Chapter 5

Liability Rules

Liability rules are used to guide compensation decisions when polluters are sued for damages in a court of law. Such rules, although employed only after damages occur and only if victims are successful in their suit, can provide ex ante incentives for polluters to use more environmentally friendly production practices. In this chapter, we discuss two relevant types of liability rules.

Introduction and Overview

Individuals who are damaged monetarily or otherwise by the activities of others may have the right to sue for damages in a court of law. If the suit is successful, the court may be guided in its compensation decision by a rule of law or precedent, known as a **liability rule**. The liability rule, while imposed *ex post*, serves as an *ex ante* incentive to deter individuals or firms from engaging in activities that may be damaging to others. For example, liability rules can be designed to hold polluters liable for the damages they cause. If polluters feel that their production decisions may result in damages for which they may be held liable, then they will likely weigh the benefits from participating in pollution-related activities against the penalties that they may expect to face as a result of their actions.

In this chapter, we will review how liability creates incentives to influence producer behavior, and the different forms these rules can take. For each form, we discuss the properties of the rule and compare them with other types of incentives.

Important Features of Liability

Liability rules are a form of performance-based incentive in that they are imposed after damages are realized (Shavell 1987). However, liability rules differ from traditional performance-based incentives because they are imposed only if a suit is privately or publicly initiated, and if a court of law rules in favor of the damaged parties.[1] Instances may therefore arise in which damages occur but no payments are made.

[1] Shavell (1987) discusses circumstances for which publicly and privately initiated approaches are most appropriate.

Liability rules can be developed under two different frameworks that are relevant for polluters: (1) strict liability and (2) negligence. Polluters are held absolutely liable for payment of any damages that occur under **strict liability**. Polluters are liable under a **negligence** rule only if they failed to act with the "due standard of care" (Segerson, 1995). For example, a producer would presumably not be found negligent (and hence liable) in the pesticide contamination of groundwater if the pesticide was applied in accordance with the manufacturer's specification and the laws regarding application procedures.

When multiple polluters exist, the principle of "joint and several liability" allows damage costs to be divided among polluters according to any distribution of the court's choosing (unless a specific distributional rule takes precedent). The distribution does not have to be based on the polluter's marginal contribution to damages. In fact, it is possible that one polluter could be held liable for all damages. That polluter is then free to sue other responsible parties to share the burden (Miceli and Segerson, 1991; Segerson 1995).

The relationship between polluters and the victims is important for choosing an appropriate liability rule. The relationship may be defined as one of either unilateral care or bilateral care (Segerson, 1995). **Unilateral care** is a situation in which only the polluter influences damages. In other words, the victim has no way of protecting himself. Alternatively, it is sometimes possible for the victim to protect himself. For example, the victim may be able to purchase a filtration system to protect against contaminated ground water. This situation is known as **bilateral care**, and any liability rule takes into account the potential for each party to act to reduce damages. Under some rules, liability is not assessed to polluters if the victim failed to take reasonable preventive actions (Segerson 1995).

Liability When Victims Cannot Protect Themselves (Unilateral Care)

The following discussion is based on the assumption of joint and several liability. In addition, unilateral care is assumed because strict liability rules are efficient if polluters can undertake preventive actions for the victims (Segerson 1990) (e.g., producers could purchase water purifiers for all victims if that is the least-cost solution for efficient pollution abatement).

Strict Liability Rules

Producers face uncertainty as to whether or not they will successfully be sued for damages resulting from agricultural nonpoint pollution. This uncertainty is likely to be site-specific and to depend on the ambient pollution level that results from the collective actions of all producers, as well as other uncertain factors such as knowledge of pollutant transport and the ability to identify individual pollutant sources. Consequently, each producer has expectations relating to natural events that influence pollution, the probability of successfully being sued, and other uncertain factors that might influence this probability. In general, producers' expectations may differ from those of the resource management agency defining the rules.

