Banking on "Green Money": Are Environmental Financial Responsibility Rules Fulfilling their Promise?

James Boyd

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Resources for the Future
1616 P Street, NW
Washington, DC 20036
Telephone 202-328-5000
Fax 202-939-3460

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Abstract

Financial responsibility rules are an increasingly common form of environmental regulation. Currently, the operators of landfills, underground petroleum storage tanks, offshore rigs, and oil tankers must demonstrate the existence of adequate levels of capital as a precondition to the legal operation of their businesses. Environmental financial responsibility ensures that firms possess the resources to compensate society for pollution costs created in the course of business operations. In addition to providing a source of funds for victim compensation and pollution remediation, financial responsibility is thought to motivate better decision-making, particularly regarding the management of long-term risks. This article describes both the promise of financial responsibility as a complement to conventional environmental regulation and a set of weaknesses associated with its current implementation under U.S. environmental statutes.

Key Words: financial responsibility, environmental liability, waste disposal

JEL Classification Nos.: Q28, L51, K32

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James Boyd[1]

1. INTRODUCTION

Financial responsibility rules are a relatively new and increasingly common form of environmental regulation. Currently, the operators of landfills, underground petroleum storage tanks, offshore rigs, and oil tankers must demonstrate the existence of adequate levels of capital as a precondition to the legal operation of their businesses. The rationale for environmental financial responsibility is similar to that for the use of minimum reserve requirements in the regulation of financial services. Banks and insurers are required to reserve capital in order to absorb unanticipated costs that threaten their ability to honor contracts with borrowers or policy holders. Similarly, environmental financial responsibility ensures that firms possess the resources to compensate society for environmental costs they create in the course of their business operations. In both cases, financial responsibility is thought to motivate better decision-making, particularly regarding the management of risks. This article describes both the promise of financial responsibility as a complement to conventional environmental regulation and a set of weaknesses associated with its current implementation.

The paper is organized as follows. Section 2 reviews arguments for the use of financial responsibility and its relationship to other forms of environmental regulation. Having laid out the benefits of financial responsibility in theory, the analysis provides a practical description of rules that currently apply to the owners and operators of regulated facilities under the Resource Conservation and Recovery Act (RCRA). Sections 3 and 4, in turn, describe the financial responsibility as it applies to waste landfills and underground petroleum storage tanks. These sections also address whether or not the promise of financial responsibility is being fulfilled under these programs.

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2. FINANCIAL RESPONSIBILITY AS A COMPLEMENT TO TRADITIONAL ENVIRONMENTAL REGULATION

U.S. environmental policy relies on two basic forms of regulation to deter environmental hazards: command and control regulation and liability law. Command and control regulations include reporting requirements, the mandated use of particular technologies, and specific limits on emissions or releases. In contrast, liability law makes few specific requirements of polluters. Instead, it motivates desirable environmental behavior by imposing on polluters the social costs of their activities. In practice, the two forms of regulation are complementary. For instance, two major U.S. environmental statutes RCRA and CERCLA (the Comprehensive Environmental Response, Compensation, and Liability Act) both establish regulations that feature command and control- and liability-based forms of deterrence. However, liability law and command and control regulation can also be viewed as substitutes. Both can be used independently to deter environmental risks.

One way in which to contrast the two forms of regulation is to think of command and control as an *ex ante* intervention. For instance, a firm that is not in compliance with regulations may be prohibited from operating or face penalties for a failure to comply. By contrast, liability is an *ex post* intervention, in that it imposes penalties only after a firm has already created a social cost. This difference in approach has important consequences for the relative desirability of the rules. Due to its *ex ante* nature, command and control requires the regulator to balance the social benefits of more stringent standards against the private costs of complying with them. This presents several difficulties. First, it requires the regulator to have detailed information on firm compliance costs -- information it is unlikely to have or be able to get firms to reveal. Second, the standards that result are often inflexible. Cross-industry standards necessarily involve some inflexibility because the regulator must monitor the compliance of many firms. Firm- or technology-specific standards, while more flexible, are more costly to derive and monitor. But any standards that constrain a potential polluter's ability to reduce risks in the least costly manner imply compliance costs that are excessively high.

In its ideal form, liability law resolves these problems. By imposing the costs of pollution on the polluter, liability law allows polluters themselves to balance the social benefits and private costs of pollution reduction. In this way, pollution reduction decisions are made by the party with the best information on how to reduce risks, allows them to do so in a flexible way, and removes the need for

government monitoring of firm decisions.[2] Unfortunately, the use of liability as a regulatory mechanism suffers from a weakness related to its *ex post* nature. Because penalties are imposed only after pollution is created, there is the possibility that the firm will not exist legally or will be in a financial condition that does not allow it to compensate society for the environmental costs it has created. This is the motivation for financial responsibility rules. Without financial responsibility, liability can fail as a system of environmental deterrence and compensation. With financial responsibility, liability law represents a desirable substitute to command and control regulation.

2.1 Insolvency and Deterrence

In general, liability for environmental damages is "strict" in the common law and under the major environmental statutes such as RCRA and CERCLA. By contrast to negligence-type liability rules, strict liability places the full burden of environmental costs on the pollution generator, independent of the safety or precaution taken by the defendant. In principle, strict liability leads to the internalization of otherwise externalized costs. When costs are internalized, firms are led to make efficient environmental risk reduction decisions. However, strict liability fails to induce efficient precaution when firms are potentially insolvent, and thus unable to meet the financial obligations implied by their liability. Environmental tort claims are considered debts that can be discharged in either Chapter 7 or Chapter 11 bankruptcy proceedings. Insolvency truncates the penalties that are borne by tort defendants, thereby reintroducing the possibility of externalized social costs. This means that when firms are "undercapitalized" relative to the scale of harm they may generate, they do not expect to bear the full social costs of pollution and may therefore not take efficient precautions against risk.[3]

It is important to emphasize that the mere possibility of bankruptcy is sufficient to weaken liability's ability to deter. The corollary to this statement is that bankruptcy need not already be observed for it to have an effect on firm incentives. From the standpoint of *ex ante* decision-making, bankruptcy occurs only with some probability. Nevertheless, this is enough to blunt the incentive to make costly investments in risk reduction. Probabilistically, costs are externalized and so the incentive

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[2] For a similar, but more exhaustive, comparison of command and control regulation and liability-type rules see Cohen (1987).

[3] For analyses which have explored or employ this reasoning see Schwartz (1985), Shavell (1984 and 1986), Landes and Posner (1987), Kornhauser and Revesz (1990), Polinsky and Shavell (1991), and Boyd and Ingberman (1994).

to avoid or reduce such costs is weakened. Also, it is important to note that incentive problems arise even when liabilities or regulatory penalties are not the sole or even precipitating reason for potential bankruptcy. If firms foresee the possibility of bankruptcy for any reason, they will rationally expect the truncation of future penalties.

