



Disclosure Strategies for Pollution Control

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Abstract. Disclosure strategies, which involve public and/or private attempts to increase the availability of information on pollution, form the basis for what some have called the third wave in pollution control policy (after legal regulation – the first wave – and market-based instruments – the second wave). While these strategies have become common in natural resource settings (forest certification and organic farming, for example), they are less familiar in a pollution control context. Yet the number of applications in that context is now growing in both OECD and developing countries. This survey will review what we know and don't know about the use of disclosure strategies to control pollution and conclude with the author's sense of where further research would be particularly helpful.

Key words: information disclosure, pollution control, regulatory reform

JEL classification: Q28, D80, L51

1. Introduction

1.1. THE DEMAND FOR DISCLOSURE STRATEGIES

The first phase of pollution control involved applying traditional legal remedies such as emissions standards. Over time, however, it became clear that these traditional regulatory approaches to pollution control were excessively costly in some circumstances (Tietenberg 1985) and incapable of achieving the stipulated goals in others (Tietenberg 1995). In response to these deficiencies in the second phase the use of market-based approaches, such as tradable permits, emission charges, deposit-refunds and performance bonds, have become much more common (Hahn 1989; OECD 1989; Tietenberg 1990; OECD 1994; OECD 1995). In some instances they have substituted for traditional remedies, but in most cases they have complemented them. In general these approaches have added flexibility and improved cost-effectiveness to the control of pollution.

Even the addition of market-based approaches has not fully solved the problems, however. In the industrialized countries the system remains overburdened by the sheer number of substances to be controlled. Neither staffs nor budgets are adequate for the task of regulating all of the potentially harmful substances which are emitted by firms and households.

In many of the developing countries the regulatory infrastructure is insufficiently developed and/or subject to corruption. In either case it is incapable of adequately handling the burden of designing, implementing, monitoring and enforcing an effective pollution control system.

Phase three in the evolution of pollution control policy involves investment in the provision of information. This increasing role for disclosure strategies seems to emanate not only from the increasing perceived need for more regulatory tools (as described above), but also from the falling cost of information collection, aggregation and dissemination. Rising benefits and falling costs imply that however inefficient their use may have been perceived to be in the past, changed circumstances merit another look.

The disclosure strategies considered in this paper involve public and/or private attempts to increase the availability of information on pollution to workers, consumers, shareholders and the public at large. Provision of greater amounts of information may either complement or replace traditional regulation strategies. Disclosure strategies seek to enlist market forces in the quest for efficient pollution control. And in so doing they interact in sometimes complex ways with traditional standard setting and enforcement strategies. Whether they complement phase one and two strategies or substitute for them, they involve a rather different role for government – one which seems to offer the possibility of fulfilling the large and growing need for control despite limited budgets and staffs. But how real is this promise?

1.2. THE CONCEPTUAL FOUNDATION FOR DISCLOSURE STRATEGIES

The starting point for thinking about information approaches to pollution control is the Coase Theorem (Coase 1960). In that landmark essay Coase pointed out that pollution control situations have a certain symmetry. Inefficient pollution imposes costs on victims which exceed the costs of controlling that pollution. In other words, the marginal benefits of pollution control exceed the marginal costs. The existence of inefficient pollution damage therefore provides a motivation for the victims to take corrective action, even in the absence of any such incentives by the polluters.

What economists have learned rather recently is that the list of victims can be very large indeed, much larger than originally thought. The list of potential victims includes not only the traditional categories of those harmed directly by the pollution, but also those who may be disturbed by it even if they are not directly affected. The fact that this “nonuse” value of pollution control can be quite large has become a familiar result to those conducting contingent value surveys. The pressure to control pollution precipitated by better information can therefore be motivated by victims experiencing both use and nonuse damages.

In the past the Coasian insight has been dismissed as a foundation for policy¹ for several reasons:

- In multiple victim circumstances it ignores the public good nature of information. When coupled with the very real transaction costs associated with the collection and dissemination of information, this characteristic tends to undermine the incentive of any individual to derive and to share information on the nature and extent of pollution damage with the other victims.
- The approach appears to force the victim to pay for controlling pollution damage which he/she did not cause, an outcome which violates the well-established “polluter pays” principle of pollution control.