A strict liability rule that can be used to attain efficient nonpoint-source pollution control is developed in appendix 5A. The rule is developed so that each producer expects to pay the total expected damages from pollution, plus or minus a lump sum component that distributes payments across polluters so that total payments equal total damages. However, while each producer expects to pay the same variable portion of the liability rule, the actual rule would have to be site-specific to account for each producer's beliefs about the nonpoint process and about the probability of being sued and found liable. Liability must be higher for producers who do not believe they will be sued and/or found liable to achieve optimal pollution control. Effectively, the site-specific aspects of the rule alter the uncertainty each producer faces about random events (weather, economic conditions) and the prospect of being sued and held liable so that the producers' and the resource management agency's expectations about uncertain events are the same. Equivalent expectations is a condition for efficient pollution control.

Finally, lump sum components must be applied to producers operating on extra-marginal land to ensure optimal entry and exit. Unlike other incentive-based instruments such as taxes, it is not possible to use lump sum instruments to reduce producers' payments to zero under liability rules because the victims must be compensated. Therefore, lump sum portions of the liability rule can be applied to producers operating on marginal and inframarginal acreage and designed to ensure that total liability payments equal total damages. This could be accomplished by providing each producer with a refund of the variable liability payment, and dividing total damages among all producers according to some distributional rule.

Negligence Rules[2]

Under a liability rule based on negligence, a producer is held liable only if he/she failed to operate under the "standards of due care." "**Due care**" can be measured either in terms of performance-based outcomes or in terms of a producer's actions. Producers may collectively be held negligent if realized damages from pollution in a water body are found to be in excess of some acceptable level. Excess damages would be an indication that at least some producers in the watershed are not using acceptable production practices. Under this rule, all producers in a watershed would be liable for damages if affected parties brought suit. Such a negligence rule, however, does not correct for suboptimal entry and exit. Because the rule applies only to those producers operating at the time the damages occurred, there is no mechanism for applying lump sum components to guarantee optimal entry and exit (Miceli and Segerson, 1991). In addition, by producing at suboptimal levels to avoid the possibility of liability, producers may bring into production more than the economically efficient amount of land (Miceli and Segerson, 1991).

Alternatively, an individual producer may be held negligent if inputs that increase runoff are used above optimal levels, inputs that mitigate runoff are used below optimal levels, or if the technology in use per-

[2] The mathematical basis for negligence rules is developed in appendix 5B.

forms poorly in reducing runoff relative to the optimal technology. Damages would be paid only by those producers not using acceptable production practices. This approach would be more costly to administer than the pollution-based rule, since the acceptable management practices would have to be identified for each site, and each site would have to be monitored for compliance. However, it is more fair in that only those producers who are likely generating unacceptable levels of runoff would be liable. In addition, an efficient solution will generally be attainable.

Liability When Victims Can Protect Themselves (Bilateral Care)

Situations may exist in which victims have opportunities to take precautions that producers cannot take for them (Wetzstein and Centner, 1992). If so, then strict liability rules applied to producers are no longer efficient because victims may suboptimally protect themselves if they feel that they can collect the full amount of damages. This result would apply to the negligence rules derived in appendix 5B as well, since the components of these rules are based on strict liability. Wetzstein and Centner (1992) suggest the use of a modified strict liability rule based on victim precaution requirements. While not derived here, a modified rule as they propose could be incorporated into either of the negligence rules developed in Appendix 5B. For example, negligence rules would be recommended for relatively safe agricultural chemicals, while strict liability would be recommended for the use of more hazardous materials.

Empirical Evidence

Both State and Federal regulators have tended to hold producers liable for damages resulting from chemical use only if they failed to apply registered chemicals in accordance with the manufacturer's instructions and any related laws (Wetzstein and Centner, 1992; Segerson, 1990; Segerson, 1995). For example, the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) restricts producers' liability in this manner.

In more than 30 States, agricultural producers applying chemicals that contaminate groundwater may be held liable under a strict liability standard (Centner, 1990). Groundwater exemption legislation that holds producers to a negligence rule has been passed or proposed in Arizona, Connecticut, Georgia, Iowa, Minnesota, New York, and Vermont. Producers in these States would be exempt from strict liability if they use chemicals "properly." In Connecticut, a producer is required to keep records of pesticide use and groundwater protection plans for 20 years after application to demonstrate due care (Lee and Leonard, 1990).

