Retroactive Liability and Future Risk: The Optimal Regulation of Underground Storage Tanks

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Abstract

The optimal design of environmental liability policy focuses on two primary policy issues: the cleanup of existing sources of pollution and the definition and enforcement of policies to promote prospectively efficient environmental risk reduction. Through the analysis of a policy toward a pervasive environmental risk -- leaking underground storage tanks -- we analyze the effectiveness of an existing policy governing retroactive and prospective liability issues and suggest ways in which that policy can be improved. While we find some theoretical support for the public financing of UST cleanups, we also find the current system to be flawed in its implementation. In general, the paper argues that public financing of past pollution cleanup costs can lead to greater future risk deterrence by allowing firms to more fully internalize the costs of future environmental risks. However, if it is practically or politically impossible to limit public financing to retroactive liabilities alone, the deterrent effect of such a system is vastly reduced.

Key Words: liability, underground storage tanks

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1. INTRODUCTION

Over the past decade, the scope of U.S. environmental policy has expanded to confront both the need to clean up existing pollution sources and the need to strengthen the incentives for precaution against future environmental risks. This paper evaluates current and potential policies governing a particularly pervasive environmental risk -- leaking underground storage tanks (USTs).[1] Because of the belated recognition of the environmental risk posed by USTs, there has been a need to deal with a retrospective environmental problem, as well as the prospective need to deter future environmental problems. In part, this paper addresses the question of whether liability for past pollution should be retroactively applied to polluters or if some fraction of the costs of cleaning up existing pollution should be financed by the public.

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[1] 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.

The social costs of such leaks are primarily associated with groundwater contamination. The average release is estimated at 600-700 gallons, and 21% of tanks are known to be installed partly or completely under the water table. ("Underground Motor Fuel Storage Tanks: A National Survey" EPA 560/5-86-013, May 1986.) EPA data shows that during 1993 alone, 453,000 gallons of petroleum products were recovered from the groundwater table (*Environment Reporter*, January 14, 1994). Over one half of the United States' population relies on groundwater for drinking (Blodgett and Copeland, 1985) and releases of the size commonly detected are more than enough to dangerously contaminate a population's water supply (Miller and Taylor, 1985).

Current U.S. environmental policy is not consistent in its answer to this question. For instance, under CERCLA and related law the presumption is that the "polluter should pay," irrespective of whether the pollution occurred a decade ago, or has yet to occur. In contrast, current UST policies finance the cleanup of past, and in some cases future cleanups, with public tax revenues.

This paper argues that the assignment of responsibility for retroactive liabilities is not a purely distributional issue. In fact, as we show, the way in which *past* liabilities are treated affects the incentives for *future* risk reduction. To the extent that liability for past pollution weakens a firm's financial condition, it can reduce the incentive to make prospective risk-reduction investments. Firms with assets eroded by retroactive liability may not expect to fully internalize future liability costs. In turn, liability for future pollution can fail as an effective deterrent against future risks. The benefit of public financing for retroactive liabilities, then, is that it may preserve the economic viability of future polluters and hence promote prospective deterrence.

However, there are also clear drawbacks to the public financing of liabilities. These arise primarily because public financing schemes do not in practice draw a clear enough line between retroactive and prospective environmental damages. For example, we argue that the current system of public financing for UST cleanups, the "state guarantee funds" (SGFs), weakens incentives for prospective risk reduction. Public financing of future pollution costs is particularly undesirable since it leads to private costs of pollution that are less than the social costs and thus weakens the incentive of firms to make efficient risk reducing investments. Our suggestion is to utilize SGFs only for past cleanup and institute a system of financial responsibility (via private insurance) for the future.

These policy issues are of particular relevance in the case of USTs. First, belated recognition of the environmental hazards posed by USTs has meant that retroactive liability issues are present. Second, USTs are often owned and operated by firms with assets that are small relative to the potential costs created by a leaking tank. And third, states and the federal government are pursuing a unique set of policies for treating both retroactive and prospective UST risks.