2.2 Empirical Evidence of the Need for Financial Responsibility

Liability-related insolvency is most popularly associated with product liability cases. Some of the more celebrated examples of product failures which have resulted in firm bankruptcy include silicone breast implants, the drug DES, the Dalkon Shield, and Johns Manville's asbestos products.[4] In the environmental arena, many firms have been bankrupted by liabilities that dwarf their assets, including petroleum underground storage tank operators, landfillers, and firms deemed responsible for Superfund cleanups. The costs of remediating polluted properties and water sources and compensating injured third parties are often obviously larger than firms' ability to pay.

To compound this problem, an additional source of concern is that firms actively seek to reduce their capital exposure to liabilities by divesting themselves of assets. In industries where liability costs are potentially significant, firms' business organization and capital investment and retention decisions may be influenced by the desire to externalize liabilities. For instance, in order to avoid "deepening their pockets" firms may avoid retained earnings, choose to not vertically or horizontally integrate, or shelter assets overseas.[5]

To investigate the impact of liability on capital investment decisions, Ringleb and Wiggins (1990) explored the rate of small firm incorporation as a function of the riskiness of a given industry. Their evidence suggests that liability has a direct impact on enterprise scale. They compared the number of small firms in 1967 -- a period before the routine use of strict liability for tort claims -- to the number of such firms in 1980, when the use of strict liability was routine and expected. Their analysis suggests that the incentive to avoid liability led to a 20% increase in the number of small corporations in the U.S.

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[4] For discussion of such cases see Roe (1984). Hazardous products have the potential to create massive litigation costs, in addition to the social costs of the injuries themselves. For instance, see Viscusi (1991) who documents 275,000 asbestos, 210,000 Dalkon Shield, and 125,000 Agent Orange cases.

[5] Allied Signal's divestiture of a facility for handling Kepone, a highly carcinogenic solvent, is a classic example. For a description of offshore financial havens, or "asset protection trusts" see "Salting it Away," *The Economist*, Oct. 5, 1991, at 32.

economy between the two periods. This type of evidence has lent urgency to policy reforms, such as financial responsibility rules, that address the problems associated with judgment-proof defendants.

2.3 The Practical Benefits of Financial Responsibility

Financial responsibility rules are most desirable when the scale of possible environmental costs is large relative to the value of the firms creating risks. Not only notorious catastrophes, such as oil tanker spills, signal the need for financial responsibility. Smaller risks, such as tank leaks at filling stations, can in aggregate lead to far greater levels of externalized environmental costs due to the far shallower pockets of firms using this type of technology.[6] Financial responsibility is also particularly appropriate when dealing with latent risks. Latency is a common characteristic of environmental hazards where risks materialize only over a period of years or decades. This creates the need for financial responsibility since, without it, the firm may cease to exist as a legal entity long before environmental costs are discovered. In this context, financial responsibility is used to ensure that existing commercial enterprises reserve capital that will be available for compensation even after the firm dissolves.

In concrete terms, financial responsibility ensures that the expected costs of environmental risks appear on a firm's balance sheets and in its business calculations. If new investments imply possible future environmental costs, financial responsibility increases the relevance of these costs to the firm's decision-making. Financial responsibility can be demonstrated through either self- or third-party insurance. The ability to self-insure requires relatively deep-pockets and implies that the firm will directly internalize expected environmental costs. Shallower-pocketed firms often cannot self-insure and must therefore acquire rights to financial assets from third parties such as banks and insurers. When third parties provide capital in this way they are obviously concerned with the likelihood that their capital will be consumed by future liabilities.[7] As a result, there is a strong incentive for the providers of capital to monitor environmental safety in order to guard against moral hazard. In order to guard against adverse selection, capital providers can also base the cost of their capital (e.g., their premiums)

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[6] For instance, the environmental costs of the *Exxon Valdez* disaster, while huge, were not externalized due to the wealth of Exxon.

[7] Skogh (1991) describes the benefits from monitoring that come when intermediate financial "guarantors" expose their assets to the liability claims of the firms they underwrite.

on observable attributes of the firms to whom they provide capital. For instance, more favorable capital costs can be offered to firms with meaningful risk management and safety programs. Moreover, financial coverage may simply be denied to firms which fail to demonstrate acceptable levels of safety. In these ways, the capital markets that arise to satisfy demand for financial responsibility in turn create financial incentives to reduce environmental risks.[8]

2.4 A Cautionary Note: Biased Estimation of Probabilities and Losses

In the absence of governmentally-provided standards or information on risks, strict liability and financial responsibility, by forcing cost internalization, leaves the burden of risk assessment to firms themselves. This is often viewed as one of the principal justifications for strict liability. After all, firms themselves should be expected to have access to better information than the government regarding the risks posed by their products. Decision-sciences research offers a cautionary note, however. For instance, individuals routinely underestimate the probabilities or scale of low probability events. They also frequently underestimate the potential consequences of a product or environmental catastrophe.[9] This has the potential to affect markets for financial coverage by creating a divergence between managers and financial markets' estimation of the marginal benefits of risk-reduction.[10]

2.5 The Design of the Rule

Financial responsibility rules require the definition of a minimum level of coverage, a description of alternative financial mechanisms that can be used to satisfy the rule, and a mechanism to monitor compliance. Ideally, firms should be able to demonstrate recoverable assets sufficient to internalize the costs of the most catastrophic hazard their businesses can create. Thus, even if there is only a small probability of a loss of large magnitude, optimal deterrence requires that the firm

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[8] Mandatory automobile insurance leads to similar, desirable incentives. With required insurance, drivers pay premiums based on their driving record and may have coverage revoked in extreme cases. Because insurance is required, this creates a broad-based, self-enforcing system to deter traffic risks.

[9] See Hogarth (1987) and Kahneman *et al.* (1982). For an economic analysis of damage assessment issues see Kaplow and Shavell (1996).

[10] Zeckhauser and Viscusi (1990) argue that, with regard to catastrophic events, people underestimate the probabilities of disaster, and so perceive insurance premiums for coverage against the events as too high.

internalize that full cost.[11] It is a misconception to think that assets sufficient to internalize the *expected* level of harm are adequate. A firm with assets equal to the expected level of harm will by definition externalize costs --and be under-deterred-- whenever the harm exceeds the expected level.

Compliance with coverage requirements can be demonstrated either through evidence that the firm has adequate wealth (e.g., cash, capital assets) or has purchased a claim on the assets of a third party that can be used to finance liabilities. In practice, these claims can take the form of insurance coverage, letters of credit, or surety bonds. Monitoring compliance is relatively straightforward. In the case of self-insurance, information such as that contained in routine financial audits is usually sufficient to demonstrate compliance. In the case of third party coverage, evidence of a contract with a licensed capital provider is sufficient.

