

**Can Environmental Insurance Succeed Where Others Fail?
Conceptual Framework & The Case Of Underground Storage Tanks**

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CAN ENVIRONMENTAL INSURANCE SUCCEED WHERE OTHERS FAIL?

THE CASE OF UNDERGROUND STORAGE TANKS

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Abstract

Private risk reduction will be socially efficient only when firms are liable for all the damages that they cause. We find that environmental insurance can achieve social efficiency even when fines and management mandates do not achieve this objective. The evolution of the U.S. Environmental Protection Agency's Underground Storage Tank program suggests that, despite hurdles for novel products, environmental insurance can succeed. Insurance avoids the problem of small firms' bankruptcies associated with *ex-post* (damage-based) fines and insurance is less costly to monitor than *ex-ante* (pre-damage) fines for a failure to effectively manage such risks.

Key words: fines; risk management; environment; insurance; Underground Storage Tanks

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1. Introduction

For environmental, health and safety risks, firm investments in protective measures might fall short of social efficiency since firms are not liable for some of the losses their actions cause. Significant negative externalities may be present, such as loss of well-being by people exposed to pollution, or by those who are unable or unwilling to use contaminated resources. If regulators levy *ex-post* fines proportional to external damages from discovered violations, firms could have an incentive to cost-effectively reduce these risks.¹ Yet the fines may not be a credible threat for small firms, who can declare bankruptcy, if such fines exceed their limited assets (Boyd, 1997).²

One approach for addressing this issue has been for regulatory agencies to specify *ex-ante* (pre-damage) process-based requirements to reduce risk. Thus non-compliant firms can be fined even without any observed damage. Examples include OSHA's (U.S. Occupational Safety and Health Administration) Process Safety Management (PSM) program and EPA's (U.S. Environmental Protection Agency) Risk Management Program (RMP). Both were created under Section 112(r) of the Clean Air Act Amendments (CAAA) of 1990 to help prevent releases of hazardous chemicals. The OSHA PSM program requires facilities containing large quantities of highly hazardous chemicals to implement accident prevention and emergency response measures. The EPA's RMP regulation requires facilities to assess the likelihood of accidents and their consequences and to submit a Risk Management Plan. Firms can be fined for failure to comply.

The *ex-ante* nature of process- (versus damage-) based incentives can address bankruptcy, at least in principle. If process inspections are frequent, *ex-ante* fines can be lower than *ex-post* fines for discovered violations (which are relatively rare), while providing the same

¹ This core of public and environmental economics is of course also featured in the law-and-economics literature (for instance, Coase 1960, Shavell 1980, Polinsky 1980, Segerson and Tietenberg 1992, and Hermalin 1995). For an application to environmental auditing see Pfaff and Sanchirico 2000.

² Ringleb and Wiggins (1990) show that firms create small entities that can "cheaply" declare bankruptcy.

economic incentives to invest in risk-reducing measures. However, the implementation of such ex-ante requirements can be challenging, due to regulatory agencies' limited monitoring capabilities to verify the effectiveness of firms' risk management practices.

With respect to Underground Storage Tanks (USTs), both Cohen and Kamieniecki (1991) and GAO (2001) have argued that limited regulatory resources have frustrated the enforcement of existing technical standards for USTs. GAO (2001) documented that most states and EPA do not physically inspect all underground storage tanks frequently enough to ensure compliance with the federal requirements. This report attributed limited inspection to a lack of staff and recommended increasing available resources to address this problem. However, this policy proposal may not be realistic within the current environment in which regulatory agencies' budgets are being cut.

Cohen 2006 argues that persistent UST leakage is now an organizational management problem that cannot be solved as a technology or policy design issue. We feel this reflects an understandable frustration with the limitations of traditional policy tools. In this paper we dig deeper into USTs to highlight how an innovative tool, environmental insurance, has worked.

