Analyzing
SUPERFUND
Economics, Science, and Law

Edited by
Richard L. Revesz and
Richard B. Stewart

Resources for the Future
Washington, DC
©1995 Resources for the Future

All rights reserved. No part of this publication may be reproduced by any means, either electronic or mechanical, without permission in writing from the publisher, except under the conditions given in the following paragraph.

Authorization to photocopy items for internal or personal use, the internal or personal use of specific clients, and for educational classroom use is granted by Resources for the Future, provided that the appropriate fee is paid directly to Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, USA.

Printed in the United States of America

Published by Resources for the Future

1616 P Street, NW, Washington, DC 20036-1400

Library of Congress Cataloging-in-Publication Data

Analyzing superfund: economics, science, and law; Richard L. Revesz and Richard B. Stewart, editors.
p. cm.
Includes bibliographical references and index.
ISBN 0-937072-75-4


HC110.P55A59 1995

363.7287 94-1681

The paper in this book meets the guidelines for permanence and durability of the Committee on Production Guidelines for Book Longevity of the Council on Library Resources.

This book is the product of the Center for Risk Management at Resources for the Future. Terry Davies, director. It was copyedited by Eric Wurzbacher. The book and its cover were designed by Diane Kelly, Kelly Design.
5

Evaluating the Effects of Alternative Superfund Liability Rules

Lewis A. Kornhauser and Richard L. Revesz

One of the central issues in the Superfund reauthorization debate concerns the fate of joint-and-several liability. The 1986 Superfund statute did not specify whether potentially responsible parties (PRPs) would face joint-and-several liability rather than nonjoint (several only) liability. In the face of this legislative silence, the courts followed the approach of the Restatement (Second) of Torts and have imposed joint-and-several liability for indivisible harm—harm for which there is not a reasonable basis of apportionment (Kornhauser and Revesz 1989, 851-53). The Superfund Amendments and Reauthorization Act of 1986 (SARA) implicitly ratified the imposition of joint-and-several liability, at least in some circumstances, by establishing a right to contribution; such a right would not arise in the absence of joint-and-several liability.

In the reauthorization debate, two groups recently have urged various curtailments in the use of joint-and-several liability. The National Commission on Superfund, comprised of twenty-six leaders from the various Superfund constituencies, did so in its final consensus report (National Commission on Superfund 1994). The Clinton administration likewise urged such curtailments in its bill submitted to the 103rd Congress in February 1994 (H.R. 3003).

The commission recommended a scheme under which PRPs would generally be responsible only for their own share of the costs and would typically not have to bear responsibility for any orphan shares of insolvent or unidentified PRPs, if they accepted a determination of their share performed by a neutral third party. Orphan shares would be funded by an increased tax and would be charged to the PRP's participating in the allocation process only if the proceeds of the tax were insufficient. Joint-and-several liability would be retained for parties that
did not comply with the requirements of the allocation process (National Commission on Superfund 1994, 14–21).

Under the Clinton administration’s Superfund bill, PRPs that accept a neutral determination of their share of the liability would not be responsible for amounts attributable to insolvent PRPs, but they would have to pay their share of amounts attributable to unidentified PRPs. Even under the current Superfund statute, courts have disagreed somewhat about what it means for a harm to be indivisible, thereby triggering joint-and-several liability.

This chapter seeks to inform the reauthorization debate by comparing the effects of joint-and-several liability to those of nonjoint liability on the basis of three criteria: deterrence, settlement-inducing properties, and fairness. Our major conclusion is that, with respect to each of these criteria, neither rule dominates the other.

Our discussion in this chapter focuses on a simple situation: a single plaintiff, whether the U.S. Environmental Protection Agency (EPA) or a state, seeks to recover cleanup costs from two defendants; we therefore do not focus on many of the real-world complications posed by Superfund. We proceed in this fashion because it is important to understand the basic questions raised by joint-and-several liability before dealing with additional complications. The major insights of this chapter are applicable to more complex situations as well.