2.6 Motivating Cost Internalization without Financial Responsibility

When a firm is insolvent or otherwise judgment-proof, the common law often extends liability to other firms with whom the injurer had contractual relationships. Retailers, for instance, may be liable for reselling a product that causes injury if the manufacturer is unable to compensate victims. The underlying motivation for "extending" liability in this way is cost internalization. By extending the reach of liability, there is an increased incentive for firms to monitor and demand greater safety from those with whom they trade.[12]

Compared to financial responsibility rules, however, this method of fostering cost internalization can introduce distortions of its own. Extended liability can distort the pattern of transactions between risk-generating firms and those with whom they contract. This happens since deep-pocketed firms have an incentive to avoid transactions with more shallow-pocketed firms whose

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[11] An exception to this proposition occurs when the underlying liability rule is negligence-based, rather than strict. Because it conditions damages on the defendant's actual care, a negligence rule can induce efficient safety investments even if firms are somewhat undercapitalized (Shavell (1986), Landes and Posner (1987)). The implication is that, the level of financial responsibility needed to induce optimal deterrence is lower under negligence than strict liability. However, given that strict liability is the applicable rule in most environmental and product risk contexts, we focus on the use of financial responsibility in conjunction with strict liability.

[12] This same motivation underlies academic proposals to relax current limitations on shareholder liability. Extending liability to shareholders promotes cost internalization and can be expected to yield corresponding benefits in deterrence. For instance, see Hansmann and Kraakman (1991) who advocate proportionally unlimited shareholder liability for corporate torts. A similar rationale is central to the literature on vicarious liability, as in Sykes (1984) and Kornhauser (1982).

liabilities they may inherit. When transactions are avoided, gains from trade are lost. This can increase production costs. Moreover, the possibility of being exposed to another firm's liability is inherently more uncertain, perhaps uninsurable, and thus more costly.[13]

2.7 Financial Responsibility in Practice

Current U.S. environmental policy requires financial responsibility for the owners and operators of landfills and underground petroleum storage tanks under RCRA. The next sections detail the implementation of financial responsibility rules under this statute and highlight a set of practical issues that can blunt the regulations' effectiveness. Described first is a set of potential weaknesses in the rules implemented under the landfill provisions of RCRA. Of the several allowable mechanisms for demonstrating financial responsibility, some are likely to lead to less cost internalization than others. The analysis explores the impact of the different mechanisms on firm incentives and suggests ways in which the law can be strengthened. Financial responsibility as it has been implemented for underground storage tanks is explored next. Under this program, financial responsibility has evolved into a system of publicly-financed liability coverage. As is explained, this significantly reduces the ability of financial responsibility to deter environmental risks.

While not discussed in detail, it is worth noting that financial responsibility is also required under the Oil Pollution Act of 1990.[14] The OPA requires financial responsibility for tankers, offshore pipelines, and oil and gas terminals. Its provisions are very similar to those under RCRA.

3. FINANCIAL RESPONSIBILITY IN PRACTICE: THE CASE OF LANDFILL REGULATION

In 1993 the EPA issued financial responsibility requirements for municipal and other "non-hazardous" landfills. This section analyzes the likely impact of the Subtitle D financial assurance requirements on the safety investments and operating decisions made by municipal solid waste (MSW) landfill owner-operators. Subtitle D's requirements are the outgrowth of an increased recognition that wastes, even those classified as "non-hazardous," can lead to significant environmental risks.[15] The

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[13] For a more complete analysis of the effects of extended liability see Boyd and Ingberman (1996 a and b).

[14] 33 U.S.C. §2716.

[15] RCRA's hazardous waste regulations (subtitle C) exempt household hazardous waste and small-generator wastes. But these types of sources contribute to a vast annual volume of waste capable of creating environmental damage. As a measure of the scale of MSW operations in the U.S., a 1988 EPA estimate placed the annual volume of municipal waste at nearly 211 million tons. U.S. EPA, 1 *Report to Congress: Solid*

principal risk presented by any landfilling operation is due to the leaching of contaminants into groundwater. Off-site soil and groundwater damage can lead to health risks and reduce the value of neighboring real estate. Airborne pollutants and underground methane buildup also contribute to the overall risk of a landfill site.[16]

3.1 Landfill Risks and the Desirability of Financial Responsibility Rules

The nature of landfill risks can impede the ability of liability-based laws to accomplish their goals of compensation and deterrence. First is the "latency" of losses. Environmental damages may develop or be detected only after years of operation, or after the landfill has closed. Second, the scale of remediation and damage costs can be large relative to the value of the firms operating them.

When landfilling results in environmental damage, or the threat of environmental damage, liability can be imposed on owner-operators through the application of common law principles, RCRA, and CERCLA. Under the common law, third parties such as neighboring property owners can recover damages due to the increased risk of disease, the costs of medical monitoring, and property damage.[17] RCRA liability is primarily a codification of existing common law public nuisance remedies in which liability derives from the existence of an "imminent and substantial endangerment" posed by the facility.[18] There is a right to citizen suit and liability can be applied to remedial actions at both active and inactive sites.[19] RCRA liability is joint and several, meaning that any one defendant can be held liable for the full amount of damages if responsibility for the harm is indivisible among multiple parties. CERCLA liability also applies to MSW landfill operations. CERCLA defines potentially responsible parties (PRPs), which generally include owner-operators, transporters, and generators of waste. All PRPs are jointly and severally liable. Liability is assumed if there is a release or threatened release of a "hazardous substance" from the site or if the release or threatened release causes the plaintiff (typically the federal government) to incur costs in response to the release.[20] Roughly 25% of all Superfund sites

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Waste Disposal in the United States 11 (1988). A frequently cited estimate is that .3-.4% of MSW is composed of hazardous substances. See testimony in *B.F. Goodrich Co. v. Murtha* (754 F. Supp 960, D Conn., 1991).

[16] See Ferrey (1988).

[17] *Werlein v. United States* (746 F.Supp. 887, 1990).

[18] 42 U.S.C. §7002. As an example of enforcement under this section, see *Dague v. City of Burlington* (732 F.Supp. 458, 1989) where the city of Burlington Vermont was found liable for operating a landfill presenting "an imminent and substantial endangerment to the public's health and the environment."

[19] See *United States v. Ottati & Goss, Inc.* (630 F.Supp. 1361, 1985).