Our analysis suggests that mandated environmental insurance can succeed in spite of the hurdles for creating novel insurance products. While the GAO (2001) report correctly identified the difficulties currently faced in the enforcement of technical standards, it did not suggest a feasible alternative. Cohen (2006) correctly notes the need for enhanced management capabilities to reduce UST releases but does not make clear how or why it is that UST owners will develop an incentive to improve management capabilities now when they failed to do so in the past.

Insurance can provide such an incentive without increasing the costs of monitoring. We document that it already has achieved this objective for the case of USTs. How? A regulatory agency mandates that UST owners must have insurance to operate. In stark contrast to knowing whether firms' risk management efforts are effective, it is easy to verify that a firm has coverage.

As private insurers who normally offer this coverage price it based on UST release risks,³ insurance premiums provide an incentive for firms to improve their risk management strategies. Insurance also guarantees that funds are available to compensate victims when accidents occur. Regular payment of premiums over time also smoothes costs relative to large damage-based fines.

However, insurance markets for environmental risks have not always existed. As Freeman and Kunreuther (1997) note, any insurer needs to be able to identify and quantify specific hazards and then set premiums that reflect these risks for each class of customers. Thus, one might expect that as more risk information becomes available, insurance markets will function more effectively. The UST case is well described by exactly this point. Initially, private UST insurance was simply unavailable. Yet premiums have fallen by more than 50 percent in the last 10 years, for single-walled tanks, as the risks have become better understood and managed.

This paper offers the first evidence, from a close examination of experimentation with UST insurance, that such an innovative policy can function effectively. Section 2 provides a simple (and not a novel) framework for comparing *ex-post* damage-based fines and *ex-ante* (pre-damage) fines that are based on non-compliance with process requirements. It then considers the relative difficulty of monitoring different types of process requirements, comparing “effective risk management” with more easily monitored insurance. Some other advantages of mandatory environmental insurance relative to other process-based risk management strategies are also discussed. Section 3 provides novel empirical evidence on the evolution of the UST program. We are witnessing a rare example of the creation of a new environmental insurance product. Section 4 summarizes our main points and then suggests directions for related future research.

³ Once the government requires insurance, insurers can refuse to offer policies unless firms demonstrate, for instance, that they do not have unsafe underground storage tanks. At the same time insurers can and do reward better protection by offering reduced premiums and can rescind policies if firms do not satisfy regulatory guidelines or misrepresent their actions.

2. Risk Reduction by Firms Facing Fines

2.1 External risks and ex-post (damage-based) fines

A firm i is uncertain about the harm h_i that its operation will cause in a given year. Harms include health loss due to air pollution, recreation loss if a lake is fouled, and aesthetic loss if particular resources are destroyed. The h_i represents harms to all parties and thus is as large as or greater than l_i , the losses to the firm. The l_i includes damage to employees, higher wages that compensate for such risks, and also lowered profits should consumers tend to favor green firms. We define $d_i = h_i - l_i$ to represent the external damages.

The firm knows the probability density functions for l_i and d_i (and thus h_i). It is also able to estimate the cumulative distribution functions and their means L_i , D_i , and H_i . The firm can implement measures to reduce but not eliminate these risks and decides whether to undertake a measure at a cost C_i so as to lower its expected future harms from L_i to L_i' and D_i to D_i' . A firm maximizing expected profits sees risk reduction as desirable if $C_i < (L_i - L_i')$. This diverges from the view of the regulatory agency, which we assume cares about not only the firm's welfare but also all other citizens, and thus compares the C_i to $(H_i - H_i')$, which is always greater than $L_i - L_i'$.

For socially efficient risk reduction, a regulatory agency needs to impose costs on the firm for causing external environmental damage. One option is to fine the firm based on the damages. Such *ex-post* fines raise the expected costs to firms of generating environmental damages. Such fines are levied for observed harms. The agency employs auditors who detect harm through either random inspection or confirmation of public reports. The number of auditors and their effort determine the probability the agency will learn of a harm. We now focus on setting the right fine.

