Environmental Risk Management Through Insurance

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Introduction

Reported threats to human health from chemical releases into the environment have become a weekly ritual. Despite contrary biomedical evidence (Ames 1983; Peto 1984), a majority of the public remains convinced that chemical effluents in the environment are a major cause of cancer, cardiovascular disease, and birth defects (Zenter 1979). In response to concern with mass exposure to toxic chemicals from waste sites, the Resource Conservation and Recovery Act (RCRA)[1] and the Comprehensive Environmental Response, Compensation, and Liability Act[2] ("Superfund") were passed.

These two acts rely more on market incentives and less on traditional proscriptive or prescriptive strictures than any other environmental statutes. They require handlers of hazardous chemicals to establish "financial responsibility," which means a guarantee to pay for damages up to a specified limit. Unless a firm can meet the test for self-insurability, financial responsibility must be met by insurance (U.S. EPA 1982). Through a demand-pull strategy, the acts

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[1]42 U.S.C. 6924 (a)(t); 40 C.F.R. 264.14 and 265.14 et seq.

[2]42 U.S.C. 9608 (1986).

encourage the establishment of a market in insurance for nonsudden or gradual pollution damage.

When RCRA was enacted in 1976, several London insurers had been developing liability policies for nonsudden or gradual pollution accidents. When Superfund was passed in 1980, a few American insurers were offering such policies. By 1983, despite the misgivings of many underwriters (U.S. Treasury 1982), at least a dozen primary insurers were offering coverage. In addition, more than 40 insurers had established a reinsurance pool to spread the risks further (Katzman 1985, chap. 5). The market-based approach to chemical risk management appeared to be on the road to success.

By the end of 1984, the pollution-insurance initiative lay in shambles. London reinsurers had withdrawn from the market, carrying many existing and prospective insurers in their wake. Pollution insurers numbered about eight worldwide, most of whom insured small-scale facilities like gas stations and dry cleaning establishments. Only two insured "heavy" risks, like chemical plants, from which catastrophes are most likely to result. By the summer of 1986, only one insurer offered coverage for gradual pollution occurrences.[3]

While there have been some signs of recovery, the pollution liability market has not developed as rapidly as the federal government had hoped. As a result, Congress twice had to postpone implementation of the financial responsibility requirements of RCRA. The development of financial responsibility requirements for generators under Superfund has been aborted.

Does the collapse of the market indicate a fundamental problem of insurability, a remediable imperfection, or merely a cyclical disequilibrium? This query raises broader questions about: (1) public policy alternatives for the management of catastrophic risks; (2) the inherent insurability of pollution liability; (3) the conditions necessary to sustain a viable pollution liability market; and (4) the value of insurance as a mechanism for rendering private risk-management decisions socially acceptable.

The fact that the insurance industry (Cheek 1982) perceives its mission as risk-spreading rather than risk-eliminating is irrelevant to the inquiry. In political economy, the distinction between the conscious purpose of actors and their social function is as venerable as the concept of the invisible hand.

[3]"Difficulty in Obtaining Liability Insurance Said Major Problem for Waste Facilities," *Environmental Reporter* 15 (15 February 1985): 1660–61.

Public Risk Management Policy

Advanced industrial economies both eliminate and create risks. The whooping cough vaccine that saves millions from infectious disease may cause brain damage to an unlucky few. The insecticide that saves masses from starvation may explode during its production, as in Bhopal. Commercial enterprises internalize some of the social benefits of these risk-reducing activities through higher profits, while most are enjoyed by the public. The question of who bears the social costs remains open.

The social costs of the risk-creating activities are readily internalized by the firm when the risks are knowingly and voluntarily taken by a potentially injured party. Where voluntary exchange exists, social costs can be signaled through labor or product markets. As implied by the Coase theorem, bargaining between workers and their employer can result in a mutually acceptable risk management package that includes a wage premium, worker compensation in the case of accidents, and some residual or retained risk. For example, workers demand higher wages for more dangerous jobs, thereby inducing employers to undertake marginal safety expenditures that cost less than the expected marginal compensation payments (Viscusi 1979). Similarly, consumers may be willing to pay more for a safer tool, to the greater profit of the manufacturer.

Where accidents affect third parties, the achievement of mutually acceptable risk management is not automatic. Potential victims of environmental pollution are not always knowledgeable about subtle exposures, such as carcinogens in the water supply. Even if they were, potential victims cannot easily signal their distress by market exchange. The transactions cost of arranging Coasean contracts between a multitude of dispersed, potential victims and one or more polluters may be prohibitive.

There are three major regimes for forcing the responsible actors to internalize the costs of accidents to third parties: tort law, statutory regulation, and user charges (Shavell 1984; Landes and Posner 1984). Activated subsequent to an accident, the tort process determines which party, if any, is liable for the ensuing costs. The anticipation of potential liability in the future creates a powerful influence on current behavior.

Statutory regulation attempts to constrain behavior prior to the occurrence of an accident. Regulations may mandate certain inputs (for example, clay liners in hazardous waste sites). Other regulations may constrain effluent volume or completely prohibit specific outputs (by banning the production of a chemical). Statutory sanctions

may include civil and criminal penalties such as fines, injunctions, and imprisonment.

User charges are fees imposed on behavior likely to result in external diseconomies, as it occurs. User charges share characteristics of both statutory regulation and the tort process. Like regulation, a user charge is implemented by state action; like the tort process, a user charge is a market mechanism that leaves risk management decisions in private hands. Traditionally, tort recoveries are assessed only if harm results and fault is determined, while user charges are assessed whether or not harm results, without regard to fault. Through the tort process, a victim can recover damages, but he does not automatically recover through a user charge regime.