[20] CERCLA, §107.

involve municipalities or MSW, a proportion that is expected to increase over time.[21] Like RCRA, CERCLA can be applied to both active and inactive (abandoned) sites.[22] Unlike RCRA, CERCLA does not have an exemption for "household" waste. This has raised the possibility of widespread municipal liability under CERCLA.[23]

The scale of these liabilities can be huge. For RCRA subtitle D actions, the EPA estimates that the costs of closure, post-closure and corrective action will range between $1 and 29 million for a typical landfill.[24] CERCLA liabilities add millions more to the potential costs of site remediation.[25] Moreover, since liability is joint and several under both CERCLA and RCRA, total liability costs may be even greater due to the transactions costs associated with litigation among potential co-defendants. Because the scale of liability costs is so large, owner-operators can be bankrupted by liability and other enforcement actions. When this happens remediation costs must be borne by other PRPs or the government.[26]

Subtitle D, in addition to its financial assurance provisions, includes design criteria that require landfill liners, leachate collection, and groundwater monitoring systems. For several reasons, these technical requirements alone cannot be relied on to guarantee efficient landfill risk reduction. First, design and operating safety regulations require enforcement activities to ensure compliance. The

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[21] *Superfund Program: Interim Municipal Settlement Policy*, 54 Fed. Reg. at 51071 (1989). The Office of Technology Assessment has also estimated that between 17,400 and 34,800 MSW sites may eventually involve CERCLA response actions.

[22] *Chemical Waste Management, Inc. v.Armstrong World Industries*, (669 F.Supp. 1285)(E.D. Pa. 1987).

[23] In *Transportation Leasing Co. V. California* (21 ELR 20826 (C.D. Cal., 1990)) the court ruled that CERCLA does not expressly exclude household wastes from its definition of hazardous substances. Quoting an EPA directive, the court argued that, "communities should recognize that potential liability under CERCLA applies regardless of whether the household hazardous waste (HHW) was picked up as part of a community's routine waste collection service and disposed of in a municipal waste landfill ..." For the directive see, EPA Office of Solid Waste and Emergency Response Directive No. 9574.00-1, *Clarification of Issues Pertaining to Household Hazardous Waste Collection Programs* (Nov. 1, 1988).

[24] *Environment Reporter*, January 7, 1994 at 1591. Conservative estimates put closure and post-closure costs at 15-20% of the total development and operating costs of a landfill. See Glebs (1988) or "Landfill Construction and Operating Costs in Michigan," mimeo, State of Michigan, Science and Technology Division, State Legislature, December 1989.

[25] As an example, in the *Transportation Leasing* case *supra* note 11 the cleanup concerned was estimated to come at a cost of $650 to 800 million. Bernstein (1989) estimates, based on municipal landfill cleanup costs in New York and New Jersey, an average remediation cost of $40 million.

[26] A typical example is the Kim-Stan landfill in Virginia. A fish kill alerted state officials to widespread contamination from the landfill in 1989. As a result, the state issued $1.5 million in fines. The landfill's owners subsequently filed for bankruptcy and eventually paid only $100,000 in penalties. See *Solid Waste Digest, Southern*, April 1994, p. 2.

existing record on enforcement and compliance under RCRA, however, is weak. For instance, the earliest Subtitle D provisions required states to enforce groundwater and methane monitoring and surface water control standards. The requirements went into effect in 1979. A 1988 EPA report, however, found only 36% of landfills monitoring groundwater, 7% monitoring methane, and 15% with surface water controls.[27] Second, even if enforced, specific technical requirements cannot be all-inclusive. By contrast, financial responsibility requirements create an incentive to reduce risks broadly, in whatever way the operator feels in its best interest.

Financial responsibility also deters the construction and operation of landfills with negative net social value. Moreover, because dedicated funds are available for remediation and closure, the legal transactions costs associated with apportioning responsibility among generators and transporters can be reduced or eliminated. Independent of whether efficient investments in safety are made, when environmental costs are externalized via bankruptcy, landfills with negative net social value may be constructed and operated. If a landfill creates social value V and all environmental costs E are internalized, then only landfills where $V > E$ will be constructed and operated. This is efficient. However, if a fraction of the costs E are borne by the government or third parties, then landfills may be operated even though $V < E$, which is clearly inefficient. Externalized environmental costs also mean that the price of tipping fees charged by landfill operators may not reflect the full social costs of disposal. In turn, this artificially low price of disposal distorts the incentive of MSW generators to reduce their production of waste.

3.2 The Alternative "Allowable Mechanisms" for Demonstrating Financial Responsibility

The FRRs mandated under RCRA are likely to improve the overall efficiency of the landfill market. However, because of "loopholes" in the regulations, financial responsibility rules are unlikely to eliminate the possibility of inefficient operation, safety, and closure decisions. To understand these loopholes, it is necessary to describe the various allowable mechanisms for demonstrating financial responsibility compliance.

The Subtitle D requirements for non-hazardous waste disposal facilities require owner-operators to demonstrate financial responsibility for closure, 30 years of post-closure care, and known corrective actions.[28] The rule requires an itemized estimate, in current dollars, of the cost of hiring a third party to perform these activities assuming "worst case" assumptions. The estimate is revised annually and financial responsibility must reflect any changes to the estimate (positive or negative) over

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[27] See "Expectations Dwindle for Subtitle D," *Environmental Information Digest*, July 1993, p. 35.

[28] The financial assurance requirements are delineated in 40 CFR 258, subpart G.

time. There are several allowable mechanisms for demonstrating financial responsibility. Multiple mechanisms can be used simultaneously.

Corporate and Local Government Financial Tests. This mechanism is the most straightforward and allows "deep-pocketed" corporations or governments to satisfy the requirement by demonstrating their financial strength. In the case of corporations, the diversity and depth of the firm's assets and debt, as well as the value of future income are particularly relevant. The requirement is most likely to be satisfied by large, diversified corporations. The proposed local government test is based on a bond rating requirement. If the minimum acceptable bond rating is not met, additional tests involving liquidity and debt service ratios may be used. Governments are prohibited from using this test if they are in default on any general obligation debt or if they operate at any more than a 5% annual revenue deficit for two or more fiscal years. Assuming the requirements are satisfied, at most 43% of the government's annual revenue can be claimed as funds to satisfy the financial responsibility requirement.

Trust Funds. The trust fund mechanism requires annual payments into a site-specific trust over the lifetime of the landfill's operation. Given a total level of required coverage COV and Y years of operation, annual payments of (COV-BAL)/Y are required, where BAL is the balance of funds already held in trust. Following the post-closure period any remaining funds left in trust revert to the owner-operator. Note that full financial responsibility is achieved under this mechanism only after the end of the landfill's operation. Thus, premature closure can result in incomplete cost internalization when this mechanism is used.

