 2004. BAPEDAL has expanded the PROPER to cover two new media — hazardous wastes and air pollution — and has set a goal of recruiting 1000 participating plants by July of 2004.
11. Ratings for all but one of these improvers were non-decreasing over time. That is, all but one were assigned a 1996 rating that was at least as high as its 1995 rating, and a 1997 rating that was at least as high as its 1996 rating.
12. Survey responses were deemed inconsistent if any channel received a ranking of first, second or third most important among the group of 18 channels but was *not* assigned a rank of either four or five on the scale of one to five.
13. The fact that BAPEDAL administered the survey entailed an important benefit — it assured a relatively high response rate. We recognize, however, that BAPEDAL's involvement may have entailed costs

as well. Specifically, it may have led to some bias in the survey results. For example, respondents may have been more apt to report that good PROPER ratings improved the firm's relationship with BAPEDAL (Table 3).

14. ISO 14001 certification requires the following: (i) initial review of plant conditions to identify environmental issues of concern, (ii) establishment of priorities for action, (iii) establishment of an environmental policy statement signed by the chief executive officer, (iii) development of performance targets based on the policy statement, (iv) implementation of the environmental management system with defined procedures and responsibilities, and (v) implementation reviews, performance measurement, and management audits.
15. Plants' survey responses are not suitable proxies because they may not be exogenous to the plant's environmental performance. For example, a plant's choice of channel c as most important does not necessarily indicate that after the disclosure of PROPER ratings, this plant was subjected to particularly intense pressure from the surrounding community independent of it's environmental performance. Rather, plants with continued poor performance after public disclosure may have been subjected to more intense community pressure, and as a result, may have been more likely to choose this channel as most important.
16. Of the 146 plants in the sample, 11 choose k_1 as first or second most important eight of which were improvers, six plants chose k_4 as first or second most important four of which were improvers, and six plants chose r_1 as first or second most important four of which were improvers.

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Appendix

A Heuristic Model of Public Disclosure

This section presents a simple heuristic model of the various "channels" (to use Teitenberg's term) through which public disclosure might operate. Our purpose here is to provide one possible analytical framework for thinking about how public disclosure "works." A variety of different models of these channels are equally plausible and we make no claim that the present model is definitive. The model is intended to buttress the presentation of the survey results which are the main focus the paper. We develop the model in three steps. First, we present a generic graphical model of a profit maximizing firm's abatement decision. Next, drawing on the literature review in Section 2, we list nine channels through which public disclosure can affect the firm's abatement decision. Finally, using the graphical model, we describe the effect of each of these channels on the firm's abatement decision. For interested readers, a more rigorous mathematical exposition of the model follows the graphical presentation.

The graphical model is the standard representation of a firm's abatement decision in the environmental economics literature (see, for example, World Bank 2000). We assume that the firm's marginal cost of pollution abatement increases the more abatement the firm undertakes, while the marginal benefits to the firm of this abatement (including, reductions in pressure applied by regulators and private sector stakeholders, and greater appeal to certain consumers) decrease the more abatement a firm undertakes. Graphically, marginal abatement costs (MAC) are increasing in abatement, while marginal abatement benefits (MAB) are decreasing in abatement (Figure 2). To maximize profits, the firm will undertake abatement until the marginal cost of this activity exceeds the marginal benefit. Thus, the firm will choose the level of abatement, α^*, such that marginal abatement costs are equal to marginal abatement benefits. Graphically, α^* is the quantity of abatement where the MAC and MAB curves intersect.

Next, drawing on the literature surveyed in Section 2, we define nine channels through which public disclosure might affect the firm's abatement decisions. We assign each channel a one-letter name that will prove a useful shorthand in our discussion of the survey data. The first eight channels have to do with the costs that can be imposed upon dirty firms by

- g consumers
- k financial markets and employees
- r formal regulatory authorities
- c communities
- n non-governmental organizations
- m the media
- a industry associations, and
- j courts

The last channel is related to the costs of pollution abatement arising from the need to acquire

- t information about abatement technologies and its own emissions.

Having defined these nine channels, we use the simple graphical model summarized in Figure 1, to consider different mechanisms by which public disclosure might work, that is, how each channel might affect the firm's abatement decision. First, public disclosure could either reduce or enhance consumers' demand for the firm's output(g), depending on whether the firm is relatively clean or dirty. Either effect, in turn, implies the marginal benefit to the firm of cutting emissions will be greater regardless of the actual level of abatement. Graphically, the MAB curves shifts up. As a result, in equilibrium, the firm chooses a higher level of abatement (see Figure 1). Alternatively, public disclosure could either raise or lower the costs imposed on the firm by formal regulatory authorities(r), depending on whether the firm is relatively dirty or clean. As with the consumer demand, in either case, this effect implies the marginal benefit to the firm of cutting emissions will be greater regardless of the level of abatement. Graphically, the MAB curves shifts up and the end result is a higher level of abatement in equilibrium. Similarly, public disclosure could either raise or lower cost imposed by financial markets and employees (k), communities (c), non-governmental organizations (n), the media (m), industry associations (a), and courts (j). Each of these effects operates the same way: each shifts the MAB curve up and results in a higher equilibrium level of abatement. Finally, public dis-