The three regimes for controlling accidental external diseconomies differ in their efficiency, distributional effects, and transactions costs (Calabresi 1970). The efficiency criterion weighs the expected marginal cost of pollution against the marginal cost of pollution control. Where these marginals are equal, the cost of pollution-engendered accidents plus the cost of accident prevention is minimized.

Third-party risks raise equity issues that are more compelling than first- and second-party risks. When the risk is borne by the beneficiary of the risky activity, such as the chain smoker, no blatant inequity calls for publicly sanctioned redress in the event of loss. When a third party becomes ill because of contamination of a water supply, the assumption of risk is neither knowing nor willful.

Equity demands symmetry between the costs and benefits of risk bearing. In the case of an accident, this means spreading the costs from the few who bear the brunt of the losses to a broader class of beneficiaries. In the environmental context, the equity criterion is only partially captured by the slogan "the polluter pays." Equity also demands the completion of the financial transfer, that is, victim compensation.

While the efficiency and equity objectives are analytically distinct, the public finds least acceptable those risky activities where the distribution of benefits and potential losses is asymmetric (Slovic, Fischhoff, and Lichtenstein 1980). This suggests that a tort regime, which facilitates compensation of potential victims by the injurer, can render a given hazard more acceptable than a regulatory regime, which does not provide for compensation.

All societal risk-management regimes incur substantial transactions costs. These costs include the overhead of establishing rules, monitoring behavior, analyzing risks, enforcing rules, and spreading or readjusting losses when accidents occur. These transactions costs

are deadweight drains from the gross efficiency gains of internalization (McKean 1980; Kakalik et al. 1984).

Efficiency and equity do not necessarily exhaust all of the attributes of risk acceptability. Libertarian values are clearly a component of risk acceptability (Abraham 1986, chap. 2). The public may reject a hazard that met both efficiency and equity criteria because the risk would be imposed rather than voluntary. Indeed, a voluntarily chosen technology may be more acceptable than an imposed technology that results in a hundredfold fewer fatalities (Slovic, Fischhoff, and Lichtenstein 1980).

As a regime that internalizes risks after an accident, a tort system by itself faces inherent limitations. In some instances, a polluting firm was dissolved before damages were discovered. In others, damages exceeded the firm's net worth (Katzman 1985, pp. 67–68). The Supreme Court has ruled that a functioning industrial polluter can escape an order to clean up a toxic waste site under the umbrella of federal bankruptcy.[4] Obviously, a business has no incentive to reduce the probability of accidents whose consequences become visible after dissolution or for which losses exceed net worth.

In an attempt to block an escape from liability through dissolution or bankruptcy, both RCRA and Superfund established financial responsibility requirements. Under RCRA, facilities that treat, store, or dispose of hazardous chemicals must prove financial responsibility for sudden accidents, at the levels of $1 million per occurrence and $3 million annually, and for nonsudden occurrences, at levels of $3 million and $6 million, respectively. Under Superfund, additional financial responsibility requirements were to be established by the end of the 1980s for generators. These requirements can serve as the basis of a user-charge regime.

Economists generally favor user charges as the most efficient regime for internalizing the third-party cost of pollution (Milliman 1982). For routine effluents, the charge is assessed on the basis of volume, such as pounds of sulfur dioxide. This charge becomes a cost of production that is passed on to the consumer.

An effluent fee on low probability–high severity chemical hazards is unworkable because the accident activating the user charge may never occur, despite the ever-present risk. Moreover, charging for gradual releases that remain hidden, before surfacing years later, is infeasible. Finally, the charge could be avoided by bankruptcy.

The 1980 Superfund act introduced two user charges. First, a production and import tax on 40 specific chemical compounds was ear-

[4]Ohio v. Kovacs, U.S.S.C. 83-1020.

marked for an emergency cleanup fund. This tax, whose rate is proportional to the presumed riskiness of the substance, is a poorly honed market mechanism; it is insensitive to the differences between careful and careless chemical handling.

A second tax, levied on hazardous waste, was earmarked for monitoring retired waste sites that have come under federal jurisdiction. This tax indirectly encouraged the reduction of waste flows, which correlate with, but are not equivalent to, the hazard. The repeal of this tax in the 1986 amendments (Title V) and the imposition of a broadly based corporate income tax are moves away from the virtues of user charges.

The Potential of Insurance

Liability insurance blends the advantages of both the tort system and user charges as instruments for internalizing the costs of accidents. Under the following conditions, insurance encourages "acceptable" risk management practices, with minimal statutory regulation:

1. Tort rules result in predictable assignments of liability for accidents, based upon reasonable judgments about causal likelihood and relative responsibility. While these rules may evolve in slightly unanticipated ways, the insurers, the insured, and potential victims can rely upon them in managing risks. These rules do not pose impenetrable barriers to recovery to plaintiffs.
2. The courts respect the sanctity of the insurance contract. In other words, both the "reasonable expectations of the insured" and the insurer's "reliance interest" are honored (Abraham 1986, chap. 5).
3. By the application of its skills in safety engineering and actuarial science, the insurance industry can identify and assess the risks of alternative chemical products and processes.
4. Insurers set premiums on the basis of expected losses, which are sensitive to safety measures taken by the chemical industry.
5. Competitive pressures among insurers result in continual improvements in the art of risk analysis. Unlike government bureaucrats, insurers suffer penalties—that is, they lose business—by overestimating risk and setting premiums too high. If they underestimate risks, they suffer financial losses.
6. With the help of insurers and risk analysts, corporate risk managers select cost-effective products and processes, which minimize the sum of insurance premiums, expected payments to victims (in excess of insurance coverage), and risk-reduction expenditures (Ehrlich and Becker 1972).

7. Because the costs of accidents are internalized and polluters have the financial means to pay victims, both efficient deterrence and just compensation result from private decisions. The public will therefore find private risk management acceptable.