Letters of Credit. Financial responsibility can be demonstrated if the owner-operator is in possession of a letter of credit from an approved financial institution (usually a bank). Letters of credit are a promise to pay from a third party institution. The credit issuer will typically require an owner-operator to provide collateral for 100% of the face value of the letter. The collateral requirements make this mechanism unavailable, or undesirable to most owner-operators. First, real estate has little collateral value since landfill property has few alternative uses and may be valueless in the event of environmental damage. And the liquidation value of capital investments such as heavy machinery is limited. In any event, owner-operators able to satisfy the collateral requirements are likely to be able to satisfy the corporate financial test. In addition, letters of credit can be revoked by the issuer as long as 120 days notice is provided to the state and owner-operator.

Surety Bonds. Like letters of credit, surety bonds make the issuer liable in the event the owner-operator is unable to satisfy its obligations. However, surety bonds feature a "sinking" fund, or annual re-payments of the principal to the bond issuer. These payments are deposited in a trust until the coverage period (the post-closure period) ends. Because of the annual installments made to the sinking fund, surety bonds typically do not require as much collateral as letters of credit. In practice, the use of

a sinking fund requires an ability to demonstrate significant cash flow. As a result, surety bonds will only be available to landfills that are many years from closure. As in the case of letters of credit, the surety can cancel the bond by providing 120 days notice of cancellation.

Insurance. Financial responsibility can be demonstrated through purchase of an insurance policy with a face value equal to the total level of required coverage. The insurer is liable for the full amount and, significantly, is prohibited from terminating or failing to renew the policy unless the owner-operator fails to pay its annual premiums. In addition, the law requires insurers to transfer the policy to any successor owners or operators.

The alternative mechanisms differ in important respects. The fact that letters of credit and surety bonds can be withdrawn by their issuers raises the possibility that financial assurance may not exist when an environmental loss is detected and remedial actions ordered. Similarly, the trust fund mechanism does not provide full financial assurance until the end of the landfill's operating lifetime. By contrast, the insurance mechanism requires a guarantee of lifetime coverage at the time a policy is purchased. Below, firm investment decisions are modeled under three different scenarios: no financial responsibility requirement, financial responsibility fulfilled via the insurance mechanism, and financial responsibility satisfied via a trust fund. This analysis allows for both a normative comparison of the different financial mechanisms and a descriptive analysis of strategic firm responses to the mechanisms.

3.3 A Model of Landfill Safety, Startup and Closure Decisions

The model below more formally describes landfill owners' startup, closure and safety decisions in three alternative regulatory environments. First firm decisions are modeled given no financial responsibility requirement. Then compliance with financial responsibility is imposed. In the first case with financial responsibility the requirement that must be satisfied via the purchase of insurance. In the second, firms can comply through the demonstration of a trust fund. In practice, firms are allowed to choose whichever mechanism they prefer. By isolating decisions under the specific mechanisms, however, it becomes clear that the insurance mechanism requires a greater level of cost internalization. As a consequence, firms are likely to comply via other means. This weakens the deterrent value of financial responsibility.

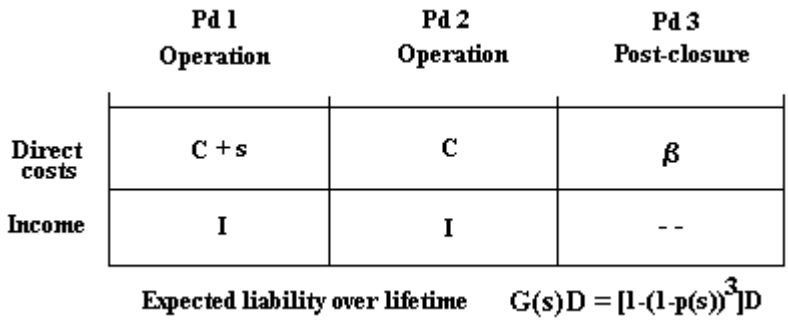
To capture the possibility of premature closure, the model features two periods of operation in which waste can be accepted and revenues earned. These periods are followed by a post-closure period. For notational simplicity, a zero discount rate is assumed.

The model employs the following notation. Let

I	=	expected income per period
C	=	operating costs per period

β	=	expected closure and post-closure costs
D	=	damages incurred due to remedial action
s	=	safety investment
$p(s)$	=	the per-period probability of a remedial action
A	=	the value of assets recoverable in the event of liability

Landfill operation entails the risk of environmental damage. If damage occurs, the firm is liable, i.e. required to undertake remedial action to restore soil or groundwater quality. To reduce the likelihood of environmental damage (and its own liability), the firm can invest in safety s. The probability of a loss $p(\cdot)$, is decreasing in s. The probability of a loss is $p(\cdot)$ in each period, but once a loss has occurred and remedial requirements satisfied, it is assumed that no further loss can occur.[29] Denote the probability of a loss occurring at some time during the three periods as $G(s)$. A loss, if it occurs, creates a social cost D, the costs of remediation and compensation to injured third parties.



The figure describes the costs and income associated with operation in the three periods. In each period the firm operates it earns revenue I and has operating costs C.[30] Following operation, the landfill requires closure and post-closure care at a cost β. Closure costs are assumed to be independent of the number of periods the firm operates.

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[29] This is a simplifying assumption. It is more realistic to assume that, given remediation due to a past loss, the probability of future losses is positive, but lower than $p(s)$. However, the assumption that the subsequent liability is zero significantly simplifies the notation and does not affect the analysis' qualitative results.

The cumulative probability of a loss over the three periods, denoted $G(s)$ can be represented by a geometric probability distribution. Specifically, $G(s) = [1-(1-p(s))^3]$. The probability of a loss in period 1 is p, the probability of a loss in period 2, given no loss in period 1 is $p(1-p)$ and the probability of a loss in the post-closure period 3, given no loss in periods 1 and 2 is $p(1-p)^2$.

[30] The assumption that income I is fixed in each period is reasonable if the costs β and D are not very sensitive to the number of units of waste disposed at the facility. The price and quantity of disposal set by the owner-operator is in this case independent of the "fixed" costs β and D.

A denotes the value of assets that can be recovered by plaintiffs in the event that the owner-operator is liable. Recoverable value is most likely to come from the salvage value of relatively immobile capital assets such as machinery. Cash assets may not be recoverable since they can be dissipated in anticipation of liability. *A* is equal to zero if, knowing it will soon be liable for environmental damages, the firm is able to convert or sell its assets, distribute the value to the firms owners and dissolve. So profit of $I - C$ earned in period 1 will not necessarily increase the firm's assets in period 2. Also, the recoverable value of land on which a landfill is located is probably close to zero in the event of environmental contamination. Therefore, the value of real estate holdings in general will not contribute to *A*.