By analyzing the connection between retrospective and prospective liability our analysis provides guidance for other areas of policy where such issues arise (most notably Superfund liability). In addition, the analysis of current UST policy reveals a set of practical problems that attend any attempt to separate past and future responsibility for environmental hazards. The analysis proceeds as follows. Section 2 provides a brief overview of UST policy and the economic issues surrounding policy design. Section 3 presents a model of remediation and future risk reduction to motivate the central conceptual results of the paper. An analysis of current SGF programs is offered in Section 4 to underscore some of the paper's central results and to provide suggestions for improvements in policy toward USTs.

2. CURRENT UST POLICY

Regulations governing the use of USTs are a central component of the Resource Conservation and Recovery Act (RCRA). Since 1984, when the first UST amendments to RCRA were enacted, state and federal approaches to the environmental risks posed by USTs have undergone a significant evolution. Two of the more important aspects of the existing program are the requirement that UST owner/operators demonstrate financial responsibility and the development of state guarantee funds (SGFs) to help them meet this need.

RCRA requires UST owners to demonstrate financial responsibility for corrective action and liability occurrence, through insurance or some other form of collateral in an amount typically exceeding $1 million for each tank system.[2] However, because of the large number of tanks already known to be leaking, RCRA effectively required insurance for an uninsurable risk.

Primarily in response to political opposition, the EPA now allows SGFs, financed through gasoline sales taxes or annual fees, to provide tank owners with the coverage required by RCRA.[3] In addition, the EPA has created a phased-in compliance schedule allowing smaller firms to put off financial responsibility and compliance with a set of technical standards governing installations, monitoring, and tank system materials. Current compliance deadlines for all firm have been extended to 1999.

Liability Rules

In recent years strict environmental liability has been increasingly promulgated through

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[2] This requirement applies to any tank system operator dispensing 10,000 or more gallons per month. Smaller volume operators are required to have at least $500,000 in collateral (Hayward, 1994).

[3] RCRA's financial responsibility requirements have been perceived as a particularly onerous regulatory requirement. 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).

statute and the common law.[4] In theory, strict liability places the burden of environmental costs on the pollution generator, thus forcing the polluter to internalize the costs of the environmental damage they create. With these costs internalized, producers are more likely to efficiently reduce risk. Strict liability fails to create this beneficial incentive, however, when the producer is unable to meet the financial obligations implied by its liability.[5] 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. Moreover, injured parties will be inadequately compensated in the event of a defendant's bankruptcy. This possibility creates the motivation for financial responsibility requirements (FRRs).[6]

USTs are a technology for which FRRs are particularly desirable. The reason is that the social costs of tank leaks can easily dwarf a typical gas station or distributor's ability to bear such liabilities, which can range up to millions of dollars.[7] For instance, a small "mom and pop" gas station does not expect to bear the full costs of a large tank leak since because they

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[4] See Landes and Posner (1987) for a history of the development and justifications for the theory of strict liability. Strict environmental liability is also mandated by statute, as in the Superfund amendments.

[5] Insolvency truncates the penalties that are borne by tort defendants, since liabilities are dischargeable debts in bankruptcy. For analyses which explore or employ this idea see Schwartz (1985), Shavell (1986), and Boyd and Ingberman (1994).

[6] Mandatory automobile insurance is desirable for the same reasons. With required insurance, drivers pay premiums based on their driving record. This creates an incentive to take more care in driving. Also, insurance provides compensation for parties injured due to unsafe vehicle operation.

[7] 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.

expect to be bankrupted well before the full settlement of claims against them.

The SGFs

Forty three of these funds currently exist, with most earmarked for the remediation of existing tank pollution sources or for the payment of future liability claims. Under a typical plan, the fund is financed through flat rate taxes on gasoline sales or deliveries -- ranging from .1 to 2 cents a gallon. Alternatively, annual operator fees (between $25 to $200) are required. The SGFs vary in the types of cleanup and third party costs that are covered, the levels of coverage, and deductibles that apply. Others provide low-interest loans for tank upgrades.