The idealized role of insurance as a regulatory tool is most closely fulfilled in the fire insurance industry. Here insurers have developed a tradition of research into fire safety and an aggressive search for cost-effective risk-reduction practices, inspection programs, and merit rating (Denenberg et al. 1974, pp. 82–85). Fire losses would undoubtedly be greater without these insurance industry activities.

Behavioral decision theory casts doubt on whether firms would indeed act as hypothesized by normative insurance theory for gradual pollution exposures. According to this theory, risk managers have a "finite reservoir of concern," and they pay little attention to low-probability events (Slovic et al. 1977; Schoemaker and Kunreuther 1979). Because of turnover, risk managers may reap no reward within the organization for reducing remote, future risks.

Agency theory, however, suggests that the insurance industry performs the function of protecting the stockholders' long-term interests. The underwriting process serves as a control mechanism that requires the formal justification of risk-management decisions (Mayers and Smith 1982). Financial responsibility requirements are an additional control mechanism that focuses the attention of managers on rare chemical accidents. Preliminary experiments with corporate risk managers suggest that they indeed pay attention to the low-probability, high-consequence contingencies as suggested by normative insurance theory (Katzman 1986). These considerations suggest that demand should not limit the development of a pollution liability insurance market. The uncertainties lie on the supply side.

Insurability of Chemical Risks

Conventional Standards of Insurability

The enactment of a financial responsibility requirement for nonsudden liabilities does not automatically create a market in pollution liability insurance. Although someone will insure any risk at a high enough price, all risks are not readily insurable at prices that will not drive the beneficial, risk-creating activity from the market.

Readily insurable exposures have several well defined characteristics (Denenberg et al. 1974, pp. 154–56; Mehr and Cammack 1980, pp. 25–35). First, exposures must be homogeneous, numerous, and uncorrelated enough to allow risk pooling. Second, the insured must have no incentive to bring about the loss. Third, the fact of the loss

must be clearly determinable. Finally, the loss must be frequent enough to calculate pure premiums. How close do chemical hazards come to these ideals?

Number and Homogeneity of Exposures

The number of potential exposures is relatively large. In the United States there are 115,000 chemical plans, 5,000 transporters, and at least 100,000 industrial waste disposal sites, of which at least 30,000 contain hazardous wastes (U.S. Congress 1980, chap. 2; Katzman 1985, p. 77). With the diffusion of industry standards of care, all of these facilities should become more homogeneous.

Most firms that meet the RCRA financial test do self-insure. Of those that purchased insurance in 1984, few obtained more than the statutory minimum (Katzman 1985, p. 93). Nevertheless, demand is likely to grow swiftly, as generators come under the financial responsibility requirements of Superfund. Ultimately, the number of exposures should be sufficient to achieve adequate risk pooling.

A major source of correlation of losses is the generic nature of many chemical products. If a given chemical is discovered to cause latent environmental harm, all manufacturers might be held jointly and severally liable. If an insurer concentrated its portfolio only upon generators or handlers of that chemical, then it would face the same correlated risk as an insurer whose portfolio consisted of hurricane insurance on the Gulf Coast. An underwriter could avoid this eventuality by insuring across many chemical products.

Perverse Incentives to Bring about the Loss

In the economic approach to the law, all accident-engendering behavior is subject to the control of the firm (Ehrlich and Becker 1972; Landes and Posner 1984). In deciding to produce a particular commodity with a particular technology, the firm chooses a given level of risk. The decision to undertake a risky activity, however, is not the same as the choice to cause an accident. In this respect, chemical exposures are no different from common mechanical exposures. As discussed below, the doctrine of joint and several liability in toxic torts reduces incentives to choose safe technologies.

Definiteness of Loss

Losses that cannot be publicly verified lend themselves to counterfeit claims. Property damage, ecosystem contamination, and many personal injuries such as tumors or birth defects can be publicly validated. Until recently, public policy toward hazardous chemicals has focused exclusively upon such injuries.

Recent research, however, questions the use of cancer as the epitome of environmental disease. Continued exposure to chemicals results in increased sensitization, that is, a lowered threshold of morbidity response. Moreover, morbidity also may take the form of a diffuse malaise, analogous to the debilitation associated with lead poisoning (Katzen 1985). In *Ayers v. Jackson Township*,[5] plaintiffs argued that a contaminated municipal water supply was responsible for malaise, rashes, and general anxiety. While the trial court rejected such reports of malaise or rashes as evidence of injury, it awarded the plaintiffs $2 million for emotional stress and $8.2 million for lifetime medical monitoring. An appeal overturned the recovery for stress and medical monitoring, and the case is now at the portals of the New Jersey Supreme Court. Regardless of this outcome, there is no guarantee that future courts will not recognize malaise as a compensable ailment in its own right. Indeed, in *Jackson v. Johns-Manville*, a federal court of appeals upheld an award for anxiety over probable future illness.[6]

Calculability of Loss Distributions

Because chemical disasters are such rare events, the computation of premiums on the basis of loss experience may be virtually impossible. Even if historical loss data were available, they would reflect outmoded safety technologies. But this problem is characteristic of any complex, innovative, technological system, like a satellite or offshore oil rig, and is not unique to chemical catastrophes.

Underwriters claim little knowledge of the risk-reduction technologies available to chemical handlers, and they express little interest in acquiring such knowledge (Cheek 1982). They believe that developing expertise would be costly and argue that the insured would conceal proprietary, technical information (Katzman 1985, pp. 86–87; AIRAC 1985).

The lack of expertise has proven to be a bugaboo. The profit potential in pollution liability insurance has given birth to firms that specialize in risk analysis. While their art is relatively immature, environmental risk analysts have developed workable techniques. Simple screening methods have been employed as a first cut (U.S. EPA 1977; Harris et al. 1982). These techniques score facilities on the basis of such risk factors as the nature of chemicals handled and proximity to populations.