The point in time at which environmental costs arise is particularly important to the firm's operation and closure decisions. The model is designed to capture the possibility that, for instance, the firm will be insolvent in the event that environmental damage occurs in period 1. A firm is insolvent if its current and future value is exceeded by its liabilities.[31] More specifically, if current assets and future income are less than future operating, closure, and liability costs, the firm is rendered insolvent and will cease operation.

The efficient safety investment. Safety investments are efficient if they minimize the combined costs of risk avoidance *s* and expected environmental damage $G(s)D$. Denote the efficient safety investment s*, where s* solves

$$\min_{s} \quad s + G(s)D. \tag{1}$$

As will be shown, whether or not the firm invests up to the efficient level depends on the firm's assets and future earnings and on the type of mechanism by which the owner-operator is able to demonstrate financial responsibility.

3.4 Safety and Operation Decisions in the Absence of Financial Responsibility

To illustrate the potential inefficiencies that can arise in the absence of financial responsibility requirements, first consider the financial condition of a firm given an environmental damage arising in period 1. Given the need to satisfy damages *D* in period 1, the firm is insolvent -- unable to satisfy its liabilities -- if the future value of operation plus the value of its assets is less than *D*. Recalling that the net value of operation in period 2 is $(I - C)$, a period 1 environmental problem results in insolvency whenever

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[31] For a more general treatment of conditions which determine bankruptcy than is offered here see Bulow and Shoven (1978).

$$(I\text{-}C) + A < D \; . \qquad (2)$$

Rearranging, a firm with assets such that

$$A < D - (I - C)$$

expects to be insolvent if a loss occurs during period 1. In the event of a period 1 loss and bankruptcy, the firm loses the value of period 2 operation (I- C) and externalizes costs equal to (D + β) - A.

Now consider the impact of potential insolvency on the firm's incentive to invest in safety. While the firm wishes to avoid a period 1 loss in order to capture (I- C) in period 2, its insolvency in the event of a loss in any period means that it will not fully internalize environmental costs. With probability $G(\cdot)$ -- the cumulative probability of a loss in any of the three periods -- the firm loses its assets A. If no loss occurs over the landfill's lifetime, the firm bears only the post-closure costs β.[32] Thus, the firm picks s to minimize

$$s + G(s)(A\text{-}\beta) + p(s)(I\text{-}C) \; . \qquad (3)$$

The second term represents the firm's expected liability in excess of the guaranteed post-closure costs β. The second term reflects the possibility of foregone period 2 profits due to insolvency in the event of a period 1 loss.

Comparing (3) to (1) implies that the firm's profit-maximizing safety choice is suboptimal.[33] Being under-capitalized, the firm does not expect to bear the full expected costs its operations can create and, as a result, it has insufficient incentive to avoid risks.

Also, in the above example, the firm externalizes an expected social cost $G(s)(D + \beta - A)$. A consequence of this externality is that landfills with negative net social value may operate. If owner-operators can extract profits in the short term, then landfills might be opened whose long-term social costs exceed their benefits.

3.5 Financial Responsibility Satisfied via the Insurance Mechanism

Now consider the incentives created by financial responsibility requirements. In particular, consider compliance satisfied via the insurance mechanism. Let the firm be undercapitalized, so that $D > A$. And assume that the financial responsibility requirement mandates coverage of D + β (coverage for post-closure care and any remedial liabilities). The insurer's expected liability in providing this

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[32] It is assumed, without loss of generality, that the firm's assets are at least as great as the costs of post-closure care ($A \geq \beta$).

[33] Since condition (2) holds, we know that $[(A\text{-}\beta)+(I\text{-}C)] < D$. Thus, $G(s)[(A\text{-}\beta)+(I\text{-}C)] < G(s)D$. And since $p(s) < G(s)$, (3) implies a smaller cost minimizing safety investment than (1).

amount of coverage depends on the likelihood of a loss *D*. This likelihood is a function of the landfill's safety.

If insurance markets are competitive, premiums will be actuarially fair (equal to the insurer's expected loss). Over the landfill's lifetime, then, premiums of $G(s)D + \beta$ will be collected. Thus, the actuarially fair per-period premium is $\frac{G(s)D+\beta}{2}$.

It is significant that the insurer, rather than the owner-operator, is liable in the event of an environmental loss. This means that the decision to operate the landfill is independent of whether or not -- or when -- a loss occurs. Consider the firm's operation decision if there is a loss in period 1. Because the insurer is liable, the firm's liability is simply equal to its period 2 insurance premium. As long as period 2 profits exceed the premium, the firm will not be insolvent. Bankruptcy would occur only if

$$(I\text{-}C) < \frac{G(s)D+\beta}{2}. \qquad (4)$$

But this is impossible, since the firm was faced with the same condition before period 1. Given that the firm chose to operate in period 1, condition (4) cannot hold.

If premiums can be conditioned on firm safety attributes, the firm has an incentive to invest in the level of safety that minimizes the cost of safety expenditures and its aggregate premiums. Given that full financial responsibility is required, and premiums are actuarially fair, firms are led to make the efficient safety investment, as in (1).

Also, with a full insurance requirement, it follows that the social benefits of operation are guaranteed to be greater than the total expected social costs of operation. Thus, there is an efficient level of entry.

3.6 Compliance via the Trust Fund Mechanism

The trust fund mechanism, as described in the previous section, requires annual payments into trust that build up to the full level of responsibility over the landfill's operating lifetime. Importantly, the schedule of payments implies that the fund's balance does not fully accrue until the final operating period. If a loss occurs before the end of this pay-in period, the trust's value may be insufficient to cover existing remediation and closure costs. Thus, the trust fund mechanism does not eliminate the possibility of bankruptcy. For this reason, the trust fund mechanism can fail to induce efficient operation decisions and investments in landfill safety.

Assume that the fund requires a final accrued balance of $(D + \beta)$. If achieved, this level of financial responsibility allows for the full internalization of post-closure and remedial action costs. Any

remaining balance is returned to the firm following the post-closure period. Since the model involves two operating periods, the firm is required to make payments of $(D + \beta)/2$ per period.

As in the previous examples it is necessary to consider the possibility of bankruptcy. In the event of a loss in period 1, the firm will be bankrupt if the value of its period 2 net profit and assets is less than its liabilities, or if

$$(I\text{-}C) + A < \frac{D+\beta}{2} . \qquad (5)$$

The firm's liabilities are $(D + \beta)/2$ since an equal payment was made at the beginning of period 1. Note that bankruptcy after period 1 is a possibility and that if it occurs there is an externalized cost $(D + \beta)/2 - A$. This means the firm's investment in safety will be inefficiently low. However, the trust fund mechanism leads to greater safety investment than if there was no financial responsibility requirement at all.