We label as β (<1) the probability the regulatory agency learns of any given harm and label as $f_i(d_i)$ the fine that will be levied upon detection of an external damage of magnitude d caused by firm i . A firm that causes d_i faces an expected fine $\beta f_i(d_i)$ in addition to private cost. Regulatory agency wants firms to compare the risk reduction cost C_i to the reduced damage to all

parties ($H_i - H_i'$). A firm on its own considers only expected private damage reductions ($L_i - L_i'$). Expected fines should make up the gap between those expected damage reductions. A fine $f_i = d_i / \beta$ achieves that, since the expected fine conditional on damage d_i is $\beta f_i = d_i$, with overall expectation D_i .^{4 5} Then risk reduction saves the firm both the expected private damages by ($L_i - L_i'$) and expected external damages by ($D_i - D_i'$).

2.2 Limited incentives for small firms from ex-post fines

In the above model, firms are assumed to be solvent after paying *ex-post* fines. In reality, small firms with limited assets may declare bankruptcy if they cannot afford the liability for environmental damages (Boyd and Kunreuther, 1997; Boyd, 1997). Then *ex-post* fines cannot pose a credible threat and small firms' risk reduction efforts will be less than what would be socially efficient.

If there are few EPA auditors relative to the number of firms, the chance (β) that a harm is detected can be low. Then for socially efficient incentives, fines would have to be high. Large external damages d_i also yield high fines of course. In either case, if the costs to firm i when it is caught are greater than its assets A_i , the firm may declare insolvency and lose A_i . In that case, the *ex-post* fines do not induce efficient risk reduction. This we refer to as "the small-firm problem".

2.3 Process mandates and ex-ante (pre-damage) fines for process faults

To address the small-firm problem, regulatory agencies have formulated technical and management requirements for firms to reduce safety and environmental risks. With process-based (versus damage-based) regulations of this type in place, a public sector agency can levy *ex-ante* (pre-damage) fines for not undertaking risk-reduction measures. With a sufficiently high

⁴ When a firm is caught and fined, its costs ($l_i + d_i/\beta$) are greater than the harm caused $h_i (= l_i + d_i)$. That is because violations are not always discovered. The socially efficient fines are proportional to external damages, but costs must also reflect the likelihood of detection (see, for instance, Shavell 1992, Kaplow and Shavell 1994, Innes 1999, Pfaff and Sanchirico 2000).

⁵ A nice feature of such fines is that they require only the information d_i , observed external damages, not information that differs across firms and which only the firms may know, such as l_i , or C_i .

probability that the firm is audited concerning these requirements, the *ex-ante* fine providing the same incentives as the *ex-post* fine can be lower than the *ex-post* fine. This should help with the bankruptcy issue when firms are caught and fewer small firms should disregard the regulations.

Yet, experience shows that monitoring and verifying firms' implementation of technical and management requirements such as PSM and RMP requires considerable time and expertise. With limited regulatory resources, OSHA focuses on firms known to have serious workplace problems. Those not in this category have less than a 1 in 80 chance per year of being inspected and this has led some firms not to implement PSM rules. Without high fines these firms have limited economic incentive to respond to OSHA's PSM or other workplace regulations (Kunreuther, McNulty and Kang, 2002).

EPA's RMP regulations also are not well-enforced. The chances of any given firm being inspected are low and the potential fines are not high. Under the General Duty Clause of the Clean Air Act, fines can be \$27,500 per day, but EPA staff say this is rarely imposed, in part due to limited monitoring. EPA's Region 3 has five auditors to inspect all facilities.⁶ As Boyd (1997) pointed out, another example of the difficulty in enforcing process-based risk management requirements is that technical standards do not guarantee landfill risk reduction. Requirements went into effect in 1979 but a 1988 EPA report found that only 36% of landfills were monitoring groundwater, 7% monitored methane, and 15% had surface water controls. Thus while such mandates could work in principle, these examples suggest there is a monitoring problem.