[5]N.J. Super.L., 461 A.2d 184, 189 N.J. Super.561 (1983), 493 A.2d 1314 (1985).
[6]54 U.S.L.W. 2400 (5th Cir. 1986).

The quantity and quality of risk analysis is likely to grow with the size of the pollution liability market. Eventually, underwriters may adopt more sophisticated methods, like event-tree and fault-tree analysis (Katzman 1985, chap. 6). Developed for weapons systems and nuclear power plants, these techniques trace the chain of events that could unleash a catastrophe.

Technological risk analysts tend to be overconfident of their ability to assess low probabilities and often demonstrate upward biases in their estimates of the reliability of complex technological systems (Fischhoff, Slovic, and Lichtenstein 1978). Insurers tend to be more cautious than risk analysts and set premiums accordingly. For example, the near-meltdown at Three Mile Island is viewed as far more likely under the assumptions of the insurance industry than under those of the technological risk analysts and regulators.[7] Nevertheless, underwriters can view risk-analytic results as a lower bound of expected losses.

Chemical Damages and the Tort Process

The fixing of insurance premiums depends critically upon the expected tort claims against the insured. The insurer must predict not only the frequency and severity of accidents, but also the distribution of tort claims against the insured. Unfortunately, claims settlement for chemical accidents is far less predictable than the settlement of claims for commonplace mechanical accidents (Best and Collins 1982).

First, many toxic chemicals persist in the environment. An accidentally released chemical may gradually seep into the groundwater or may become concentrated as it accumulates in the food chain. As a result, the time of a spill or release may precede the time of human exposure by many years. Second, for some toxic chemicals, particularly carcinogens, the time of human exposure may precede the manifestation of injury by several decades. Chemical exposures to one generation may even harm their offspring. Under traditional tort law, a statute of limitations prevents the filing of a suit more than three to five years after an accident. Because of the time lags between

[7]If the Bayesian prior probability of a meltdown is 1/30,000, as taken from a report by a distinguished nuclear engineer to the Nuclear Regulatory Commission, then the probability of one meltdown in 500 reactor-years is only 0.015. If the Bayesian prior probability is 1/1060, as revealed in premiums of the nuclear liability pool, then the probability of one meltdown in 500 reactor–years is 0.27. While Three Mile Island was not a meltdown, it came close and makes the insurers' prior probability appear more plausible than that of engineers and regulators. See Wood (1981).

chemical release and human response, conventional statutes of limitations may prove an insuperable barrier to recovery.

Third, there are multiple pathways through which a given chemical may reach humans. These include the environment, the workplace, and the home. A given biological response, such as lung cancer, may result from one or several alternative chemicals. The multiplicity of potential pathways raises two problems in establishing liability: identification of the defendant and proof of causation.

Under traditional tort law, the plaintiff must identify one or more specific defendants. If an environmental release can be traced to action or inaction of one identifiable party, then specific liability can be assigned. In many cases of gradual environmental release, however, identifying that defendant whose molecule caused the plaintiff's exposure may be virtually impossible. At an abandoned hazardous waste site, for example, many companies may have discarded identical chemicals.

Proof of causation depends upon presenting sophisticated biomedical evidence, most of which is indirect or analogous in nature. Epidemiologists have difficulty sorting out health effects of life-style (especially diet and voluntary consumption of stimulants) as well as occupational and environmental exposures to chemicals. Toxicologists are uncertain about long-term human responses to low, intermittent doses of chemicals, especially when many chemicals act in concert. Not surprisingly, expert testimony about causality is rarely conclusive.

The latency period between exposure and manifestation of illness obfuscates the search for causality. The latency period increases opportunities for further confounding causes to intrude. Moreover, the quantity and quality of evidence (including eyewitnesses) decays over time.

Advances in biomedical measurement may make the assignment of liabilities even more difficult. As lower and lower concentrations of chemicals in the environment become measurable, the number of chemical hazards for which human exposure can be measured, and hence the number of alternative explanations for an injury increases. As techniques for diagnosing vague symptoms improve, the potential number of measurable adverse effects increases as well (Katzen 1985).

The New Toxic Torts

The barriers of traditional tort law virtually prohibited the recovery of damages from long-term chemical injuries. Indeed, the inability of victims to internalize the costs of environmental damage through the tort process is a probable cause of the growth in environmental

regulation. In the past decade, changes in toxic tort law have been nothing less than revolutionary, although uneven from state to state. In some states barriers to recovery in toxic tort actions have also been reduced by statute (U.S. Congress 1980; Priest 1985).

Over 40 states have abandoned traditional statutes of limitations by adopting a "discovery rule." Under such a rule, the "clock begins to run" not with the chemical release but with the victim's exposure or the manifestation of injury. A few state legislatures, however, have reaffirmed the traditional statute of limitations, which begins at the time of the alleged exposure. In such states, recovery for long-latent damages from chemicals is nearly impossible, with exceptions for victims of Agent Orange and asbestos (Katzman 1985, chap. 3).

Landmark cases in the areas of pharmaceuticals and asbestos have addressed the problem of apportioning liability among defendants for a specific chemical exposure. Most courts have adopted rules of joint and several liability.[8] A chemical manufacturer may be joined as a defendant with a contractor (such as a transporter), a competitor who dumped a similar chemical in a common site, or a successive landowner. While a court may apportion liability according to the relative share of hazardous chemical produced or discarded, it need not do so. Once a joint defendant is found liable, the burden of apportionment is transferred from the plaintiff to the defendant. If other parties are unidentifiable or bankrupt, then one viable defendant may be held liable for all the damages. This rule of apportionment increases the probability that *someone* pays for environmental risks imposed on third parties.