Many States make compliance with acceptable agricultural best-management practices a defense to nuisance actions (ELI, 1997). Negligence rules of this sort are consistent with the philosophy that producers have a basic "right to farm" and that they should not be penalized as long as they adhere to standard, accepted practices. However, because current negligence rules are based on what has been accepted historically, they may not reflect the current damages caused by previous "standard, accepted practices," and pollution levels will be excessive relative to optimal levels.

Summary

The characteristics of nonpoint-source pollution, including dispersion of harm and the inability to identify sources, could make very small the probability of a producer being sued and held liable under strict liability rules. A negligence rule may be more appropriate in these cases because it is not necessary to prove a producer's contribution to damages. A producer would not be held liable if he/she complied with acceptable farming practices.

In general, liability rules suffer from many of the same problems that ambient-based incentives do. To achieve an optimal solution, all producers must have realistic beliefs about their collective effects on ambient pollution levels, the profit functions for all sites, and the joint distribution functions of all other producers. The rule-making system must account for each producer's beliefs about the actions of other producers and about aspects of the nonpoint process. For negligence rules, the system must also have site-specific information about producers as well as information about the nonpoint process in order to identify the "optimal" set of practices that defines "due care." These unrealistic assumptions about the information required for producers and the rule-making system limit the feasibility of liability rules.

Finally, the litigation process for liability may be expensive relative to other regulatory methods (Shortle and Abler, 1997). This expense may prevent individuals from attempting to claim damages, letting polluters go unregulated (Shavell, 1987). Thus, liability rules are likely to be at most second-best when transaction costs are considered, and are probably best suited for the control of pollution related to the use of hazardous materials or for infrequent occurrences such as accidental chemical spills or manure lagoon breaks (Wetzstein and Centner, 1992; Shortle and Abler, 1997).

Appendix 5A— Strict Liability Rules[3]

Suppose the extent of producers' liability depends on the damages that arise as a result of the ambient pollution level. It is appropriate for the liability rule to depend on the ambient pollution level as well. Define a site-specific liability rule in general terms by the function $L_i\ (a)$. Producers are held liable only if they are sued by a damaged party and are found to be responsible. Therefore, producers face additional uncertainty about whether or not they will be held liable. Producers have their own beliefs regarding the site-specific probability that they will be sued and held liable, and their own beliefs about the distribution of random variables influencing natural events. Denote the site-specific probability that a producer will be sued and held liable as $q_i\ (a, \eta_i)$, where η_i is a vector of random variables that may influence this probability.[4] Similarly, denote a producer's site-specific joint distribution function defined over all random variables as $h_i\ (v, W, \eta)$ where v is an (nx1) vector with ith element v_i, and η is an (nx1) vector with ith element η_i. In general, a producer's site-specific joint distribution, $h_i\ (v, W, \eta)$, differs from the rule-making system's, denoted by $g\ (v, W)$.

Assuming producers to be risk-neutral, each producer will choose input use to maximize expected per-acre profit, restricted on the choice of technology

$$V_i(A_i) = \underset{x_{ij}}{Max}\left\{p_i(x_i, A_i) - E_i\{q_i(a,h_i)L_i(a)\}\right\}$$

where E_i is the mean operator corresponding to $h_i\ (v, W, \eta_i)$. The first-order necessary condition for an interior solution is

$$\begin{aligned}&\frac{\partial p_i}{\partial x_{ij}} - E_i\{[q_i(a,h_i)L_i'(a) + \\ &\frac{\partial q_i}{\partial a}L_i(a)]\frac{\partial a}{\partial r_i}\frac{\partial r_i}{\partial x_{ij}}\} = 0 \quad \forall i, j\end{aligned} \tag{5A-1}$$

The solution to (5A-1) yields input use as a function of technology choice, $x_i(A_i)$. The producer's optimal choice of technology, A_i^{**}, will satisfy the following condition

$$\begin{aligned}&V_i(A_i^{**}) - V_i(A_i') = [p_i(x_i(A_i^{**}), A_i^{**}) \\ &-p_i(x_i(A_i'), A_i')] - \{E_i\{q_i(a^{**}, h_i)L_i(a^{**})\} \\ &-E_i\{q_i(a,h_i)L_i(a')\}] \geq 0 \quad \forall A_i' \neq A_i^{**}\end{aligned} \tag{5A-2}$$

where $a^{**} = a(r_1^{**},..., r_n^{**}, W)$, $a' = a(r_1^{**},...,r_i(x_i(A_i')\ A_i'),..., r_n^{**}, W)$, $r_i^{**} = r_i(x_i^{**}, A_i^{**}, v_i)$, and $x_i(A_i^{**})$.