Both of these sources of concern can be easily overcome. By regulation polluters can be made responsible for supplying the information. Furthermore the traditional point of view that victims can only act by means of paying bribes to the polluter turns out to ignore the large number of ways that victims can be empowered.

1.3. OVERVIEW

While disclosure strategies (particularly labeling) strategies have become common in natural resource settings (forest certification programs, for example), they are less familiar in a pollution control context. Yet the number of applications is increasing in both OECD and developing countries.

Generally these right-to-know policies are justified on ethical grounds. In this paper we explore quite a different justification – whether providing greater information might be part of a larger strategy to promote efficient pollution control.

This paper reviews what we know and don’t know about the use of disclosure strategies to control pollution. It is important to note that this review will not cover two related fields. First, we shall not examine the rather large literature on the relationship between regulator and polluter when the stakeholders have private information (Lewis 1996). Second, we shall not examine the literature on the role of strategies (e.g. auditing) for increasing the amount of information available to the firm itself (Sinclair-Desgagné and Gabel 1997). Our focus is rather on information made available to consumers, workers, shareholders and the public at large.

Following a review of the conceptual foundations for disclosure strategies the paper considers how the policy setting influences the type of information strategy employed. Examples of innovative disclosure strategies (U.S., Latin America, Indonesia, etc.) and the channels through which they operate are followed by a review of the empirical research on their effectiveness. The paper closes with the author’s sense of what we have learned and where further research would be particularly helpful.

2. The Context

The point of departure for disclosure strategies is understanding the economic incentives which face the parties involved in the pollution situation. Those incentives are a function of the setting in which the pollution arises. It can arise in the

household setting (such as dealing with radon gas or lead paint), an occupational setting (such as when workers are exposed to benzene), in the product setting (such as when consumers buy produce with pesticide residues) or the community setting (such as when residents are subjected to toxic emissions from a nearby plant).

From an economic point of view the most difficult setting to incorporate disclosure strategies involves situations where the polluter and pollutee have no obvious contractual relationship. Whereas disclosure strategies could build upon the purchase relationship for consumption-related pollution, and the wage relationship for employment-related pollution, no such behavioral linkage exists in this final category.

In addition to the public good characteristics of information provision which plague the other types of pollution problems, in this case another source of market failure arises. To the extent that the failure to provide the requisite information increases the amount of pollution, the damage caused is another form of externality (Kennedy et al. 1994). It represents the purest case of externality. Examples would involve ambient air and water pollution.

In this case the pollutees still have some incentive to take action to reduce the environmental risk to which they are exposed, but the action has to be indirect. This case raises some fundamental problems about how the information would be generated, distributed and used.

3. Disclosure Strategies for the Community Setting

The typical information strategy involves four separate functions: (1) establishing mechanisms for discovering environmental risks, (2) assuring the reliability of the information, (3) publicizing or sharing the information, and (4) acting on the information.

3.1. DETECTING ENVIRONMENTAL RISKS

The necessary first step in an information approach is discovering the extent and magnitude of environmental risks. Environmental risks will normally be detected only after some investment in information is made. Who should make that investment? What incentives do they face?

The degree of environmental risk faced by a community is determined by somewhat complex causation process. How much of the substances are emitted, the degree of exposure to the substances, and the sensitivity of the population to this exposure are all highly relevant considerations.

3.2. ASSURING RELIABLE INFORMATION

Information has both quantity and a quality dimension. Effective risk communication assumes not only that the requisite information is forthcoming, but also that

it is reliable. Inaccurate or partial information could be worse than no information at all to the extent that it promotes a false sense of security or it promotes unjustified fears. And firms have incentives to mislead the public either by overstating their environmental accomplishments or by selective omission (noting the positive outcomes and ignoring or burying the negative ones).