2.4 Mandatory environmental insurance

As an alternative to the standard tools above, consider a requirement that firms purchase environmental insurance to cover private losses and social harm from accidents. A mandatory insurance system could in principle solve the small-firm problem and the monitoring problem

⁶ Kunreuther, Metzenbaum and Schmeidler (2006) also emphasize the lack of inspection. They do not, however, focus on small firms and bankruptcy.

while smoothing the costs of damages over time and providing funds to compensate victims.

2.4.1 Addressing the small firm problem

The competitive insurance premium I_i making an insurer and risk-neutral firm i willing to transact must equal the annual expected private loss for a firm plus expected external damages. But if a small firm's assets are less than its private losses and *ex-post* fines if an accident occurs, i.e. if we have a small-firm problem, it affects insurance purchases as well. Small firms will not purchase insurance at the competitive premium since their expected losses are lower given that it will declare bankruptcy should it suffer a large loss. Thus, if the small-firm problem is of central concern, then the environmental insurance must be mandatory.

2.4.2 Addressing the monitoring problem

Mandatory insurance is easier to monitor than technical and management requirements. An agency needs to inspect firms physically to make sure that risk management requirements are effectively implemented. For insurance, an agency has only to confirm that a firm has purchased an approved environmental insurance policy or, more generally, provided legal documentation that sufficient financial resources have been set aside to cover potential damage from an accident.

2.4.3 Cost smoothing

Ex-post fines tends to be high since they cover the damages from a discovered violation plus a punitive component to set incentives correctly given that not all violations are discovered. Without insurance, the fines plus private costs are incurred in infrequent large chunks following accidents. Uncertainty and indivisibility can create hardships and possibly lead to bankruptcy. With insurance, costs involve predictable and relatively small premiums. This smoothing of costs due to existing risks benefits a small firm. Socially speaking this reduces the chance of bankruptcy while at the same time encouraging investments in risk reduction measures.

2.4.4 Funds for compensation

Even when firms' risk reduction investments are socially efficient, there will be some

residual risk. Accidents will occur and thus funds are needed to compensate those who incur damage. For large firms *ex-post* fines cover the expected damages from accidents caused by them due to violations of a regulation. When small firms go bankrupt, however, such fines may go unpaid so that there are insufficient funds for compensation. In contrast, insurance provides a ready source of funds to compensate damages.

3. The Evolving Case of Underground Storage Tanks (USTs)

We present the first evidence from the field that mandatory insurance can function effectively, using the case of underground storage tanks (USTs). Leaking USTs represent one of the most common environmental problems in the United States. Products leaking from USTs including gasoline, diesel, waste oil and other hazardous substances can contaminate groundwater and pollute drinking water. We highlight how insurance can overcome key hurdles to risk reduction.

3.1 The small firm problem before the FRR mandate

In 1984, Congress directed the EPA to publish regulations that would require owners and operators of USTs (often in gas stations) to prevent, detect, and clean up releases. The regulation imposed strict liability on UST owners and operators (Section 9003 of RCRA Subtitle I). Key actors clearly could be fined.

Such liability did not pose a credible threat for most UST owners and operators. Ninety percent owned only one station and had net worth less than \$90,000 (GAO, 1988). EPA estimated that the cost of cleaning groundwater contaminated by a leaking tank generally ranges between \$75,000 and \$225,000 and could even be higher. Most of the firms would go bankrupt should a release occur. This dampened the incentive to prevent accidents and imperiled the supply of funds for compensation.

Concerns led to the Financial Responsibility Requirements (FRRs). In 1986, Congress amended Subtitle I of the Resource Conservation and Recovery Act (RCRA) and directed the EPA to publish regulations that would require all UST owners and operators to demonstrate they

are financially capable of cleaning up releases and compensating for damages. There are two primary ways UST owners and operators comply with FRRs, purchasing private insurance or participating in a state fund.⁷ When the latter was not available (see section 3.5), UST owners and operators had to purchase insurance to demonstrate compliance. Thus, insurance is mandated through FRR. It must be mandated because of the small firm problem. Owners with limited assets were not willing to purchase fair-priced insurance and did not do so until FRRs were mandated.