DETERRENCE

We consider in this first part the relative effects of joint-and-several liability and nonjoint liability in transmitting to generators of hazardous wastes appropriate incentives for waste reduction and care. The first section of our discussion on this topic covers the role of liability rules in transmitting incentives for desirable conduct concerning wastes generated both before and after the passage of Superfund. The second section presents the model that guides our inquiry. The third section analyzes the situation in which the generators have sufficient solvency to satisfy the judgments entered against them; it shows that joint-and-several liability and nonjoint liability have identical effects but that both, when coupled with strict liability, produce underdeterrence. The fourth and final section studies how the situation is different when one of the defendants has limited solvency; it shows that, under these circumstances, it is not possible to draw any general conclusion about whether joint-and-several liability is preferable to nonjoint liability. (A more technical treatment of the issues discussed in these last two sections can be found in Kornhauser and Revesz 1989, 1990.)

THE EFFECTS OF ALTERNATIVE SUPERFUND LIABILITY RULES 117

The Role of Liability Rules

The relative desirability of competing regimes’ imposing liability on generators of hazardous wastes should be evaluated by reference to the incentives that the regimes transmit for desirable conduct. Generators make several relevant decisions that can be influenced by liability rules; the following list is by no means exhaustive.

First, a generator must determine the volume of hazardous wastes that it will produce. Because the wastes are generated as a byproduct of profitable economic activity, this decision is affected by the costs of different production processes as well as the expected liability associated with the generation of hazardous wastes. So, for example, a generator must trade off the costs of more expensive production processes that would yield a smaller amount of wastes per unit of useful output against the higher costs, including the expected liability, of disposing of a larger amount of wastes.

Second, a generator must determine whether to recycle, to treat (that is, render nonhazardous), or to dispose of the wastes. Each of these processes has certain immediate costs and gives rise to different levels of expected liability.

Third, a generator must choose a level of care for the handling of the wastes in the predisposal phase. More care raises the cost of disposal but decreases the generator’s expected liability.

Fourth, for wastes that it chooses to dispose, a generator must choose a disposal site. Different sites might charge different fees, present different risks that at some point hazardous wastes will be released into the environment, and give rise to different cleanup costs in the event of a release.

Fifth, both in the case of on-site and off-site disposal, a generator must decide on the effort that it will expend in monitoring the disposal site to detect releases of the wastes into the environment. In fact, such monitoring has led to the cleanup of a number of sites that are not on the National Priorities List (NPL). Once a release occurs, cleanup costs might rise quickly as a function of the time that the problem is left unattended. Thus, by monitoring a site and perhaps undertaking a cleanup before the site has come to the attention of EPA, a generator can reduce its liability. Here, a trade-off exists between the monitoring costs and the expected liability.

Sixth, once a release is detected—whether by the generator, by another PRP, or by EPA or a state—a cleanup has to be undertaken. A liability scheme can provide incentives for the generator to act to ensure that the cleanup is performed in a cost-effective manner.

In analyzing the effects of liability rules, the Superfund program should be separated into two distinct components: a prospective com-
pensive, for wastes generated and disposed after the passage of the statute in 1980; and a retrospective component, for wastes generated and disposed prior to the passage of the statute.

Obviously, with respect to the retrospective component, a liability scheme cannot create incentives for actions that have already been completed. They can, however, provide incentives for monitoring the site and for ensuring that a cleanup is performed in a cost-effective manner. Opponents of retrospective Superfund liability typically overlook these incentives.

With respect to monitoring, it would be desirable if PRPs undertook cleanups at non-NPL sites before the site came to the attention of EPA or the state (Probst and Portney 1992, 15). Not only would EPA then be able to better deploy its scarce enforcement resources, but environmental problems could be addressed earlier, before the cleanup costs escalated. This problem of cost escalation is particularly acute under the Superfund program, where groundwater remediation comprises a large part of cleanup costs. Such remediation is less likely to be necessary, or its extent reduced, if the cleanup is undertaken soon after the problem is discovered.