Accurate information can be promoted by standardizing the method of collection (specifying acceptable collection instruments and procedures, for example, as well as the nature of the information to be gathered) and by making the penalties for falsifying information appropriately large.² The ISO 14000 process, a set of voluntary environmental management standards crafted by the International Standards Organization, represents one international way to standardize the certification of good environmental practice.

When allegations of a potentially actionable environmental risk are raised from the community, a process must be established to verify and validate the claim. Lodging a complaint does not assure its validity. The organization which receives the complaint may be the control authority, a court, or perhaps a special commission set up for the specific purpose of dealing with these claims. Its function is to determine whether the claim is valid by establishing whether the community has met the required burden of proof.

3.3. DISSEMINATING THE INFORMATION

For this strategy to work the necessary information must reach the pollutees in a usable form. This step may even be automatically satisfied by information raised by the community itself, but for information produced by the government or the polluter it is not.

Transparency is the key to assuring the availability of useful information.³ In practice this means that the information must be in a form which can be used by the community and the community must have access to it.

3.4. ACTING ON THE INFORMATION

Once the information is generated about an environmental risk, the next step is to define what can be done with it. The options range from letting the information generate its own pressure through preexisting channels to establishing new channels for pressure to be applied.

Existing channels can be used in many different ways.

- In the *product market* consumers may choose less environmentally harmful products when effective information makes the choices clear. In addition to the obvious case where consumers may be directly harmed by the product (such as pesticides) this channel can also be used by consumers who choose to buy “green” products even if they are not directly harmed by the pollution (such as those who pay more for chlorine-free paper). Product market effects are

enhanced when disproportionately large buyers (large chains or the government, for example) decide to take environmental considerations into account.

- In the *capital market* owners of shares of common stock in polluting firms may decide to invest in companies with a more “green” record, either for moral reasons or because they believe that ultimately environmentally benign firms will face fewer clean-up costs and therefore will be more competitive. Some evidence suggests that “green” firms may have higher rates of return.⁴ The ability of green investors to make these choices has been facilitated by the rise of several “green” mutual funds where the investment advisors carefully screen the firms using well-defined criteria.
- In the *labor market* environmentally responsible employers may find it easier to hire employees, and to retain employee loyalty. These situations could either result because employees perceive that environmentally responsible employers are likely to be more financially stable over the long run or because they have a moral preference for the types of activities they support with their labor.
- In the *judicial system* parties directly harmed by the pollution can recover compensatory damages by suing polluters (called “tort law” actions). In addition, judicial “oversight” actions can be brought against public enforcement authorities which are not fulfilling their statutory responsibilities. Furthermore, the results of these judicial actions can also be made available to the public.
- In the *legislature*, when existing legislation seems inadequate, the information may build community support for additional legislation.

It is also possible to establish new channels through which pressure may be brought.

- Following the United Nations Conference on the Human Environment at Stockholm in 1972, many countries incorporated environmental considerations in their constitutions. These *constitutional principles* were in general related to the following basic ideas: the State and all its citizens are responsible for environmental protection; all humans have the right to a healthy environment; the State and all citizens must foster development that is environmentally appropriate. Some constitutions, like those of Colombia, Ecuador and Chile, contain the right of people to live in an unpolluted environment. As a result of these constitutional provisions the right to a clean and safe environment has become a fundamental right for each individual, enforceable through judicial action.
- The public can be given certain enforcement powers. *Private enforcement actions* differ from more conventional liability actions in that in private enforcement the initiator of the action is not seeking compensation for pollution-related damages. Rather the private enforcer is seeking to bring a noncomplying polluter into compliance or to prevent pollution which is perceived as violating individual rights to a clean environment. Private enforcement actions can either be *direct*, where the private enforcer is empowered to

bring claims before the judiciary on its own behalf (called “citizen suits”) or *indirect*, where the enforcer is only allowed to file complaints with a designated legal authority (called “complaint actions”).⁵

4. Selected Functioning Programs

4.1. THE TOXIC RELEASE INVENTORY PROGRAM

The Toxic Release Inventory (TRI) was enacted by the US Congress in January, 1986 as a part of the Environmental Protection and Community Right to Know Act (EPCRA). It is designed to provide information to the public on releases of toxic substances into the environment. Most of the substances involved are not themselves subject to release standards.