3.2 The problem of monitoring UST technical standards

EPA's UST programs also include process-based risk management requirements, which mandate technical standards for the prevention, detection and correction of releases from tanks. Tanks installed after December 22, 1988 must meet requirements concerning correct installation, leak detection, spill, overfill, and corrosion protection. USTs installed before December 22, 1988 had to meet these requirements by December 1998. For example, all metal UST system components that are in contact with the ground and routinely contain product must be protected from corrosion. Facilities that violate these technical requirements are subject to fines up to \$11,000 per day per tank per violation, at least in principle.

Those who have studied UST programs agree that the states' environmental agencies do not have adequate resources to monitor USTs and enforce technical standards. Cohen and Kamieniecki (1991) indicate that the combination of limited resources and the vast size of the regulated community makes it impossible to effectively enforce UST technical standards. For example, in 2000, Michigan's UST regulatory agency only had 21 inspectors responsible for about 10,000 UST facilities with 30,000 USTs. According to GAO's 2000 survey, only nineteen states physically inspect all of their tanks at least once every three years—the minimum EPA

⁷ Other mechanisms include self insurance, obtaining a guarantee, a surety bond, or a letter of credit. Those are less appealing than private insurance because they may require assets to be pledged as collateral that are beyond the resources of the average tank owner (GAO 1988).

considers necessary for effective UST monitoring.⁸ About 29 percent of the regulated tanks were not operating or maintaining their tank protection devices properly in 2000.^{9 10} The states and EPA regions attribute insufficient enforcement to the lack of personnel and financial resources. For instance, in a survey on USTs, forty-six states responded that they needed additional resources to enforce UST technical standards (GAO 2001). The respondents from North Carolina wrote: “It is critical to have enough inspectors to visit each owner or operator at least once every three years to provide one-to-one assistance. There is no other substitute! Owners and operators need to know that the state will be back to see how they are doing. Field presence is essential!!” (GAO survey of Federal UST Requirements, 2000). Verifying management has substantial costs.

Verifying firms’ possession of insurance is easy by comparison. In Michigan, which relies on private insurance, the Department of Environmental Quality requires UST owners and operators to submit a certificate *with the insurer’s signature*. This does not involve a large cost to either the Department or the tank owners and operators. Tank owners and operators are subject to a fine of up to \$11,000 per tank per day per violation (RCRA Subtitle I, Sec.9006(d)(2)) if they do not possess valid insurance.¹¹ The Michigan Department of Environmental Quality is confident that more than 90 percent of UST owners and operators have valid insurance in force.¹² In Florida, another state that primarily relies on private insurance market, more than 98 percent of firms have the financial backing required by FRRs. Breaking

⁸ Ten additional states inspect all of their tanks but less frequently than every three years. The remaining twenty-two states do not inspect all tanks but instead they generally target inspections to potentially problematic tanks such as those close to drinking water sources.

⁹ The GAO survey (2000) acquired information from each state as to the number of tanks in their state, and the percentage of these tanks that had federally required equipment operated properly. Our estimates are based on these data.

¹⁰ Improper operation and maintenance is the leading cause for tank leak. Half of the respondents reported that “operators did not operate and maintain the required equipment properly” is the major cause of UST releases, and none of them said it was not a cause at all.

¹¹ A recent example is Yellow Cab (Washington, D.C.) case (Email communication with Carol Amend at the EPA Region 3, November 29, 2005).

¹² Email with Kevin Wieber at the Michigan Department of Environmental Quality, June 15, 2006

down their choices, 78 percent have purchased insurance, 14 percent self insure, and the remaining firms utilize other approaches such as letters of credit.