While this rule serves the goal of compensating victims, it is counterproductive to efficient deterrence. By making a firm "its brother's keeper," the costs of poor waste-handling practices are spread to other firms, and incentives for deterrence are attenuated. Joinder attenuates incentives for risk reduction because the benefits may be shared by the industry rather than internalized in the firm (Katzman 1985, pp. 57–60). By employing joint and several liability to search for the "deepest pocket" for purposes of compensation, the courts have created a "moral hazard." The emergence of mutual institutions to offset the disincentives for deterrence is discussed below.

[8]Borel v. Fibreboard Paper Products Corp., 493 F.2d 1076 (5th Cir. 1974) permitted asbestos workers to sue the suppliers to their employers, without identifying one specific supplier whose asbestos caused disease. In Sindell v. Abbott Laboratories, 26 Cal.3d 588; Cal. 607 P.2d 924; 163 Cal.Rptr. 132 (1980), plaintiffs ingested a drug to suppress miscarriages. Several daughters developed cervical cancer during puberty. The court apportioned damages according to the manufacturers' market shares.

In tort actions involving hazardous chemicals, the courts have virtually abandoned the theory of negligence in favor of strict liability, as they had earlier in the areas of worker compensation and product liability (Priest 1985). While the plaintiff no longer has to prove that the defendant failed to exercise care in specific ways, recovery under strict liability still depends upon a formidable proof of scientific causation.

Insurability Consequences of Legal Risks

Underwriters have had difficulty in anticipating the behavior of the courts, and they seriously underestimated the legal risks of pollution exposures. Despite their caution, the premiums that insurers collected in 1983 were about one-third of the losses expected after eventual claims settlement.[9]

To offset their losses, it seems logical that underwriters would simply increase their premiums by a factor of three or more until they surpass the break-even point. There are two possible explanations why they have not done so: differential response of insurers and insured to ambiguity, and the adverse selection problem.

First, low probability losses are poorly calibrated and consequently ambiguous. Hogarth and Kunreuther (1985) have performed some interesting experiments on the impact of ambiguity about loss frequencies on both the offering price and selling price of insurance. They found that for very low-probability losses, insurers demand a premium that exceeds the expected losses by a substantial margin. The insured firms were willing to pay less than the expected loss, a common result (Slovic et al. 1977; Hershey and Schoemaker 1980). The more ambiguous the estimate of the frequency, the greater the divergence between required premiums and willingness to pay.

Second, in setting premiums, insurers may be less capable of discriminating among risk classes than the insured, an example of the "lemon" problem (Akerlof 1970). Premiums based on industry averages encourage firms that believe they are less risky than the average to self-insure. This exodus leaves the insurers with the riskier exposures. The ratio of losses to premiums then rises, the insurer raises its premiums, driving additional firms into self-insurance, ad infinitum. Insurers could attempt to reduce adverse selection by acquiring more information, but this is costly. Acquiring more information raises the overhead and premiums, further exacerbating adverse selection.

[9]"Insurers Warned to Write Pollution Coverage," *National Underwriter* (25 July 1985): 28.

Although the empirical relevance remains to be tested, these arguments suggest that an insurance market for low-probability risks might not emerge in the absence of financial responsibility requirements. Several states prohibit self-insurance and set the required insurance above the federal levels. These stricter requirements for financial responsibility do not appear to have affected the attractiveness of these states for either the insurer or the insured (AIRAC 1985, Table 5).

The Rise and Fall of the Market

Several major oil spills in the 1960s raised public and industry awareness of a whole class of accidents that could have long-term consequences. In response, the basic commercial insurance policy—the Comprehensive General Liability (CGL) form—written after 1971 appended a clause that excluded nonsudden or gradual pollution "occurrences." These were defined as continuous or repeated releases of pollutants that resulted in unanticipated or unexpected damages to persons and property (Tyler and Wilcox 1981). The exclusion did not apply to sudden chemical accidents, such as explosions, which are similar in temporal demarcation to mechanical accidents.

This exclusion created a gap in coverage and a potential opportunity. In response, Environmental Impairment Liability (EIL) policies were developed on the London market by 1973. As they have evolved, EIL or pollution liability policies have been tailored to the distinction between sudden and nonsudden pollution (Katzman 1985, chap. 5).

For common mechanical accidents the dating of the accident and loss is not difficult. As noted, however, there may be significant time lags between the time of a chemical release, human exposure, and manifest injury. The difficulty of defining the time of a nonsudden chemical release obfuscates the activation of conventional insurance policies, which are triggered by an occurrence. The insured may have been covered by several underwriters during the relevant period. The losses cannot easily be allocated among a sequence of insurers, who can never be sure that the books are closed on any given policy year.

To obviate this difficulty, EIL policies are issued on a "claims-made" basis rather than an occurrence basis. The insured is covered for claims made during the policy year, even if the gradual or recurring chemical release or human exposure occurred prior to the policy date.

EIL policies specify a retroactive date for such occurrences. At first glance, a retroactive date appears redundant because the policies are not activated by the pollution occurrence. Since businesses acquire and divest specific operations, it is important for the insurer to know how far back in time information must be collected. If an especially hazardous operation were divested before the retroactive date, current claims for resulting damages would not be honored.

While insurers have differed in their terms, all EIL policies cover liabilities for bodily injury and property damage to third parties, the cost of legal defense of a claim, and off-premises cleanup of a preventive nature. Some policies cover on-premises cleanup of a preventive nature, when there is an imminent off-premises hazard. All policies exclude damages resulting from willful violation of regulations and the costs of routine cleanup.

The intent of the insurance industry was to segment the market between liabilities from sudden occurrences and those that were gradual and nonsudden. The former, which includes conventional mechanical accidents, would continue to receive coverage under the traditional CGL policy, with its pollution exclusion. The latter, which includes latent pollutant damages, would be covered under the new EIL policy.