TRI states that firms who *use* 10,000 pounds or more of a listed chemical in a given calendar year, or firms who *import, process or manufacture* 25,000 pounds or more of a listed chemical must file a report on each of the chemicals in existence within the plant if they also have ten or more full time employees.

Reporting of emissions or use of listed chemicals is accomplished annually. The reports include such information as the name of the company, name of the parent company if it exists, toxic release and frequency of release as well as the medium in which the chemical is released.⁶ Firms must also report emissions to their state and local authorities as well as fire and emergency officials.

The information is available to the public.

Has it resulted in reduces releases of toxic emissions into the environment? Apparently it has. According to official EPA data total releases are down by a little more than over 44%.

4.2. INDONESIA’S PUBLIC DISCLOSURE PROGRAM⁷

Indonesia’s regulatory structure for controlling pollution is weak due to budget constraints and staffing deficiencies. Faced with a growing industrial sector, Indonesia’s National Pollution Control Agency (BAPEDAL) decided to initiate a program, called PROPER – Program for Pollution Control, Evaluation and Rating) for rating and publicly disclosing the environmental performance of Indonesian factories.

Indonesia has chosen a single-index approach to the provision of information. Under this approach the authority compiles the various raw pollution information and aggregates it into a single (hopefully easy-to-interpret) index.

Under the Indonesian scheme each polluter is assigned a color rating based on BAPEDAL’s evaluation of its environmental performance.

- A *black* rating is assigned to factories which have made no attempt to control pollution and are causing serious damage.

- A *red* rating is assigned to factories which have some pollution control, but which fall short of compliance with local standards.
- A *blue* rating is assigned to factories which are in compliance with national regulatory standards.
- A *green* rating is assigned to factories whose emissions control and environmental management procedures significantly exceed those needed for local compliance.
- A *gold* is reserved for world-class performers, those which rank among the cleanest plants of that type anywhere in the world.

In the pilot phase of PROPER, 187 plants were rated. When the program was officially launched in June 1995, only the names of the five Green plants were publicly announced. The 121 plants rated as Red or Black were privately notified, and given until December 1995 to improve their performance. Full disclosure was implemented on December 29; the pilot phase results are displayed in Table I.

Table I. Number of firms in each classification category, various dates

Color	June 1995	December 1995	September 1996
Gold	0	0	0
Green	5	4	5
Blue	61	72	94
Red	115	108	87
Black	6	3	1

Source: Data provide by the World Bank site: <http://www.NIPR.org/proppres/sld036.htm>.

These data suggest that PROPER's short-term impact in the below average category has been substantial. Before full disclosure in December, half the Black plants made successful efforts to upgrade their status, along with a substantial number of Red plants. No short-term impact is observable in the overcompliance range, but this is not surprising. Attaining Green or Gold status will require longer-term investments, while rapid installation of basic abatement equipment can be sufficient to promote escape from a Black rating.

The concept is spreading. The Philippines' Department of Environmental and Natural Resources (DENR) is introducing a public disclosure program called EcoWatch modeled on Indonesia's PROPER program. EcoWatch will soon have its first disclosure of factory performance ratings. The program started on a high note last year when President Ramos publicly introduced EcoWatch along with the leaders of around 20 Philippines Business Associations. The Associations signed an agreement with DENR to support EcoWatch by providing information for program development and encouraging participation by members (Manila Bulletin, April, 1997 as cited in <http://www.NIPR.org/comrole.htm#ecowatch>).

4.3. GREEN ELECTRICITY PRICING⁸

As of 1997 some 13 electric utilities in the United States had adopted some form of green pricing. Under a green pricing scheme the customer is asked to pay a premium of up to 15% of the normal bill.⁹ In return the utility acquires renewable energy sources according to a set formula.

Surveys consistently reveal that from 56% to 80% of respondents to polls indicate a willingness to pay more for environmentally friendly energy sources. Green pricing attempts to tap this willingness to pay as a means of financing renewable energy sources which are not quite cost-effective. (The cost-effective sources would presumably be added to the mix even without green pricing.)