For the purpose of evaluating existing UST regulations, we draw a distinction between a strict and retroactive system of liability with FRRs -- which holds owners liable for all existing and potential future pollution costs -- and an SGF-based system, which provides state money for coverage of some fraction of pollution costs. The former system is akin to the FRRs originally proposed under RCRA, the latter to the current system.

Strict retroactive liability and FRRs combined with actuarial estimates place the average cost of cleanups and financial responsibility at between $60,000 and $100,000 per tank.[8] Comparing this figure to the gross annual revenues for retail gas outlets, which can be as low as $25,000, the magnitude of the distributional impact on the industry becomes clear.[9] Had the original FRRs been strictly enforced, many operators would have been unable to find insurance or bear the full costs of site remediation.

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[8] *Environmental Information Digest*, August 1993, p. 16.

[9] The EPA considers annual profits of less than $15,000 a "hardship factor" that allows the firm to delay FRR and technical compliance deadlines.

In general FRRs, where firms must bear the costs of any future liabilities with their own resources or via private insurance coverage, provide an incentive for firms to upgrade tanks and mitigate existing pollution sources. The reason is that insurance for non-state of the art tanks or for sites with existing contamination either is not available or will cost the firm more than if the firm makes investments in greater tank safety. This type of incentive reduces the need for government inspection and enforcement of technical standards.

In order for firms to reduce their insurance premiums, they are induced to make efficient safety investments on their own rather than being forced to do so by the government. Correspondingly, it is in the best interest of insurers to verify and monitor the technical compliance of those operators they underwrite. This market-based enforcement mechanism promotes tank safety -- without direct EPA intervention except to verify compliance with the FRR -- through experience-rated premiums, coverage that can be denied, and insurers who can exchange information on firms that fail to comply with standards.[10]

In contrast, the state SGFs are less likely to have these desirable incentive effects. Since liabilities are covered by the funds, rather than by a private insurer, and since a flat tax is charged, rather than a true insurance (risk-based) premium, the incentives for monitoring and technical upgrade provided by premium levels and possible withdrawal of coverage in a private insurance system are not present with a state fund system.

In the next section we explore RCRA's impact on the cleanup of existing pollution, the

[10] Note that this same reasoning underlies the use of automobile insurance requirements. Drivers have an incentive to exercise care in driving in order to reduce their premiums. And insurance can be withheld from particularly unsafe drivers.

incentive to reveal information regarding existing problems, and the deterrence of future pollution.

3. ANALYSIS OF RETROACTIVE LIABILITY, GUARANTEE FUNDS, AND FINANCIAL RESPONSIBILITY

Our analysis focuses on two broad policy questions: First, what policies best motivate efficient, prospective investment in UST safety? And second, what policies best motivate the timely cleanup of existing pollution sources? We consider three categories of policy, strict retroactive liability, short-horizon guarantee funds, and long-horizon guarantee funds; the latter being most descriptive of current policy toward USTs.

A. Assumptions and Notation

To analyze the problem more formally, consider a model with a temporal structure involving three periods, t = -1, 0, 1, corresponding respectively to the past, current, and future periods.

D_{-1} = the social costs of an existing leak given remediation at $t = 0$

$D_{-1,1}$ = the social costs of an existing leak that is unremediated until $t = 1$

D_1 = social costs of future leak given no contamination today

u = the cost of upgrading a tank system

r = the cost of remediating an existing leak

p_1^u = probability of a future leak given upgraded safety

p_1^n = probability of a future leak given non-upgraded safety

A = firm value

Assume that the costs of an unremediated leak increase over time, so that $D_{-1,1} > D_{-1}$.[11] For sites that have no contamination at t=0, a future pollution cost D_1 occurs with probability p_1^n if the firm does not upgrade its tank system and p_1^u if it does upgrade (where $p_1^n > p_1^u$).[12] We also assume that the total damage costs of not remediating an existing leak are greater than the costs of remediating an existing leak plus the costs of a future leak if it occurs ($D_{-1,1} > D_{-1} + D_1$). Thus, upgrading a tank known to be leaking is socially desirable relative to leaving a leaking tank unremediated.