An Efficient Liability Rule

Comparison of (5A-1) with (2A-1) implies that the following liability rule, when applied under strict liability, ensures the marginal conditions for efficiency will be satisfied:

$$L_i(a) = [D(a) + k_i]\left[\frac{g(\cdot)}{q_i(a,h_i)h_i(\cdot)}\right] \tag{5A-3}$$

where k_i is a lump sum amount that is yet to be defined. To see that rule (5A-3) leads to the efficient marginal conditions, note that the liability each producer expects to be held responsible for ex ante under rule (5A-3) is

$$\begin{aligned}E_i\{q_i(a,h_i)L(a_i)\} &= \iiint q_i(a,h_i)\Big\{[D(a)+k_i] \\ &\quad [\frac{g(\cdot)}{q_i(a,h_i)h_i(\cdot)}]\Big\}h_i(\cdot)dndwdh_i \\ &= \iint [D(a)+k_i]g(\cdot)dndw \\ &= E\{D(a)+k_i\} \quad \forall i\end{aligned} \tag{5A-4}$$

[3] The mathematical foundations for efficient, strict liability rules are developed in this appendix. Unless otherwise stated, the underlying model and assumptions are as developed in Appendix 2A.

[4] Segerson (1995) defines q as a deterministic function of a.

Thus, each producer expects to pay an amount equal to total expected damages, plus a constant. The producer's marginal conditions for input use (conditional on technology) will be efficient because taxes of the same form as the left-hand side of (5A-4) have been shown to induce the efficient marginal conditions (Horan et al. 1998a,b; Hansen 1998).

For the special case in which $q_i = 1$ and $g(\nu, W) = h_i(\nu, W, \eta)$, the liability rule defined by (5A-3) becomes uniform. More generally, however, the liability rule in (5A-3) is also a nonlinear function of ambient pollution levels and is site specific. Even though the efficient liability rules are site specific in general, each producer will expect to pay the same variable amount, plus or minus a lump sum amount.

Each producer expects to pay the same variable portion of the liability rule because the liability rule is designed to offset the effects of heterogeneity. In effect, the "correction term" $g(\cdot)/(q_i(a, \eta_i)h_i(\cdot))$ alters the uncertainty that each producer faces about random events and the prospect of being held liable so that each faces the same uncertainty as the resource management agency. Liability must be higher for producers who either believe they will not be found liable (i.e., $q_i\ (a, \eta_i)$ is small) or who feel they do not contribute to ambient pollution levels (i.e., $h_i(\cdot)$ is small) in order to induce them to operate efficiently.

The lump sum part of the liability rule is used to ensure longrun efficiency and to ensure that total payments equal total damages, as is required in a liability framework. For producers operating on extramarginal land, the lump sum component can be set to ensure that these producers expect it to be more profitable to retire extramarginal acreage from production. For producers operating on marginal or inframarginal land, setting the lump sum portion of the expected liability rule as follows ensures that polluters in the region are held liable for total damages

$$k_i = \frac{q_i(a^*, h_i)h_i(\cdot)}{g(\cdot)}[D(a^*)]r_i - D(a^*) \quad \forall i \le n \qquad \text{(5A-5)}$$

where ρ_i defines the manner in which damages will be distributed among producers ($\sum\rho_i = 1$). Thus, total damages are divided among producers on a site-specific basis, minus a lump sum refund of the variable payment. Because k_i depends on the realization of the term $D\ (a^*)$, k_i, is random *ex ante*.