Green pricing provides an example of a voluntary information disclosure strategy. Utilities that are prepared to offer green options to consumers willing to pay a price premium; can advertise that fact, but utilities that are not prepared to offer that option do not have to.

5. Empirical Analysis

The literature on economic analysis of disclosure strategies is rather young, but it does contain some useful, if partial, information.

5.1. DOYLE (1990)

In the early stages of this study, a review of the literature on risk communication and motivating self-protective behavior found that traditional information and awareness programs (such as advertising campaigns and public service announcements) were likely to fail when they are targeted at the general population.

- To test this hypothesis for the radon context this study sent a mail survey to 920 households that had purchased radon test kits as part of an intensive information and awareness campaign in the Washington, D.C. area. Although about 33,000 homes in this area exceeded the EPA action level for radon by a factor of five or more (had a radon reading of 20 picocuries per liter or higher), the survey results indicate that *only 1.2% of this group had taken convincing remedial action as a result of the campaign*. In addition, only about a third of the homes in this 1.2% group conducted a post-mitigation retest to confirm that mitigation had been effective.
- In contrast, a separate telephone survey of 303 home buyers in Boulder County, Colorado found that over 40% of recently purchased homes were tested for radon gas at the time of home sale and that this testing was often motivated by information provided by the realtor. Even though no intensive information and awareness campaign has been conducted in Colorado and currently no state laws are in effect concerning radon, *54% of tested homes in their sample that had radon levels above the EPA action level underwent mitigation (with 87% of those completing follow-up testing) as part of the home sale transaction*.

The authors believe that these results suggest that a radon information and awareness program targeted at the point of home sale, when the transaction context provides a strong economic incentive to repair any problems a home might have, could be highly effective in comparison to information targeted at the general population.¹⁰

5.2. ARORA AND CASON (1996)

Using an econometric model this study attempts to isolate the factors which influence a firm's decision to participate in EPA's 30/50 Program. The study draws the following conclusions:

- The largest firms with the greatest toxic release were the most likely to participate in this voluntary program.
- The authors found no evidence that firms either free ride on emission reductions prior to the program's initiation or that they participate to divert attention away from poor compliance with mandatory regulation.
- Firms in industries with more contact with final consumers (proxied by normalized advertising expenditures) were more likely to participate in the program.

5.3. NAYSNERSKI AND TIETENBERG (1992)

The data used in this analysis included 1205 citizen actions. The data base included information regarding plaintiffs, defendants, filing dates for notices and/or complaints, penalties, and statues involved in the claim. The analysis examined the effects of various incentives on the types of claims filed. The following conclusions emerged from this study.

- The effectiveness of the citizen suit process is affected to a large degree by the incentives offered private enforcers in the program. In particular allowing private enforcers to extract penalties which are earmarked for environmental improvement and to be reimbursed for legal expenses increases the attractiveness of the private enforcement process for private enforcers.
- For one class of polluters, public facilities, citizen suits seem a distinctly superior form of enforcement.
- Since citizen suits are typically based on proving noncompliance with specific effluent/emission standards, determining that citizen suits have led to greater compliance does not necessarily indicate that they have led to greater cost effectiveness. Complete compliance is not necessarily cost-effective if the effluent/emission standards are not themselves cost-effective.
- Since the evidence suggests that private enforcers respond to specific incentives, if the incentives are not applied uniformly to the various pollution problems a bias will be created. Those problems which treat private enforcers

favorably will be preferred whether or not they represent the most serious problems.

5.4. MUOGHALU, ROBISON AND GLASCOCK (1990)

This study examines the capital market impacts of hazardous waste mismanagement lawsuit filings and settlements for the 1977–1986 period. The sample contained 128 initial lawsuits against firms and 74 case settlements which were announced in the print media (generally the *Wall Street Journal*).

- Though significant results were obtained for the day of the announcement, no significant results were obtained for intervals from 2 to 5 days *prior to* or 1 to 5 days *after* the announcement.
- The results indicate that stockholders suffered on average a statistically significant loss in market value of 1.2% at the filing of the lawsuit, but no significant abnormal returns at the disposition of the suit.