With respect to cleanup decisions, there is strong evidence suggesting that, for a given cleanup level, the cleanup costs are lower when the actions are undertaken by PRPs rather than by EPA; current estimates of this differential run at around 20%. Moreover, EPA is constrained in the number of sites at which it can supervise cleanups. It has no alternative but to do so at sites that have no PRPs with the resources or expertise to perform cleanups. For other sites, it relies heavily on PRPs, which now perform about 70% of the cleanups. The vast majority of the PRPs currently undertaking cleanups generated hazardous wastes before the passage of Superfund. If these parties did not face liability, the cleanups would have to be performed by EPA. Thus, in the absence of retroactive liability, not only would cleanup costs be higher, but our ability to address the problem of contaminated sites would be impaired.

The Model

In our analysis we model a situation in which two manufacturers, Row and Column, dispose of hazardous wastes at a single landfill. These actors benefit from the dumping because the wastes are the byproduct of profitable economic activity. At some time in the future, these wastes may leach into the environment and cause serious damage, including, perhaps, the contamination of groundwater supplies. For ease of exposition, we think of this damage as the cost of cleaning up the landfill and the surrounding area affected by the release. We assume initially that, as the volume of wastes at the landfill grows, this cost increases more rapidly than linearly. We then show that this assumption of convex cleanup costs is not necessary for our central result, which holds even if the cleanup costs are linear or concave.

The expected damage from a release does not fall directly on the generators unless a legal provision shifts the liability to them. Instead, it falls on those who would either undertake a cleanup or, alternatively, suffer the consequences if the problem were left unattended. In our discussion, we assume that EPA initially bears the cleanup costs and then seeks reimbursement to the extent allowed by the liability regime.

The efficient amount of wastes is that which maximizes the social objective function: the sum of the benefits derived by the manufacturers minus the expected damages. An economically rational generator, however, does not make its decision based on the social objective function. Instead, it seeks to maximize its private objective function; the benefit that it derives from the activity that leads to the production of the wastes minus whatever share of the damage allocated to it. This share depends on the liability regime that applies in the case of a release of hazardous wastes. For expositional convenience, we assume that the only way in which an actor can affect its expected liability is through the quantity of wastes that it chooses to generate. The results developed below, however, extend to the more complex situation discussed in the previous section on the role of liability rules.

Superfund has adopted a regime of strict liability as opposed to negligence. For a rule of strict liability, we compare joint-and-several liability with nonjoint liability, first when Row and Column both have sufficient solvency to pay their share of the damage (the full solvency case) and then when Row’s solvency is limited. Under a rule of joint-and-several liability, EPA could recover its entire judgment from either one of the defendants. That defendant, having paid the full cleanup cost, would then have to resort to a contribution action in order to recover the other’s share of the cost. We assume, instead, that the contribution action is joined with EPA’s claim against the two generators, and that EPA recovers from each in proportion to its share of the liability.

The argument can best be developed by reference to a simple example. Let $x$ and $y$ be the amount of wastes generated by Row and Column, respectively. Let $(100 + 200) + (100 + 200)$ be the benefits that Row and Column, respectively, obtain from engaging in the economic activity that produces wastes as a byproduct. If either Row or Column exits the market, it does not receive the fixed component of $100$, but the remaining actor receives that additional amount; one can thus think of the market as guaranteeing a $200 profit, which is either split by two firms or captured by a single firm. Let $x + y$ be the damage from the
disposal of these hazardous wastes. Net social benefits are maximized where \(z = y = 10\); thus, one efficient outcome is for Row and Column to generate 5 units of wastes each.

We can now illustrate the difference between joint-and-several liability and nonjoint liability under both strict liability and negligence regimes. Under strict liability, as long as the defendants are sufficiently solvent, joint-and-several liability transmits the same incentives as nonjoint liability. Under either rule, each defendant would pay its share of the total damage. So, for example, if Row generated 4 units of wastes and Column generated 6 units, Row would pay 40% of the total damage of $100, or $40, and Column would pay 60% of this amount, or $60. Joint-and-several liability and nonjoint liability produce the same consequences because there is no scenario under which either defendant would be called upon to pay costs attributable to the other.

In contrast, the choice between joint-and-several liability and nonjoint liability matters under strict liability when at least one of the defendants has limited solvency. If Row were wholly insolvent, Column’s liability would be unaffected under nonjoint liability; it would still pay $60. Under joint-and-several liability, Column would instead pay the full damage of $100.