Early payments into the trust fund (in this example, the period 1 payment) reduce the potential externality that can be created by an insolvent owner-operator. Recall that without financial responsibility, the firm externalizes an expected cost $G(s)(D + \beta - A)$. With a trust fund, the firm externalizes an expected cost $p(s)[(D+ \beta)/2 - A]$, which is clearly less. While the possibility that costs will be externalized means that operations with negative net social value can still exist, the externality is lower with the trust fund mechanism than in the absence of financial responsibility. Of course, the insurance mechanism externalizes no costs and is therefore clearly preferable since it leads to efficient safety investments and guarantees that only operations with positive net social value will exist.

The analysis in this section illustrates the desirability of financial responsibility requirements, and in particular the desirability of fully-funded responsibility at the time of a landfill's startup. It should be emphasized that the analysis assumed financial responsibility for both closure costs and potential remedial actions D. Current Subtitle D regulations, however, require financial responsibility for the remedial component of costs only after an environmental loss has been detected and remediation ordered. This is equivalent to requiring drivers to purchase liability insurance only after they are involved in a collision. Defining financial responsibility in this way does not prevent a landfill owner-operator's insolvency and the corresponding inefficiencies suggested by the model. Once a loss occurs, the landfill may have only a limited number of years of operation left. Thus, the firm's ability to finance remediation (its financial responsibility) through future cash flow may be limited. Clearly, requiring financial assurance for a known remedial event may be impossible if the landfill is near the end of its operating period.

While not treated specifically, the model also suggests that the letter of credit and surety bond mechanisms do not guarantee efficiency. Even if coverage is required for both possible remedial events and post-closure costs, the fact that financial assurance can be withdrawn by the lender or surety means that an owner-operator may not be in compliance at some point during the landfill's operation. In fact, if the landfill's underwriters expect a future environmental problem they may have an incentive to withdraw coverage. This makes it more likely that the firm will be unable to cover its environmental costs in the event a remedial action is required.

The full benefits of financial responsibility are achieved only by mechanisms which (1) require coverage for all possible environmental costs, and (2) require coverage that cannot be withdrawn until the end of the lifetime coverage period. These requirements are currently not reflected in the law.

4. DIFFICULTIES POSED BY RETROACTIVE LIABILITY

Financial responsibility acts as a complement to the regulation of "prospective" environmental hazards. But much environmental regulation has a "retrospective" aspect, as well. Retrospective environmental problems complicate the implementation and effects of financial responsibility.

4.1 Retroactive Liability

Environmental regulation has been marked in recent years by a broad set of reforms. Broadly, these reforms have addressed two distinct social problems: how to better deter future pollution and how to deal with existing pollution that has accumulated over decades of relatively unregulated environmental activity. Retroactive liability arises out of the need to assign responsibility for pollution costs that already exist. Firms that in a technical sense polluted legally in the past are nevertheless responsible for the costs of that pollution in the present. Thus, many regulated firms face both historic (existing) and prospective (uncertain) environmental risks.

Financial responsibility is a policy tool geared toward prospective deterrence. It leads to cost internalization which fosters more efficient investments in precaution. Financial responsibility is not an appropriate tool to foster the cleanup of existing environmental problems. In fact, the failure of regulation to account for the interaction between financial responsibility rules and retroactive liability accounts for several problems associated with financial responsibility regulations. For instance, a common complaint from firms that must comply with financial responsibility rules is that pollution coverage is simply not available.[34] A reason for this lack of coverage is that insurers expose their own assets to retroactive liability when they underwrite prospective liabilities.

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[34] See General Accounting Office (1994).

In general, retroactive liability increases the costs of demonstrating prospective financially responsibility, as when it increases the expected liabilities of third party insurers. It also increases costs when firms self-insure by consuming assets that otherwise could be used as collateral against future liabilities.[35]

Also, financial responsibility rules do nothing to promote the cleanup of existing environmental problems. Firms with the capital to absorb existing risks are already "financially responsible." Firms without adequate capital have no incentive to demand -- and capital providers have no incentive to supply -- coverage for existing costs. Firms with existing costs want to externalize as much of those costs as possible. And insurers or lenders certainly want to avoid exposing their capital to known liabilities.

Because retroactive liability imposes large --potentially bankrupting-- costs on the private sector, it may be difficult or impossible for smaller firms to comply with prospective financial responsibility rules. The result can be fierce political opposition to compliance with financial responsibility rules. Below is described the outcome of political opposition to financial responsibility for underground petroleum storage tanks (USTs). Opposition has led to the creation of public liability funds that mimic, but ultimately undermine, the goals of financial responsibility. Failure to distinguish between the goals of cleaning up existing pollution and deterring future pollution has led to a decidedly undesirable means of regulating UST risks.

4.2 UST Regulation

Regulations governing the use of USTs are a central component of RCRA. In addition to monitoring, construction, and technical requirements, RCRA requires the owners and operators of USTs to demonstrate financial responsibility for tank leaks. Specifically, RCRA requires financial responsibility for remediation and third party liability costs through insurance or some other form of collateral in an amount typically exceeding $1 million for each tank system. USTs are a technology for which financial responsibility is particularly desirable. The costs of tank leaks can easily dwarf a typical gas station or distributor's ability to bear such liabilities. Tanks are frequently owned by small

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[35] Retroactive liability can be inefficient, since making firms responsible for historic liability costs can actually weaken the incentive to take precautions against future environmental costs. The retroactive application of liability yields no deterrence-related benefit. The decisions that led to the existing liabilities were made years or decades earlier. Also, retroactive responsibility for accumulated environmental costs reduces firm asset values. As a consequence, retroactive liability reduces the value that firms seek to protect from future environmental costs. This can reduce the incentive to guard against the occurrence of future costs, see Boyd and Kunreuther (1996).

businesses (from farmers to "mom and pop" service stations) and liabilities can range up to millions of dollars.[36] It is in just this type of situation that liability is most likely to fail as an effective deterrent.

The other important distinguishing feature of UST regulation is that many tanks have been slowly leaking for decades. Thus, RCRA financial responsibility rules have taken effect alongside the discovery of huge existing liabilities.[37] The result has been intense opposition to UST financial responsibility rules, particularly from small business owners.[38] In response to opposition, the states and the EPA have chosen to allow "state guarantee funds" (SGFs) to help UST owners comply with RCRA's financial responsibility rules. Forty three states now have SGFs. The typical fund is financed through a flat tax on gasoline sales or deliveries and are therefore a form of publicly-funded financial responsibility. At least two-thirds of all UST cleanup is paid for with public money.[39] Importantly, the SGFs provide coverage for both historic and prospective environmental hazards.