A denotes the gross value of the firm, including the value of capital investments, real estate and expected future revenues. If the firm's liabilities exceed its value *A*, the firm is *insolvent* and will declare bankruptcy.[13] Also, if the firm's total expected costs, including expected liabilities, exceed *A*, the firm will cease operation and exit the market.

Given an existing leak, immediate, detection, remediation, and upgrade are efficient. Formally, this requires that

$$D_{-1,1} - [D_{-1} + p_1^u D_1] > u + r \tag{1}$$

or, the difference in expected environmental costs, given an existing leak, of not remediating and upgrading exceeds the costs of upgrade and remediation $u + r$. Also, assume upgrades are efficient even when there is no existing contamination. This implies that

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[11] Costs increase over time due to the migration of contaminants or overall increases in pollution levels that arise when a leaking tank is not repaired or removed.

[12] The primary cause of leaks is the corrosion of bare steel tanks, the second being the improper installation of piping. These risks are significantly reduced by investment in safer tank design (e.g. double-walled fiberglass vs. bare steel tanks), vapor or soil monitoring devices, and proper installation of piping and fittings.

[13] In general, tort claims are considered debts that can be discharged in either Chapter 7 or Chapter 11 bankruptcy proceedings.

$$(p_1^n - p_1^u)D_1 > u \tag{2}$$

B. Remediation Decisions under Strict, Retroactive Liability

Given strict retroactive liability, what are the firm's incentives to remediate existing pollution and upgrade tank systems? If a firm remains solvent given all potential liabilities, then strict liability creates the incentive to remediate and upgrade since the firm expects to bear the full costs of failing to do so. However, if the firm's assets A are sufficiently low then it will not bear the full social costs of its production if liabilities result in insolvency. Therefore, given potential liabilities, the possibility of insolvency can lead the firm to make inefficient risk reduction decisions.

Consider a firm that discovers historic liability at $t = 0$. Clearly, if $A < D_{-1}$, then the firm knows that it will have no recoverable value remaining after settling claims due to its existing liability. It therefore has no incentive to remediate. Even if $A > D_{-1}$, if it is also true that $A < D_{-1,1}$, the following is possible:

$$A - [D_{-1} + p_1^u D_1] < u + r\ . \tag{3}$$

If so, the increase in expected liability costs due to *not* remediating and upgrading is less than the costs of remediation and upgrade. Efficient remediation investments in this case will not be made because the firm will prefer to take its chances and become insolvent if a leak is discovered.

The firm's risk reduction decision is a function of its value. Let *large firms* be defined as those where $A \geq D_{-1} + D_1$. These firms have a clear strategy to remediate existing liabilities and upgrade tank systems since they expect to fully internalize the benefits and costs of cleanup and tank investment decisions. Define *small firms* as those with little or no value A. This type of firm has no incentive to remediate or upgrade, since the costs of doing so exceed the firm's value.

Medium-sized firms, those with values between the two extremes, may either upgrade or not, depending on whether or not the firm has historic liabilities.

The Decision To Upgrade Given Historic Liabilities

To explore the importance of historic liabilities to the firm's remediation and upgrade decision, we derive the firm value *A* that leaves and owner-operator indifferent between upgrading and not upgrading given (i) existing pollution and (ii) no public financing of cleanup (no SGF to cover the costs of past leaks).

First, note that the firm's costs if it does not remediate and upgrade are $\min\{D_{-1,1}, A\}$. Whenever $D_{-1,1} < A$, the firm has assets sufficient to internalize even the largest possible social cost $D_{-1,1}$ and so will upgrade (since upgrade is efficient). Therefore, only the case where the firm's expected costs are bounded by *A* is of interest.