Outside of USTs, the relative ease of enforcing mandatory insurance is illustrated by the Pollution Insurance for Marine Vessels. The Federal Water Pollution Control Act (FWPCA) requires owners and operators of vessels over 300 tons to demonstrate that they have the financial resources to cover cleanup costs and repair or replacement of natural resources. Almost all owners and operators, for the approximately 23,000 to 25,000 vessels, use insurance. The enforcement appears to be easy: once financial responsibility is documented, the Coast Guard issues a Certificate of Financial Responsibility that must be carried aboard each vessel and produced upon demand. If a vessel does not have a valid certificate, the Coast Guard can deny the vessel entry to port or detain it in port as well as impose a fine up to \$10,000. Compliance, i.e. possession of insurance, is high. Of the thousands of vessels using the U.S. waters annually, the Coast Guard detains about 15 per year for noncompliance with this requirement (GAO, 1988).

3.3 The evolution of UST insurance

The above figures concerning UST insurance in Michigan and Florida are encouraging. More generally, in the states without UST state fund programs,¹³ a large majority of the UST owners and operators comply with UST FRRs through the purchase of private insurance.¹⁴

However, UST insurance did not always work so well. In the late 1980s, according to the GAO's 1987 survey, firms claimed that it was extremely difficult for them to obtain adequate pollution liability insurance for tanks. One firm said it contacted 44 insurance companies and was unable to find coverage. Others said their insurance brokers had to contact as many as 20 insurance companies before they were able to obtain insurance. Firms also said that available tank insurance became more expensive over time. One small firm testified that between 1986

¹³ For a detailed discussion, see Yin (2006).

¹⁴ Interviews with Mark Barolo at EPA Office of Underground Storage Tank, May 20, 2004

and 1987, its premium tripled from \$3,000 to \$10,000 for coverage that was reduced from \$4 million to \$2 million by the same insurer (GAO, 1987). Thus, when FRRs were promulgated in 1987, private environmental insurance for USTs was generally unavailable.

The reasons for the unavailability of private insurance are two-fold. First, at that time, private insurers perceived that tank leaks and the magnitude of potential losses resulting from leaks were unpredictable. There was limited knowledge concerning UST releases (both probability of release and potential loss per release). Second, the insurance industry believed that judicial decisions were becoming less predictable making it difficult to relate the risk associated with a policyholder's operation to court settlements.¹⁵ (Cohen and Kamieniecki, 1991 pp. 111)

Insurers felt that they could not accurately quantify the risk to set actuarially-based premiums. However, such hurdles have now been remedied. Stakeholders, including UST owners, government agencies and private insurers have gained more insight into the likelihood of tank releases and potential losses from historical data. Regulatory requirements and their legal interpretations were clarified. Thus, average risks in the industry came to be better understood. Premiums have decreased significantly as information about the sources of risk improved. For an 11-15 year-old single walled tank, the insurance premium was \$1,500 in 1995 but only \$500-\$700 in 2004, as shown in Table 1.

¹⁵ The liability not only includes the costs for taking corrective action, but also for compensating third parties for bodily injury and property damage.

Table 1: Tank Quality and Insurance Premium (per Tank)

| Type of Tank | | Insurance Premium in 1995 | Insurance Premium in 2004 |
|----------------------|-------------|---------------------------|---------------------------|
| Single-walled | | | |
| Tank | 6-10 years | \$700 - \$1,450 | \$350-\$470 |
| Age | 11-15 years | \$,1500 | \$500-\$700 |
| | 16-30 years | \$2500- \$4,000 | \$760-\$1,690 |
| Double-walled | | | |
| Tank | 6-10 years | \$350-\$725 | \$228-\$302 |
| Age | 11-15 years | \$400-\$725 | \$320-\$356 |

Source: Public Sector Consultants, Inc. (1995). Michigan Office of Financial and Insurance Services (OFIS)

Not only have prices for UST insurance decreased over time overall, but also prices more accurately reflect risks as information has improved in this market. Table 2 shows a rate structure that Zurich North America used to set premiums for insuring USTs. This table indicates that UST releases can be accurately predicted based on some observable characteristics, such as tank age and structure. Such prediction permits differential premiums (e.g., \$200 for a 5-year-old double-walled tank vs. \$1,700 for a 30-year-old single-walled tank). Corrosion protection, leak detection and overfill detection are also used to determine the right premiums, as seen in Table 2.