The distribution of payments (i.e., ρ_i) can take a variety of forms. For example, suppose that

$$r_i = p_i^* / \sum_{i=1}^{n} p, \text{ where } p = \sum_{i=1}^{n} p_i^*$$

Then, a budget-balancing solution will exist when each producer operating on marginal or inframarginal land expects to earn profits after liability payments

$$p_i^* - E_1\{q_1 D(a^*)\}\frac{p_i^*}{p} \ge 0 \qquad \text{(5A-6)}$$

Condition (5A-6) can be written as

$$[p - E_1\{q_i D\}]p_i^* \ge 0 \qquad \text{(5A-7)}$$

which implies that the ex ante budget-balancing condition is feasible (i.e., no marginal or inframarginal land will be retired due to the expected liability payment) if

$$p \ge E_i\{q_i D(a^*)\} \quad \forall i \le n \qquad \text{(5A-8)}$$

This condition requires that aggregate pre-liability profits be greater than expected damages when $q_i = 1$, and less than expected damages otherwise. Uniform and other distributions for ρ_i are feasible under more stringent conditions (see e.g., Horan and others, 1998a for a discussion of budget-balancing solutions for ambient-based taxes).

The informational requirements necessary to attain an efficient outcome under strict liability are extreme. The resource management agency must have perfect information on each producer's production, runoff, and joint density functions, and fate and transport. Each producer must also have perfect information on his own as well as other producers' production, runoff, and joint density functions.

Appendix 5B—Negligence Rules[5]

Under a negligence rule, producers are held liable only if they failed to use the "due standard of care." This standard may be defined either in terms of a damage (or other performance-based) target, D_0, or in terms of design (i.e., input use and technology) standards.

First, consider the class of negligence rules based on input use and technology. Define Θ_i as the set of A_i such that $E\{D(a^*)\} \leq E\{D(a_i^*)\}$, where

$$a_i^* = a(r_1^*, \ldots, r_{i-1}^*, r_i(x_i^*, A_i, n_i), r_{i+1}^*, \ldots, r_n^*, W)\ \forall i$$

Then an optimal negligence rule is

$$N_i(a) = \begin{cases} L_i(a) & \text{if } \begin{cases} y_i > y_i^*, z_i < z_i^*, A_i \in \Theta_i \forall i = 1, \ldots, n \\ \hline y_i > y_i', z_i > z_i', A_i \in \Theta_i' \ \forall i > 0 \end{cases} \\ 0 & \textit{otherwise} \end{cases} \tag{5B-1}$$

where y_i is the subset of inputs that increases runoff levels, z_i is the subset of inputs that reduces runoff levels, and $L_i(a)$ is the liability rule defined by (5A-3) and (5A-5).

Efficient entry and exit are ensured by setting input and technology standards y'_i, z'_i and Θ'_i at levels such that profitable operation on acres $i > n$ is not possible without being held liable. Thus, producers who fail to retire extramarginal land will be subject to liability if they attempt to produce at profitable levels. However, because the liability rules, $L_i(a)$, have been designed to ensure efficient entry and exit, production on extramarginal land will not be expected to be profitable. Alternatively, producers operating on marginal or inframarginal land will choose to operate at the efficient level and pay no penalty. If they chose to operate at greater levels of y_i, smaller levels of z_i, or at technology outside of the set Θ_i, then they would be subject to a significant penalty in the form of the liability rule. Thus, producers expect to be more profitable by operating at the efficient level.

Alternatively, a negligence rule could be based on a damage target, D_0. For the damage target, all producers are held liable whenever $D(a) > D_0$. Otherwise, no producer is held liable. Consider the following negligence rule

$$N_i(a, D_0) = \begin{cases} \{L_i(a) & \textit{if} \quad D(a) > D \\ 0 & \textit{otherwise} \end{cases} \tag{5B-2}$$

where $L_i(a)$ is again the liability rule defined by (5A-3). The k_i terms (in $L_i(a)$, see 5A-3), however, are not necessarily defined as in (5A-6). In the strict liability case, the k_i terms are constructed to ensure efficient entry and exit and that the aggregate liability equals total damages. However, such a construction will not necessarily be effective in limiting entry when a negligence rule is imposed because it is not possible to target specific polluters and specific production practices as it is with the negligence rule (5B-1). Instead, polluters may all avoid liability by producing at suboptimal levels (Miceli and Segerson, 1991), and production may be profitable on more than the efficient number of acres without the threat of a liability penalty.

[5] The mathematical foundations for efficient negligence rules are developed in this appendix. Unless otherwise stated, the underlying model and assumptions are as developed in Appendix 2-A.