In this case, the firm faces the following choice when deciding whether or not to remediate and upgrade. If it does not remediate, its costs are *A*. If it does remediate, expected costs are

$$EC^r = [D_{-1} + u + r] + [A - (D_{-1} + u + r)]\, p_1^u. \qquad (4)$$

The first term in brackets denotes retroactive liability, remediation, and upgrade costs. The second term reflects the firm's expected future liability. With probability p_1^u the firm loses the value remaining after expenditures during period t=0 are made.[14]

In making its remediation decision the firm compares its costs if it does not remediate, *A*,

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[14] The key point is that the firm's need to finance the expenditures D_{-1}, u, and r, reduces its value, either by requiring cash outlays or a stream of debt payments to creditors.

to EC^r and chooses the cost-minimizing strategy. This comparison implies that the firm will upgrade only if

$$A > D_{-1} + u + r. \qquad (5)$$

This is intuitive. The firm bears a cost *A* if it does not remediate. Therefore, remediation and upgrade occur only if their combined costs are less than *A*. Put differently, the firm knows that it will only remediate if it has assets remaining after incurring remediation costs. Note also that the condition expressed in equation (5) does not depend on the probability of a future leak, p_1^u. As long as condition (5) holds and there is some positive probability that there will be no future leak ($1 - p_1^u > 0$) there is a positive probability that the firm will face costs less than *A* by remediating and upgrading at t=0.

The asset value A^* which makes the firm indifferent between bearing these costs and not taking any action is $A^* = D_{-1} + u + r$.

The Decision to Upgrade Given No Historic Liability

For the case where no past leakage occurred, the firm still faces a decision as to whether or not to upgrade. Let A^{**} represent the level of assets where the firm is indifferent between upgrading or not. The indifference level is determined by substituting A^{**} for D_1 in (2) and setting the left-hand side of (2) equal to *u*, yielding

$$(p_1^n - p_1^u)A^{**} = u .$$

Whenever the firm's assets are below A^{**} it will prefer to not upgrade because the expected reduction in liability from this action is less than the cost of upgrading.[15]

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[15] Note that A^{**} is less than D_1.

In sum, the firm's decision to upgrade or not depends on both its value A and whether or not it believes it has historic liabilities. While it is philosophically appealing to "make the polluter pay" retroactively, doing so cannot correct inefficient, past decisions. If the goal of policy is to promote more efficient prospective cleanup and investment decisions, then retroactive liability is undesirable. When a firm pays for historic pollution problems some of its resources are consumed. This reduces the assets that can be lost to future liability claims. In this way, retroactive liability can weaken prospective deterrence. Thus, retroactive liability can have a negative effect on investments geared toward future safety. Since A^* is normally greater than A^{**}, more firms have an incentive *not* to remediate and upgrade when they have existing liabilities.[16] Of course, it is in just this situation that remediation and upgrades are most socially desirable.

C. Guarantee Funds and the Incentive to Remediate and Upgrade

We now turn to the way in which guarantee funds and financial responsibility requirements affect this link between retroactive liability and prospective deterrence.

As shown above, a policy of strict retroactive liability can discourage remediation and upgrading when historic liabilities exist and the firm is undervalued relative to its potential liabilities. The firm must either commit to a future stream of debt payments or, alternatively, liquidate capital assets in order to bear the costs of the existing liability. If the firm's remaining value is small enough that it will become insolvent in the event of a future tank failure, it will not

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[16] It is straightforward to show that $A^{**} < A^*$ whenever $D_{-1} > D_1$. We would normally expect this to be the case, since a tank that is upgraded and inspected regularly would create fewer environmental problems than one that has already leaked.

bear the full social costs of that failure and therefore will not upgrade its facilities.

From the standpoint of prospective efficiency, it is desirable to have firms fully internalize the costs of their production. Guarantee funds, by absolving firms of historic liabilities, allow for remediation of existing contamination without reducing the firm's value. Since the firm is left with greater value it has a greater incentive to take efficient prospective risk reduction measures -- such as upgrading a tank system.