5.5. LAPLANTE AND LANOIE (1994)

This study examines the capital market effects on Canadian firms of some 47 announcements of environmental events, including environmental regulation violations (12), initiation of legal action (9), settlement of suits (13), and investments in emissions control (13) covering the 1982–1991 period.

- Announcements of incidents and lawsuits did not trigger any significant abnormal stock market returns.
- Announcements of suit settlements which resulted in fines resulted in a decline in value of about 2%.
- Announcements of investments in emissions control equipment resulted in an abnormal loss on the day of the announcement of about 1.2%.

This contrasted with an earlier result involving American firms (Muoghalu, Robison and Glascock, 1990). That study found that the American stock market reacted to the announcement of the initiation of a law suit. The authors attribute the difference to the less credible enforcement of environmental regulations in Canada; Canadian investors are seen as being influenced only by the outcome.

5.6. BADRINATH AND BOLSTER (1996)

This article examines stock market reactions to 730 EPA judicial actions for a sample of publicly traded firms from 1972–1991.

- The market value of the average affected firm dropped 0.43% during the week of settlement.

- While high relative fines appear to affect stock market prices, the analysis uncovered no consistent relationship between the magnitude of relative fines and prices.
- The estimated market penalty was larger for more recent actions and for repeat offenders.

The authors note that while these results reflect an environment where no special attention is paid to providing public information about enforcement actions, they also appear to support the possibility of substantial social benefits from providing more systematic information.

5.7. HAMILTON (1995)

An event study was performed on 436 publicly traded companies to ascertain whether the announcement of the information compiled under the Toxic Release Inventory affected stock prices. This was complemented by a study of media coverage of this information compiled by searching the Nexis database and the *Wall Street Journal* index for 1989.

- Holding emissions constant, the more dispersed its pollution across facilities and the more information available to the public about the company's pollution patterns prior to the TRI, the less likely journalists were to treat the firm's TRI releases as news.
- Most of the publicly traded firms in the sample did not receive any coverage of their TRI releases in the print sources traced by this study.
- For those companies which reported TRI data to the EPA, the average abnormal return on the day the information was made public was negative and statistically significant.
- These effects were smaller for firms where investors had previous information about pollution patterns (such as companies with exposure at Superfund sites).

5.8. KHANNA (1997)

This study also examines stock market and waste management responses to disclosure of the Toxic Release Inventory, but in this case the sample period was 1990–1994 and the focus was on the chemical industry.

- Chemical firms incur statistically significant losses in market value during the one day period following the disclosure of the Toxic Release inventory.
- These losses have a significant negative impact on subsequent on-site releases and a significant positive impact on wastes transferred off-site for recycling and treatment, but their impact on total toxic wastes generated by these firms is negligible.

5.9. KONAR AND COHEN (1997)

Comparing the 40 firms with the largest abnormal reductions in their stock prices to a control group of otherwise similar firms, this analysis examined differences in the behavior of firms in these two samples. In general they found:

- The top 40 firms were found to be among the top 1/3 of polluting firms (per dollar revenue) in their industries, but not necessarily the largest emitters in terms of overall emissions.
- The top 40 firms subsequently reduced their emissions more than other firms in the industry (including those firms with the largest TRI/\$ revenue prior to the disclosure of TRI levels).
- The top 40 firms made more significant attempts at improving their environmental performance by reducing the number and severity of oil and chemical spills.
- The top 40 firms had a lower likelihood of receiving higher fines from the government in subsequent years.

5.10. DASGUPTA AND WHEELER (1996)

This study examines environmental complaints lodged in China by citizens over the 1987–1993 period to discover the factors that seem to explain the number of complaints. The results indicate:

- The incidence of complaints does mirror abatement benefits and the intensity of exposure for visible pollutants, but not less visible, but potentially equally harmful, pollutants.
- Regions with higher education levels tend to initiate many more complaints, all other things being equal. This implies that a reliance on complaints alone would result in inappropriately low allocation of inspection resources to less-educated, relatively 'silent' regions.