SGFs are the political consequence of RCRA's failure to account for the huge impact of retroactive liability on small firms. While public financing is an economically defensible and perhaps desirable way to finance the cost of retroactive liabilities,[40] it is a particularly undesirable form of

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[36] In 1984 Exxon paid an out-of-court settlement to residents of East Meadow, New York of between $5 and $10 million to settle a leaking UST claim, while Chevron paid about $10-$12 million to avoid a similar suit in Northglenn, Colorado. Also, in Maryland a 1990 sample of ten sites calculated a per-site cleanup average of $710,000. This includes $3,000,000 in costs associated with the restoration of one community's water line. See "Report of the Governor's Task Force on Underground Storage Tanks," State of Maryland, 1990.

[37] USTs are the most common method of petroleum storage for fuel distributors, municipalities, large firms, or any other organization which stores large amounts of fuel. There are approximately 1.4 million such tanks in the United States and Environmental Protection Agency estimates of the fraction leaking have been as high as 35%. To date, there have been 185,000 confirmed releases. The total cost of UST remediation is expected to be between $30 and $40 billion. See "USTs: A Busy Decade Ahead," *Environment Times*, November 1992, p. 31 or "The Underground Storage Tank Market: Its Current Status and Future Challenges" Environmental Information Ltd., Minneapolis, MN.

[38] Contributing to opposition was a front page article in the *New York Times* with the headline "Fuel-Leak Rules May Hasten End of Mom and Pop Service Stations," that included an estimate by the American Petroleum Institute that the rules would force the closure of 25% of the nation's service stations (*The New York Times*, June 19, 1989:A1). Around the same time, Congress backed off of its original mandate to the EPA. Witness the comment by one representative that "It is the small- and medium-sized businesses which will be unable to meet the requirements and, in some cases, will be forced completely out of business ... some action may have to be taken by the EPA, and some action may have to be taken by Congress ... I am not going to just sit around and watch the small businesses be legislated out of business by the Federal Government" (Representative Richard Ray, Nov. 18, 1987, Hearing before the House Committee on Small Business Subcommittee on Energy and Agriculture, Y4.Sm1/2:S.hrg.101-690).

[39] *Environment Reporter* 12/25/92, p. 2091.

[40] Guarantee funds, by absolving firms of historic liabilities, allow for remediation of existing contamination without reducing the firm's value. Firm left with greater value have a greater incentive to take efficient

prospective financial responsibility. By subsidizing private environmental costs SGFs undermine deterrence. Instead of internalizing future environmental costs as financial responsibility is meant to do, SGFs externalize future costs and thereby blunt the incentive to reduce environmental risks.

5. CONCLUSION

Financial responsibility rules resolve the principle weakness of liability-based forms of environmental regulation: specifically, that defendants will not be legally available or financially able to bear the judgments imposed upon them. Because liability and financial responsibility promote cost internalization, they create a powerful form of incentive-based regulation. With the knowledge that costs will be internalized, potential polluters have a clear economic incentive to take appropriate precautions against environmental damage. Moreover, this method of regulation affords firms the flexibility to reduce risks in the ways they best see fit and reduces the need for continuous governmental monitoring of technology adoption or other types of firm behavior.

While financial responsibility rules hold great promise, analysis of their present implementation reveals weaknesses. First, firms can continue to externalize environmental costs due to loopholes associated with allowed mechanisms for compliance. Clearly, it is desirable to allow a variety of means for compliance with financial responsibility rules. Variety allows for compliance to occur at the least cost and may foster a profusion of new financial market products to provide risk coverage and assessment. But, as discussed in section 3, variety is accompanied by inconsistency in the degree to which the mechanisms demand cost internalization over the life of a firm's activities. For instance, the insurance mechanism ensures full cost internalization from the time the firm begins operation. In contrast, trust funds ensure full cost internalization only after a period of years or even decades. Because financial responsibility can be costly for firms to demonstrate, the ability to minimize these costs will always be appealing. The most direct way to minimize the costs of financial responsibility is to use a method of compliance that externalizes as much risk as possible. Only a consistent statutory commitment to financial mechanisms that promote total cost internalization will guarantee that the full promise of this form of regulation is fulfilled.

It is also important to understand the political consequences of financial responsibility rules, particularly the way in which they affect small businesses. Financial responsibility is relatively harder (more costly) for small firms to demonstrate. The larger the firm, the more likely it is that self-insurance, or a corporate parent's assets, can be used to comply. For large firms, compliance with financial responsibility may involve little more than the preparation of audited financial statements.

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prospective risk reduction measures, assuming that they are prospectively liable and have to demonstrate privately-provided financial responsibility.

Small firms, by definition, cannot self-insure and so must pay for the involvement of a third-party insurance or capital provider. This is costly for several reasons. A small firm must compensate the third party for the "actuarial" cost of the third party's exposure to liability plus the coverage's "load," or markup. In addition, the firm is required to participate in risk assessments, paperwork, and a set of transactions with which it may be unfamiliar. Smaller firms consequently find it harder to comply with financial responsibility rules and may in fact be forced to cease operation (GAO, 1994).[41]

This burden, particularly if faced by a large number of affected businesses, can generate significant political opposition, as in the case of the UST program. In contrast, there has been relatively little political opposition to financial responsibility from the industry regulated under the Oil Pollution Act. This is due, at least in part, to the relative ease with which large oil and shipping firms can self-insure.[42] When small-firm opposition is particularly strong, compromise solutions --such as the publicly-financed state funds used for UST compliance-- should be resisted because they undermine the incentives for precaution toward which financial responsibility is geared.

Despite the political difficulties, meaningful financial responsibility compliance for small firms is an important goal. After all, the social benefits of financial responsibility are likely to be greatest when applied to small firms. Perhaps the most important step that can be taken to promote financial responsibility is to provide third-party coverage providers with immunity from the retroactive liabilities of the firms they underwrite. Without this immunity, third-party insurance providers will either avoid the financial responsibility market altogether, or raise the price of coverage in order to compensate for the risk of inheriting retroactive liabilities. In either case, the ability of small firms to acquire financial responsibility coverage at actuarially fair rates is undermined. Thus, guaranteeing underwriter immunity from the retroactive liability of covered parties is an important means to promote the prospective, deterrence-related benefits of financial responsibility rules.

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[41] In a survey of pollution insurance availability, the GAO found serious compliance difficulties for small firms. And, not surprisingly, the survey also found that "smaller companies were more likely to cite the difficulty of meeting the act's financial requirements as the reason for closing than larger companies."

[42] The oil and gas industry has seen the formation of "mutual" insurance companies to help spread risk among the relatively deep-pocketed members of this industry (Crow and Knott, 1994).

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