Short- versus Long-Horizon Guarantee Funds

We consider two types of guarantee fund: a short-horizon guarantee fund (SHGF) provides coverage of liabilities incurred prior to t=0. After t=0, no coverage is provided and firms are strictly liable for future leaks. Long-horizon funds (LHGFs) differ only in the time-frame over which coverage is provided. Specifically, a long-horizon fund provides coverage for future, in addition to past, liabilities.

An SHGF is the optimal policy for firms with limited assets because it absolves such firms of existing liability costs and thus maximizes the incentive to make prospectively efficient risk reduction investments. More specifically consider firms with assets $A^{**} < A < A^{*}$. With an SHGF, these firms will be willing to remediate past leaks and upgrade at t=0 whereas they would not if forced to use their own assets.

What incentives are created by long-horizon funds? Like SHGFs, LHGFs absolve the firm of historic liability. However, because of the longer coverage horizon, LHGFs also subsidize the costs of cleanup for (1) leaks that occur during t=1 and (2) unremediated existing leaks. This subsidy of future cleanup costs weakens the incentive to upgrade and remediate at -t=0, since firms with clean properties at t=0 know they will not bear the full costs of future leaks.

Given LHGF coverage, firms may choose to not invest in the efficient risk reduction technology.

To illustrate this point, suppose that the LHGF pays for a fraction β of the liabilities from future tank leaks. Given β, a firm with no historic liability will upgrade only if

$$(1-\beta)\min[D_1,A]\,[p_1^{n}-p_1^{u}] > u \quad (6)$$

Note that as β approaches 1, the incentive to upgrade is entirely removed since the firm will not bear any expected liability costs. Thus, LHGF coverage weakens the incentive to make efficient prospective investments, whether or not historic liabilities exist.

The incentive problem created by LHGF coverage can be reduced or eliminated if guarantee funds for future leaks are made conditional on the firm having upgraded its tanks and having remediated existing contamination. It is crucial that both (1) compliance at t=0 be verifiable *ex post* and (2) that exclusion of coverage given failure to upgrade and remediate at t=0 be credible.

Consider the case where a firm with $A > D_1$ and no historic contamination believes there is a probability $0 < \gamma < 1$ that it will have coverage denied if it failed to upgrade. If the firm upgrades its expected costs are

$$p_1^{u}(1-\beta)D_1 + u, \quad (7)$$

or, the probability of a leak times its non-covered liability costs plus the cost of upgrade. If it does not upgrade, its expected costs are

$$p_1^{n}\,[\gamma D_1 + (1-\gamma)(1-\beta)D_1]. \quad (8)$$

These expected costs reflect the possibility that the firm will be provided with coverage even though it did not upgrade its system (which occurs with probability $(1-\gamma)$). Note that if $\gamma = 1$ (the regulator can perfectly exclude non-compliant firms from coverage), the firm expects not upgrading to be more costly than upgrading.[17]

Thus, the disincentive to efficient prospective investment created by an LHGF can be reduced if coverage is credibly conditioned on efficient investment decisions at t=0. If coverage cannot, or is not, conditioned in this way, LHGFs lead to strictly less efficient safety decisions than those that arise under a SHGF.

D. Financial Responsibility Requirements (FRRs) and Insurance

RCRA originally intended that "financial responsibility" requirements (FRRs) for UST owner-operators be satisfied through either self-insurance (i.e. sufficient assets to bear liability for tank leaks) or through the purchase of liability insurance from third-party providers. Set high enough, FRRs guarantee that firms fully internalize the costs of tank hazards and are thereby induced to make efficient safety investments. However, FRRs are not a desirable policy when firms are responsible for retroactive liabilities.

As shown below, FRRs combined with strict, retroactive liability will lead to less efficient safety investments than if an amnesty for retroactive liability were provided via a mechanism such as an SHGF. Moreover, an SHGF prevents the exit of firms that should remain in the market, but that would be forced to exit if liability were retroactive.