6. Summary and Conclusions

The research to date is sufficiently sketchy and incomplete that it is not yet possible to draw firm conclusions about the efficient niche for disclosure strategies in the wider realm of environmental policy. Nonetheless the results do provide a basis for forming a series of hypotheses which could serve to focus future research.

The evidence in general suggest that disclosure strategies can ultimately motivate polluters to reduce emissions even in the absence of more traditional regulatory controls. This is an important result because disclosure regulations are normally justified only in terms of the moral principle that victims have the right to know the risks they face. This analysis suggests that disclosure strategies may have an efficiency role to play as well.

Disclosure strategies may complement traditional strategies or substitute for them, depending upon the circumstance. Citizen suits, for example, clearly complement traditional regulations while the use of disclosure strategies to control radon gas in the household setting substitutes for a strategy which sets exposure standards and forces homeowners to come into compliance. In some case disclosure strategies may provide interim incentives to control pollution until such time as more traditional regulation can be established (such as in developing countries or in controlling air toxics in the United States).

The research to date also sheds light on some of the determinants of successful disclosure strategies. More information is not always better. The amount and type of information conveyed is important. And the incentives victims face in acting on the information are also important. Combining the availability of information with empowering citizens bring civil actions against noncomplying polluters can be an effective means of reducing emissions through increase compliance. Yet the degree to which this combination represents a move toward efficiency depends crucially on specific design features (such as attorney reimbursement, disposition of penalties, etc.) of the private enforcement program.

The literature also raises a cautionary note with respect to the distributional impacts of disclosure strategies. Can it be that in certain circumstances disclosure strategies benefit only the more educated victims? When actions taken by victims have a strong regional component (as, for example, with the complaint processes examined in the China study), resources may be diverted from less educated (less vocal) regions and toward the more educated regions which complain more.

Ideally we would like to know how much to invest in disclosure strategies and how to target those investments to promote efficient pollution control. In fact we are far from having enough information to make those determinations. Yet the information we have is sufficient to suggest that disclosure strategies do hold some promise. That should serve to motivate the further research which will be necessary to eliminate the knowledge void.

Notes

1. I am one of those who was quick to dismiss it. See Tietenberg (1992).
2. This may be one area where criminal penalties may be justified. See Segerson and Tietenberg (1992).
3. In the United States the Center for Environmental Information and Statistics became operational and open to the public on Jan. 1, 1998. The Center provides easy access for the public to EPA's massive environmental information resources through computers and other means.
4. A study conducted by Richard Clough of Duke University indicated that portfolios invested in "environmentally responsible" companies generally return one to three percentage points more annually than the holdings of "irresponsible" companies (*Investor's Business Daily*, 5/27).
5. Private enforcement mechanisms are currently being actively used in both the United States and Europe to enforce environmental standards as well as in Latin America (Tietenberg 1996). In

- the U.S. some fourteen statutes authorize citizen suits and some thousands of claims have been initiated (Naysnerski and Tietenberg 1992). According to Sand (1991) in Europe the number of public and private environmental complaints filed rose from about 10 in 1982 to 460 in 1989. More than half of these have been filed by private individuals or organizations.
6. Polluters must also report the scientific as well as the common name for the chemical being addressed by that form and give the amount a rating. The ratings go as follows: Immediate (acute) health hazard, delayed (chronic) health hazard, fire hazard, sudden release of pressure hazard, and reactive hazard. The category under which a chemical and its level of emission fall is designated by section 312; 40 C.F.R. sect. 370.2.
 7. This section is based upon Afsah, LaPlante and Wheeler (1996). This paper is available on the web at http://www.NIPR.org/work_paper/1672/index.htm.
 8. This section is based upon Moscovitz (1993) and Lamarre (1997).
 9. Despite the fact that in Detroit Edison's Solar Currents plan customers pay an average of 14% more, the program quickly became oversubscribed. Some 70 customers are currently on a waiting list (1997).
 10. This study was subsequently published in concise form as Fisher, et al. (1991).

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