Table 2: Rate Factors for USTs used by Zurich North America (2004)

Base Rates:

| Age | 0-5 | 6-10 | 11-15 | 16-20 | 21-25 | 26-30 | 31-35 | >35 |
|----------------------|-------------|-------------|-------------|---------------|-----------------|-----------------|-------------|---------|
| Single-Walled | \$284-\$339 | \$350-\$470 | \$500-\$700 | \$760-\$1,030 | \$1,100-\$1,380 | \$1,450-\$1,690 | \$1,750 | \$1,850 |
| Double-Walled | \$185-\$221 | \$228-\$302 | \$320-\$356 | \$365-\$426 | \$441-\$509 | \$441-\$509 | \$526-\$582 | \$620 |

| | Yes | No | Unknown |
|-------------------------------|-------------------|-----------------|---------|
| Leak Detection | 0% | +10% | +10% |
| Overfill Detection | 0% | +10% | +10% |
| Corrosion Protection | 0% | +10% | +10% |
| | Yes, Claim Closed | Yes, Claim Open | No |
| Location Prior Release | 10% | 20% | 0% |

Sources: Michigan Office of Financial and Insurance Services (OFIS). Premiums are based on \$1 million coverage with a standard deductible of \$5,000.

Setting prices that reflect risk by class of customer is crucial for insurance markets to function well and to create economic incentive for firms to invest in risk reduction. Today the UST pollution liability insurance has become a well-functioning and competitive market with a large number of insurance providers (Cohen, Kamieniecki and Cahn, 2005).¹⁶

3.4 Why isn't there more insurance? Should there be?

While the evidence regarding the success of insurance is encouraging, it comes from a small subset of states in the U.S. The absence of a private insurance market in most states even today is due to competition from state funds. In response to the initial lack of private insurance, and lobbies from well-organized fuel distribution industries such as the Petroleum Marketers Institute, most states in the U.S. established state fund programs in the early 1990s. Table 3

¹⁶ For a list of UST pollution liability insurance providers, please see <http://www.epa.gov/oust/pubs/List%20of%20Providers%2012-06%20Update.pdf>.

shows the availability of state fund programs as an FRRs compliance mechanism by state over time.

Table 3: Availability of State Fund Program as an FRRs Compliance Mechanism

| Category | States |
|--|--|
| No <i>State Funds</i> that could be used as an FRRs Compliance Mechanism | AK, MD, NY, DE, HI, OR |
| Have <i>State Funds</i> that could be used as an FRRs Compliance Mechanism | AL, AR, CA, CO, CT, GA, ID, IL, IN, KS, KY, LA, MA, ME, MN, MO, MS, MT, NC, ND, NE, NH, NM, NV, OH, OK, PA, RI, SC, SD, TN, UT, VA, VT, WA, WY |
| Transition from State Funds to Private Mechanism | AZ: (6/30/2006), FL:(1/1/1999), IA:(11/8/2000), MI:(6/30/1995), TX:(12/23/1998), WI:(1/1/1996), WV:(9/30/2000) |
| Transition from Private Mechanism to State Funds | NJ (8/31/1997) |

Source: U.S. Environmental Protection Agency (EPA); State UST Financial Assurance Funds Survey 1999-2007.