The Effect of FRRs Given No Historic Liability

To emphasize the desirability of FRRs that apply to prospective risks, consider firms with no historic liability and an FRR of F dollars, where $F \geq D_1$. Faced with the FRR, firms

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[17] Since $(p_1^n - p_1^u)D_1 > u$, by construction, it follows that $p_1^n D_1 > p_1^u(1-\beta)D_1 + u$.

will either self-insure (if $A > D_1$) or purchase insurance. If insurance is purchased, an actuarially fair insurer will charge a premium of $p_1^u D_1$ if the tank is upgraded and a premium $p_1^n D_1$ if it is not.

Self-insurance leads to the direct internalization of expected liability costs and therefore induces efficient investment decisions.[18] When the FRR is satisfied through third-party insurance, premiums that reflect actuarial risks motivate the same efficient investments. Private insurance firms are likely to base premiums on tank characteristics (i.e., whether they are upgraded or not) in order to avoid adverse selection problems. They may also engage in monitoring activities, such as measurement of tank inventory levels, to detect leaks early and minimize cleanup costs. For safety characteristics that are verifiable only ex post, such as maintenance, the insurance contract can be written so that failure to comply with underwriting conditions reduces or voids coverage.[19]

Note that the actuarial cost of meeting the FRR is $p_1^u D_1$. Thus, the FRR leads to the exit of firms from the market, but only when the value of the firm A is less than $p_1^u D_1$. In other words, a full financial responsibility requirement leads to the exit of firms whose value is less than the expected contamination costs associated with the operation. This is clearly efficient and implies that when historic liabilities are present, a short-horizon guarantee fund, combined with prospective financial responsibility, leads to efficient investment decisions and market exit behavior.

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[18] This follows from equation (2).

[19] Private insurers will tend to require compliance as a condition for coverage. In the terminology of the previous section, third-party insurers will structure contracts so that $\gamma = 1$.

The Effect of FRRs Given Retroactive Liabilities

FRRs that are applied to firms with existing liabilities can remove their incentive to remediate and upgrade and lead to the exit of firms that from the standpoint of prospective efficiency should remain in the market. To see this, consider full financial responsibility, which means $F \geq D_{-1} + D_1$ given that historic liabilities must be covered.

In the previous example, where no historic liability existed, any firm where $A \geq p_1^u D_1$ chose to remain in the market. An equivalent firm, but one with historic liability, is forced to exit the market by an FRR.[20] To see this, note financial responsibility implies that the firm bears the retroactive liability cost D_{-1} and the prospective liability premium $p_1^u D_{1.}$ Given the FRR, the firm will remediate and upgrade only if

$$A \geq D_{-1} + u + r + p_1^u D_1, \tag{9}$$

or if the firm's value exceeds the costs of retroactive liability, remediation, upgrade, and expected prospective liability. It follows that one consequence of FRRs which cover both future and retroactive liability is that they lead firms with assets A between $p_1^u D_1 < A < D_{-1} + u + r + p_1^u D_1$ to exit the market. However, these firms should remain in the market given the prospective benefits and costs of production. Moreover, when firms exit, they do not remediate and upgrade. The immediate effect of an FRR under strict retroactive liability is to reduce the number of firms that will remediate and upgrade.

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[20] The inability of firms to self-insure or purchase third-party coverage is largely responsible for the creation of the existing state guarantee funds. As mentioned in the introduction, RCRA's financial responsibility requirements generated political opposition, particularly from small owner-operators. As a result, a majority of the states opted for the funds we now see (LHGFs) in order to comply with RCRA's mandate.