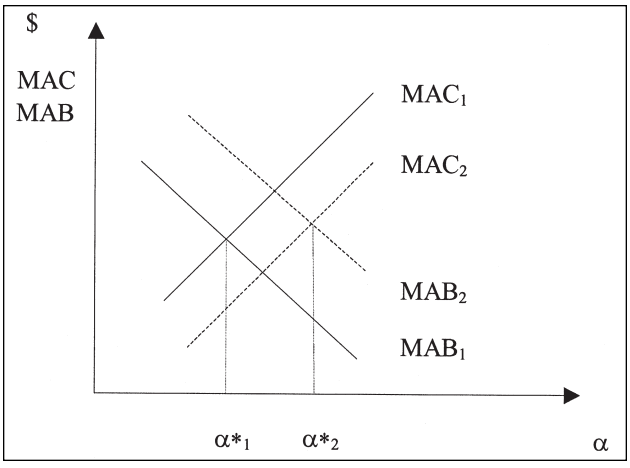

Figure 1. Marginal abatement cost (MAC) and marginal abatement benefit (MAB) schedules; optimal abatement level, α*.

closure could reduce the cost to firms of acquiring information about abatement (t), lowering the marginal cost of abatement at every level of abatement. Graphically, the MAC curve shifts down, and the end result is a higher level of abatement (Figure 1).

The next several paragraphs present a more rigorous mathematical version of the foregoing model. To keep the model as simple as possible and to focus attention on pollution abatement, we assume that the firm makes production and abatement decisions sequentially. First it chooses a level of output, q, and a vector of levels of financial and human capital, **k**. Subsequently, it chooses a level of abatement, a, treating both q and **k** as fixed. We model the firm's second stage abatement decision only. Note that "abatement" here may also include pollution prevention. The firm chooses α to maximize profit, π, given by,

$$\pi = P[g(\alpha,d)]q - C[\alpha, t(d)] - \mathbf{W}(\alpha,d)\mathbf{k} - H(\alpha,d)$$

where,

$$H(\alpha,d) = r(\alpha,d) + c(\alpha,d) + n(\alpha,d) + m(\alpha,d) + a(\alpha,d) + j(\alpha,d)$$

and,

- P(•) is the equilibrium price of output
- g is an index of green consumerism — the sensitivity of P to the plant's emissions
- d is a measure of the public disclosure of information about the plant's emissions
- q is the quantity of output
- C(•) is the cost of abatement
- t is the plant's information about abatement technologies and its own emissions
- **W**(•) is a vector of the costs of two types of capital: financial and human
- **k** is a vector of two types of capital: financial and human
- H(•) is the total cost of the plants' emissions generated by external agents
- r(•) is costs generated by formal regulatory authorities
- c(•) is costs generated by communities
- n(•) is costs generated by non-governmental organizations
- m(•) is costs generated by the media
- a(•) is costs generated by industry associations, and
- j(•) is costs generated by courts

Following the literature discussed in Section 2, we make the following assumptions about the price and cost functions:

- the stronger is green consumerism, the lower is the equilibrium price the plant receives for its output (P is decreasing in g);[1]
- the less the plant abates and the more the public knows about its emissions: the stronger is green consumerism (g is decreasing in α and increasing in d), the higher are the costs of financial and human capital (**W** is decreasing in α and is increasing in d), and the greater are the costs imposed on the plant by external agents (r, c, n, m, a, and j are all decreasing in α and increasing in d);
- the less the plant abates and the more information it has about its emissions and abatement technologies, the lower is the marginal cost of abatement (C is increasing in a and decreasing in t).

Finally, we make the reasonable assumptions that,

- abatement has a diminishing marginal impact on green consumerism, capital costs and costs imposed by external agents, and that it has an increasing marginal impact on abatement costs (g, W, H and C are all convex in abatement).

The first order condition for the choice of the optimal level of emissions, α*, is,[2]

$$\left\{\frac{dP}{dg}\frac{\partial g}{\partial \alpha}\,q - \frac{\partial W}{\partial \alpha}\,k - \frac{\partial H}{\partial \alpha}\right\} - \frac{\partial C}{\partial \alpha} = 0 \qquad (1)$$

The first term in parentheses represents the marginal benefit of abatement due to: an increase in equilibrium price of output (the first term in the parentheses); a reduction in the costs of labor and capital (the second term); and a reduction in costs imposed by formal regulatory authorities, communities, non-governmental organizations, the media, industry associations and the courts (the third term). We will refer to the sum of these three terms as the marginal abatement benefit (MAB). The last term in (1) is the marginal abatement cost

(MAC). The plant chooses α^* such that MAB is equal to MAC.

Using (1), it is straightforward to show that the total derivative of α^* with respect to d is unambiguously negative. Therefore, public disclosure will increase abatement. Figure 1 makes this point graphically. Given our assumptions on P(•), C(•), W(•), and H(•), the MAC schedule is increasing in α and the MAB schedule is decreasing in α. The plant chooses the level of emissions where these schedules intersect. An increase in d will cause t(•) to increase and the MAC schedule to shift down. It will also cause g(•), W(•), and H(•) to increase and the MAB schedule to shift up. Each of these shifts will cause a* to increase.

Notes to Appendix

1 To keep the exposition simple, we implicitly assume that the plant is an inherently dirty one — for example, an aged coal-fired power plant-so that regardless of its choice of α, green consumerism always reduces equilibrium price. We could just as easily assume the plant is an inherently clean one whose equilibrium price is always increased by green consumerism. Allowing green consumerism to increase or decrease equilibrium price depending on the plant's choice of α makes the model needlessly complex given our limited goal of illustrating how various channels discussed in the literature operate.

2 The convexity of g(•), C(•), W(•), and H(•) guarantee the second order condition is met.