A UST state fund is normally financed through a gasoline tax. In Illinois, for example, there is a tax of 0.3 cents per gallon of motor fuel, and 0.8 cents per gallon environmental impact fee. This provides UST owners and operators with protection against tank leaks at essentially zero cost. Although tank owners and operators have to pay a fee (\$100 in most states) to qualify for state fund programs, they pay this fee as part of tank registration whether or not they claim benefits from the state funds. This effectively eliminates the demand for private insurance.

State funds programs collect fuel taxes or tank fees and redistribute the proceeds based on a needs criteria. A significant feature of this approach is that the availability of the programs and the cost for participating in these programs are not related to risk. Therefore, it creates little incentives for tank owners and operators to reduce risk. Private insurers, in contrast, encourage firms to undertake risk reduction investments through the availability and cost of insurance policy. An insurer can and will often require potential policyholders to undertake specific loss reduction activities before providing insurance coverage. UST insurers in Maryland refused to provide coverage to a high percentage of petroleum marketers who did not meet underwriting

standards. They were considered uninsurable due to very old tanks or failure to provide a record of compliance with tank management requirements (Maryland Governor's Task Force, 1990). Denying coverage provides a significant incentive for UST owners and operators to undertake mitigation measures. Furthermore, as noted in Table 2, insurers normally build risk-based pricing mechanisms into their rate structure to encourage risk reduction efforts. For example, the premium will increase by 10 percent for having no corrosion protection, or having a prior release.

In addition, insurers have a financial interest in engaging in UST owners and operators' risk reduction activities because they are responsible for financing both cleanups and third party claims from tank release. For instance, AIG Environmental Group, Inc. (AIG) and Tanknology – NDE International, Inc. formed an agreement whereby AIG provides substantial premium discounts for UST owners and operators utilizing Tanknology compliance management or monitoring services. Tanknology's services can reduce the risks of UST ownership (National Petroleum News, 1998).

A priori, such insurance practices could be expected to encourage risk-reducing measures and reduce UST releases. While evidence is limited, Yin, Kunreuther and White (2007) find that private insurance has helped Michigan reduce the fraction of UST facilities with a release by about 20 percent, compared to what would have occurred had they maintained their state fund.

4. Summary

Cohen 2006 has argued that the problem of leaking UST has become principally a management problem, which involves hiring an adequate staff, purchasing needed equipment, developing standard operating procedures, training staff in those procedures and in the use of equipment, and implementing the procedures. He suggests that this cannot be solved as a technology issue or public policy design issue. We disagree in light of our positive findings.

Traditional policy instruments, such as *ex-post* fines and process-based risk management requirements, have limited usefulness because of the small firm problem and the limited

monitoring capabilities of regulatory agencies. However, mandatory environmental insurance with premiums reflecting risk can provide appropriate incentives for UST owners and operators to improve their operations. We agree with Cohen (2006) that it requires time to enhance capacity to manage, but we also believe that such an innovative policy design helps speed up this process.

In summary, by examining the case of USTs we showed that mandatory environmental insurance may be a desirable alternative given the *small firm* problem and limits on monitoring. Insurance has an advantage over state funds by encouraging appropriate risk reduction efforts on the part of insured. We expect a greater reliance on private insurance in this market over the next few years since the sunset dates for five state fund programs will occur between now and 2011.¹⁷

Mandatory environmental insurance may not be applicable for every environmental risk. Future research should investigate what types of risks are most appropriate for utilizing this policy tool so that the success of UST insurance can be extended to other areas. There is also a need to understand how mandatory insurance can be used in combination with other instruments to encourage firms to adopt risk-reduction measures. For example, third party audits required by ISO certification, are seldom used by insurance companies to adjust their premiums, or by governments for regulatory monitoring. A better partnership between insurers, third-party auditors and governments can potentially create more effective incentive systems for firms to operate in a more socially responsible manner.

¹⁷ Those states (sunset dates) include ME (12/31/2010), MO (12/31/2010), ND (7/31/2011), NE (6/30/2009) and VT (7/1/2009). See State UST Financial Assurance Funds Survey 2007.

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