The CGL and EIL policies are quite different in their regulatory implications. The CGL policy is forward-looking, because incidents that occur in the future as a result of behavior in a given policy year are covered by that year's policy. The risk analyst and underwriter thus look at the future stream of losses resulting from this year's actions. Risk-based premiums thus have a deterrent effect on current risk-management decisions.

The EIL policy is backward-looking, because it is activated by claims made in the policy year resulting from past actions. The risk of insuring firms that were heavily engaged in handling chemicals (or shared facilities with such firms) depends more upon past risk-management practices than current ones. Chemicals released into the environment several decades ago may already have initiated latent diseases. While the past cannot be undone, some of the consequences can be.

In some cases, chemical spills are like a slow avalanche, which creates a present danger with ample warning. If firms are capable of remedial action, such as cleaning up older waste sites or purifying damaged aquifers, current behavior can affect current liability. Under the slow avalanche model, the current premium structure can reward mitigation efforts that reduce the probability and severity of an accident.

Nevertheless, the EIL policy may have perverse effects on deterrence. The claims-made format internalizes costs less efficiently than the occurrence format. Insurance premiums are factored into the cost of production, which is passed on to current consumers. Premiums on occurrence policies reflect future risks resulting from current production, and efficiency requires that current consumers pay these costs. Premiums on claims-made policies, in contrast, reflect risks from the past. Consumers who benefited from hazardous products in the past cannot be assessed once damage is discovered. The more involvement a firm had with hazardous chemicals in the past, the higher will be its claims-made premiums and the more its current customers will be overpaying. For new chemical firms, premiums will not reflect a legacy of the past, and its consumers will be underpaying for future risks (Abraham 1986, chap. 3).

Because they have no toxic skeletons in the closet, new firms may be able to purchase EIL insurance for lower premiums than established ones. This cost advantage might encourage the creation of new fly-by-night chemical or waste-management firms, which drive older firms out of business. This contingency raises the underwriters' risk, because Superfund authorizes direct claims against insurers of abandoned facilities.

In other respects, a claims-made policy is less risky for insurers than an occurrence-based one. In underwriting a claims-made policy, the insurer is not making a commitment into the indefinite future, when liability rules, medical detection technology, and jury awards may differ from today's. Furthermore, under a claims-made format, if an insured switches insurers from year to year, the liability falls unequivocally upon the insurer at the time the claim is made.

The claims-made format also imposes risks upon the insured. Suppose an insured firm undertakes a hazardous activity for a single year only, as a small part of a larger operation. This firm will have to purchase an EIL policy for the indefinite future, without any guarantee that coverage would be available in the future when damages may become manifest.

These considerations indicate great mutual advantages to long-term "monogamous" contracts between the insured and the insurer. Such a contract might specify annual adjustments for loss experience or for changes in interest rates. It might be voided if a facility were downgraded below industry standards. If the term of the contract is long enough, say more than 10 years, the distinction between claims-made and occurrence policies blurs.

Resuscitating the Market

Reductions in the number of pollution liability insurers are occurring just when federal and state financial responsibility requirements are being extended. As risk managers are demanding more insurance coverage, the supply is diminishing. How can this disequilibrium be resolved?

The collapse of the pollution liability insurance market in 1984 was partially a result of cyclical readjustments in reinsurance markets. The practice of setting premiums on the assumption of high-interest earnings proved disastrous when interest rates fell.[10] Unexpectedly high losses resulted from large mechanical accidents (such as satellite losses or oil rig collapses). Underwriters allege that large indemnity payments for toxic litigation contributed to their loss of underwriting capacity, although critics (Anderson 1985) contend that insuring asbestos manufacturers has been profitable.

To some extent the shortage of reinsurance is self-correcting, as premiums rise and new capital flows into this sector. The across-the-board spurt in insurance premiums and reduction in availability of coverage after 1985 reflect this equilibrating process. Market volatility also may be an aspect of learning how to insure a new line.

If the collapse of the pollution liability market were merely a cyclical or learning-curve effect, then the market would revive spontaneously. In this case, the proper public policy is to do nothing. So long as premiums are unregulated, the supply of insurance should be forthcoming.

There remain fundamental problems of insurability that result from legal risks. Judicial decisions in three areas have undermined the predictability of insurance contracts: (1) activation of liability policies for first-party damages; (2) reinterpretation of the pollution exclusion; and (3) adoption of theories of joint and several liability.

Indemnity for First-Party Cleanup

A liability insurance policy is intended to be activated by damage to third parties, not to the insured itself. EIL policies are not intended to indemnify insured firms for on-site cleanup necessary to comply with the law. Nevertheless, the courts increasingly require insurers to indemnify polluters for cleaning up their own property under the RCRA provision of preventing an imminent hazard to third parties (Schmalz 1982; Aickin 1985).

[10]"Money Management by Insurance Industry Blamed for Lack of Environmental Coverage," *Environmental Reporter* 16 (24 January 1986): 1789–90.

Underwriters argue that in arbitrarily rewriting insurance contracts, the courts are using their industry to finance a social program. The insurer's pocket is not so deep as the public believes. The $100–$200 billion estimated cost of cleanup (Aickin 1985) exceeds the $48 billion surplus and the $90 billion premium income of American property-casualty insurers (Huebner, Black, and Cline 1982, pp. 514–15).

While compelling in some respects, the insurance industry's argument is flawed. Rulings to indemnify the insured for the costs of on-site cleanup are efficient if the cost is less than the expected cost of off-site damage, that is, the probability of damage multiplied by its severity. Insurers might have to pay even more if the damage were permitted to occur. Indeed, voluntary efforts provide some evidence that some cleanups cost less than expected damages (Clean Sites 1984). This does not imply, however, that all EPA-ordered cleanups are cost-effective.

In principle, there is no reason why all insurers could not knowingly underwrite policies on cleanup costs, as several now do (AIRAC 1985). Insurers routinely cover accidents that have already happened, gambling on collecting a premium greater than the discounted settlement costs (Smith and Witt 1985).