In conclusion, the optimal policy response to a public or environmental safety concern where historic liabilities are present involves public provision of funds for the remediation of existing risks (an SHGF), combined with private financial responsibility to guarantee the internalization of future liabilities. This set of policies leads to efficient safety and remediation decisions and only forces the exit of firms whose value of continued production falls below their expected future contamination costs. In contrast, strict retroactive liability -- whether combined with FRRs or not -- can lead to distortions in both remediation and upgrade decisions. Equally undesirable is the long-horizon guarantee fund which provides coverage for both past and future liability. This policy weakens the incentive of firms to remediate in a timely manner and make prospectively efficient safety investments.

4. CONCLUSIONS AND IMPLICATIONS FOR EXISTING POLICY TOWARD USTs

The above analysis suggests that both state guarantee funds and private insurance have a role to play in the encouragement of efficient UST management. SGFs are ideally suited for the coverage of retroactive environmental problems, while private insurance should be used to meet RCRA's prospective financial responsibility requirements. More specifically, each state's UST program should offer amnesty from the costs of existing contamination up to some specified date. The SGF finances the cleanup of historic contamination and provides an incentive for the timely discovery and reporting of environmental problems. Beyond the date up to which SGF covers losses, the tank owner is liable and subject to financial responsibility requirements.

Under this type of system there is an incentive for private insurers to enter the market and provide prospective coverage against future leaks. Currently, however, private insurers have no incentive to enter the market in most states because the costs of SGF coverage is much lower than the premiums private insurers would have to charge.[21] The situation is ripe for change since almost all SGFs are experiencing financial difficulty and several have either become insolvent or have refused to process additional claims.

Consider the Michigan Underground Storage Tank Financial Assurance (MUSTFA) program which was adopted by the state legislature in 1988. Under this program UST owners are reimbursed for remediating contaminated sites and making payments to injured third parties. In addition, the program subsidizes loans for the replacement of leaking tanks. A fee of 7/8 of a cent per gallon of refined petroleum sold finances the program.

An audit of the MUSTFA program in 1993 found that during the first two years of the program total revenues were slightly less than $110 million and expenditures were approximately $250 million. A more detailed analysis of the program in 1995 projected that the existing claims would exceed available cash to pay claims by between $85 and $235 million dollars.[22] MUSTFA has subsequently announced that it has stopped accepting claims because the fund is insolvent. UST owners have been advised to seek other sources of coverage in order to comply with RCRA's financial responsibility requirements.[23] One of these options is private insurance.

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[21] In numerous states SGFs are financed through taxes on gasoline. In this type of case the cost of coverage to UST owners is effectively zero.

[22] The wide range in the estimates is due to different assumption regarding cost containment. The higher figure is derived given the assumption that no changes are made to lower costs. The lower figure assumes the introduction of more stringent limitations on eligibility for the program, cost limitations for site investigations, and lower standards for soil remediation. See Public Sector Consultants (1995) at 20.

[23] See *Environmental Alert Bulletin*, "UST Funds," June 1995, p. 2.

There are a number of variations on the type of private insurance system that could be put in place. New Jersey, for instance, currently has no SGF so that private insurance is the only option for firms with insufficient assets to self-insure. The State of Washington has a program whereby owners are required to obtain private insurance or self-insure for the first $75,000 of coverage while the state covers the balance. Also, UST owners must conduct an environmental assessment to determine if releases have occurred in order to qualify for the program. Several states' SGFs (e.g., Michigan, Minnesota, Ohio, and Maryland) have deductibles that mimic a common feature of private insurance.

Each state needs to consider how to use private insurance to supplement or replace its existing program. Our analysis suggests that the public sector can play an economically beneficial role in financing the cleanup of past leaks. However, it also indicates that private insurance is the preferred mechanism for satisfying FRRs aimed at prospective risks. In lieu of a private market, it is clearly desirable to have state funds mimic the safeguards used by private insurers to limit moral hazard and adverse selection problems -- deductibles, co-payments, and the denial of coverage for failure to meet technical standards. The prompt sunsetting of public funds for retroactive liability coverage enhances the incentive to detect and clean up existing problems. It will also ensure that future problems are minimized by forcing UST owner-operators to fully internalize the prospective environmental costs of their UST systems.

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