Reinterpreting the Pollution Exclusion

The courts increasingly ignore the pollution exclusion by redefining gradual pollution as "sudden" and "accidental" from the standpoint of the insured's knowledge and intent (Rich 1985). In essence, the courts have transformed the CGL policy into a pollution liability policy with unlimited coverage. Because of the gradual nature of pollution, the limits of previous years can be activated ad infinitum once the coverage of one year has been exhausted. While such a layering of policies has not occurred so far, there is no guarantee that it will not in the future (Anderson 1985).

Uncertainty about judicial interpretation of *past* insurance contracts does not render future environmental liabilities uninsurable. If underwriters refuse to insure a single exposure henceforth, they will still encounter liabilities under old CGL policies. To obviate future confusion, the industry's Insurance Services Office has tightened the pollution liability exclusion in the CGL form. As of January 1986, the form did not include coverage for sudden and accidental pollution. On a prospective basis, this exclusion neatly partitions the market for pollution-related accidents from other risks. Contractual confusion about whether a particular incident is sudden or gradual is irrelevant in a consolidated claims-made EIL policy.

Joinder of Defendants

The widespread application of joint and several liability in toxic torts remains the single most important obstacle to insurability. When defendants are joined, an underwriter faces the risk of indemnifying a client for claims resulting from damages caused by other firms. In setting premiums, the underwriter can analyze the inherent risks of its insured, but it cannot easily assess the risks resulting from joinder. Although the underwriter can offer incentives to its client for reducing risks, it has no contractual means of influencing the behavior of firms with whom its client may be joined.

Joint and several liability is one focus of current tort reform debates. The limitation of a defendant's liability to its share of the damages also reduces the likelihood of a plaintiff's receiving full compensation, if other defendants are dissolved or bankrupt. Alternative approaches also are being pursued. Since joint and several liability can be viewed as mutual insurance de facto, the chemical industry appears amenable to more formal arrangements.

First, the development of chemical industry standards can reduce the insurer's risk of future damages from the joinder of a careful client to a careless competitor. Because voluntary standards are unenforceable against free riders, the chemical industry generally favors the establishment of tight statutory standards of care. Chemical firms currently inspect common disposal sites to make sure that RCRA standards are being enforced.[11] Insurers also have an incentive to monitor the insured's adherence to regulations, because coverage lapses in the event of willful violation.

Second, in collaboration with environmental organizations, the chemical industry has established a foundation aimed at restoring abandoned multiple-user hazardous waste sites. As suggested by the slow avalanche model, this voluntary cleanup reduces future perils from past practices.[12]

[11]Congressional testimony is summarized in *Chemecology*, the organ of the Chemical Manufacturers Association (CMA); see, for example, "Limit Landfill Use, CMA Spokesman Urges" (February 1983, p. 3) and "Disposal Law May Need Changes, CMA Spokesman Tells Congress" (May 1983, p. 12).

[12]For a description of individual initiatives, see the following in *Chemecology:* "3M Funds Disposal Site Cleanup" (September 1983, p. 10); "Chemical Company [Chevron] Voluntary Action Speeds Disposal Site Cleanup" (November 1983, p. 5); "Monsanto Earmarks $25 Million for 1984 Waste Cleanup Program" (April 1984, p. 8); "Industry Leader [Ciba-Geigy] Urges Voluntary Waste Cleanup" (April 1984, p. 8). For a discussion of the role of large companies in the formation of Clean Sites, Inc., also see *Chemecology:* "Speeding Hazardous Waste Site Cleanup—Industry, Conservationists Work Together" (May 1984, pp. 2–3); "Environmental, Industry Groups Tackle Hazardous Waste Disposal Sites" (July/August 1984, p. 2).

Third, the chemical industry can establish a mutual insurance company or a "captive." Adherence to industry standards of care can become a precondition of insurability. Because the chemical industry is in a better position to calculate its own risks than the insurers, industry-owned mutual insurance pools have a comparative advantage over traditional insurers. The superior technical knowledge of mutuals diminishes the adverse selection problem. Mutuals could contract with conventional insurers to perform claims-settlement and other administrative functions.

The rudiments of a mutual market are visible. An asbestos removal firm has formed a captive that will cover others in the industry (Tarnoff 1985). Hazardous waste management firms have formed a mutual, Waste Insurance Liability, Ltd. Sixteen chemical companies have established Primex, Ltd. to provide excess CGL coverage.[13]

Alternatives to a Pollution Liability Market

If the pollution liability market fails to revive spontaneously, there may be considerable political pressure to create artificial markets. For example, states might create assigned risk pools. Insurers that wished to write CGL policies in a state may be required to write EIL policies. Because a particular underwriter might refuse to do business in such a state, assigned risk pools would have to be established in all of the major underwriting jurisdictions simultaneously. Alternatively, the federal government might establish its own insurance program.

Assigned risk pools or federal insurance funds would function in a regulatory capacity only if they were able to set premiums freely. If premiums were regulated on grounds of equity or affordability, then insurance would serve no deterrent function. State automobile-liability pools provide poor examples of flexible premium setting, for most mandate cross-subsidies from good drivers to bad. Similarly, federal deposit, pension, crop, and flood insurance programs have suffered considerable pressures to equalize and subsidize premiums (Mehr and Cammack 1980, p. 257).

A federal pollution insurance program would be subject to intense lobbying on the part of business to obtain similar premium subsidies. Since the principle that "the polluter pays" is firmly entrenched in

[13]"House Panel, Association Announce Efforts to Resolve Environmental Insurance 'Circus'," *Environmental Reporter* 16 (17 January 1986): 1766–67; *Insurance Review* 48 (September 1986): 16.

public policy, public anxiety over toxic chemicals may eliminate pressures to make premiums "affordable."

If none of these insurance strategies work, the experiment in market-mediated risk management will fail. The remaining approach is to separate the problems of deterrence and victim compensation. Statutory standards of care would continue to serve the deterrent function, badly at that. Either first-party medical and disability insurance or a quasi-public fund, such as workers' compensation, would serve the compensation function.

First-party insurance for medical expenses and property damage is a workable risk-spreading device (Danzon 1984). Insurers would not have to distinguish between environmental, occupational, or other causes. Such injuries as pain and suffering, emotional distress, and birth defects are not insurable on a first-party basis. Requiring victims to pay for their own insurance against pollution-engendered damages, however, would be perceived as unfair by the public.

In contrast, the system of workers' compensation is funded by the employer and accepts "rebuttable presumptions" of causality that lessen the burden of proof and expedite compensation on a no-fault basis. The establishment of workers' compensation was supported by both management and labor as a means of reducing the transactions costs of settlement. As a result, the expected value of the recovery could increase without radically increasing the payments by employers (Friedman and Ladinsky 1967). Since the premiums are based upon the employer's particular loss experience, the system provides positive incentives for careful risk management.

A congressionally mandated study suggested the creation of a two-tiered compensation mechanism for toxic injuries. Tier one consists of an administrative system for reimbursing medical payments and lost wages, based upon rebuttable presumptions. The compensation fund is to be financed by a tax on the production of chemicals, such as that earmarked for Superfund. Tier two consists of the new toxic tort law, with more formidable barriers to recovery balanced against the potential for large awards for pain, suffering, and other damages. Because of the lesser burden of proof, tier one would offer recovery to a larger number of victims than tier two, but at a considerably lower level of compensation (Soble 1977; U.S. Congress 1980).

When Superfund was passed, victim compensation schemes like those outlined in tier one were defeated. Opponents saw the attenuated burden of proof as offering an open-ended entitlement. Citing the experience of the Black Lung Fund for miners (Strader and Sheehe 1981), opponents saw no grounds for excluding anyone with

the remotest claim of environmental exposure to chemicals (Schmalz 1982).

Conclusion

The problem of environmental risk management is difficult, and there is no panacea. The most fruitful approach to risk management is developing statutory regulation, tort law, and insurance as a mutually reinforcing tripod. This is not eclecticism for its own sake, for each regime plays an essential role. Statutory financial responsibility requirements increase the chance that the successful plaintiff will not face a bankrupt defendant. Statutory standards of care, supported by the chemical industry, reduce the moral hazard from joint and several liability. A tort system provides a basis for compensation unattainable through regulatory statutes. Under a stable statutory and tort regime, pollution liabilities become more predictable and hence more insurable.

Undoubtedly, environmental risks are far more complex and more difficult to understand than most insurable exposures, and the knowledge base for effective risk management is weak. There are positive signs, however, that the art of environmental risk analysis is developing rapidly under the impetus of market incentives. Based upon solid risk analysis, insurance premiums can serve as powerful incentives for achieving cost-effective risk-reduction decisions.

Would efficient risk-management decisions, arrived at by market signals, be socially acceptable? The lack of public acceptance of some technological hazards, such as toxic chemicals or nuclear power, often dumbfounds engineers and economists, who believe they have "proven" that these technologies are safer than household hazards. In despair, these experts attribute this discrepancy to irrationality, ignorance, or irresponsible interest-group politics.

While the public tends to overestimate the frequency of rare accidents, they have fairly definite perceptions of the attributes of hazardous technologies. The public is particularly averse to technologies that burden the few with substantial costs for the benefit of the many. As a consequence, potentially efficient chemical risk management decisions may be unacceptable unless compensation is actually paid, swiftly and surely to redress the asymmetry.

The new toxic tort regime and financial responsibility requirements make a substantial contribution to victim compensation and thus to reducing public aversion to chemical hazards. The critical element is the creation of a viable competitive market in pollution liability insurance. While no panacea, pollution liability insurance

can serve as the keystone of an efficient and equitable environmental risk management system.

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Interest Groups and the Antitrust Paradox

Bruce L. Benson, M. L. Greenhut, and Randall G. Holcombe

Economists have generally assumed that the intention of the antitrust laws is to increase economic efficiency. Many observers, however, have noted that the antitrust laws are applied inconsistently and often do not use economic analysis to promote economic efficiency. Judge Robert Bork (1979) referred to this failure of the antitrust laws to promote economic efficiency as the "antitrust paradox," and Peter Asch (1970) called it the "antitrust dilemma." The special interest theory of regulation developed by Stigler (1971) and others assists in understanding the antitrust paradox, because pursuant to it one must not expect antitrust to be applied to benefit the general public.[1]

The special interest view of economic regulation has found its way into evaluations of the antitrust laws.[2] For example, Judge Richard Posner (1969, p. 87) claimed that Federal Trade Commission (FTC) investigations are seldom in the public interest and are undertaken "at the behest of corporations, trade associations, and trade unions whose motivation is at best to shift the costs of their private litigation

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[1]Stigler (1985) does not see the special interest theory as completely convincing in the case of antitrust. Some extensions of the special interest theory of government are found in Posner (1974), Peltzman (1976), McCormick and Tollison (1981), Becker (1983), and Holcombe (1985). Some of the many empirical examinations of the theory include Abrams and Settle (1978), Jarrell (1978), Kau and Rubin (1978), McCormick and Tollison (1981), Smith (1982), and Ross (1984). A parallel development to the literature on interest group regulation is the rapidly growing literature on rent seeking. See Tollison (1982) and Benson (1984) for a discussion of the relationship between the two developments and reviews of the relevant literature.

[2]See, for example, Posner (1969), Faith et al. (1982), Weingast and Moran (1983), Benson (1983b), Benson and Greenhut (1986), and High (1984–85).