The choice between joint-and-several liability and nonjoint liability matters under negligence when none of the defendants has limited solvency. If Row were wholly insolvent, Column’s liability would be unaffected under nonjoint liability; it would still pay $60. Under joint-and-several liability, Column would instead pay the full damage of $100.

Full Solvency

Having established that, for strict liability, joint-and-several liability has the same effect as nonjoint liability if the defendants are sufficiently solvent, we show that strict liability—regardless of whether it is coupled with joint-and-several liability or nonjoint liability—fails to transmit desirable incentives: it leads to the overproduction of wastes. Recall that social welfare is maximized when Row and Column each generates 5 units of wastes. Assume that Row has tentatively decided to generate 5 units and that Column, without consulting Row, is trying to figure out how much to generate. If it also generated 5 units, it would accrue benefits of $200 and face a liability of one-half the total damage of $100, or $50; its net benefits would therefore be $150. What would happen, however, if Column generated 6 units rather than 5? Its benefits would rise from $200 to $220, its share of the damages would rise from one-half to six-elevens (6/11), and the total damages would rise from $100 to $131. In sum, Column’s net benefits would be $154 rather than $150.2

In turn, Column will have imposed a cost on Row. Row’s share of the damages will fall from one-half to five-elevens (5/11), but, as a result in the increase in damages, it will have to pay $55, rather than $50. Its net benefits will fall from $150 to $145. Thus, by deciding to generate 6 units of wastes rather than 5, Column captures an additional $4 in net benefits, but imposes costs of $5 on Row. As a result, Column’s action decreases the aggregate level of net social benefits.

Of course, Row can play the same game too. The symmetric Nash equilibrium of this game (the point at which neither Row nor Column has an incentive unilaterally to change its strategy) occurs when each of these actors generates 6.67 units of wastes. We will denote this level as \(x^*\), which is larger than \(x^+\) (the socially optimal level of wastes generated). The net benefits of each of these parties is then $144.42, rather than the $150 that each would have accrued if they both had acted in the socially optimal fashion.

Thus, strict liability (coupled with either joint-and-several liability or nonjoint liability) underdetermines: it leads to the production of an excessive amount of wastes. (We stress, however, that this underdetermination is a product of the convexity of cleanup costs.) This problem could be averted if Row and Column acted cooperatively. Then, they could agree to each generate 5 units of wastes instead of 6.67 units, and each would obtain net benefits of $150 rather than $144.42. In the case of generators of hazardous wastes, such cooperation is probably unrealistic because large numbers of actors are involved and they make their decisions at different times.

The inefficiency that we illustrated by reference to a specific example is a general feature of strict liability in the context of joint torts. This inefficiency stems from the fact that an actor who contemplates generating more than the socially optimal level of wastes, given that the other actor is generating the socially optimal level, does not bear the full increase in damages that it imposes on society. Instead, the other generator bears part of this damage. The resultant externality produces the socially suboptimal results.

A rule of negligence avoids this inefficiency when coupled with joint-and-several liability, as long as the standard of care is set at the socially optimal level. Assume, again, that Row has tentatively decided...
to generate 5 units of wastes and that Column, without consulting Row, is trying to figure out how much to generate; the standard of care is 5 units for each of these actors. If Column also generated 5 units, it would accrue benefits of $200 and face no liability at all, as it would meet its standard of care; the total damages of $100 would go uncompensated. What would happen, however, if Column generated 6 units rather than 5? Its benefits would rise from $200 to $220, and the total damages would rise from $100 to $121. Under negligence, however, Column would be responsible for the full damages: both the amount attributable to its negligent conduct and that attributable to the nonnegligent conduct of its cogenerator. Thus, generating 6 units rather than 5 reduces Column’s net benefits from $150 to $99.

The reason that negligence coupled with joint-and-several liability transmits the correct incentives is quite straightforward. When one actor is not negligent, joint-and-several liability assigns to a negligent actor two components of damages: the additional damage caused by its negligence and the damage that would have resulted if both actors acted nonnegligently, which otherwise would have been borne by the plaintiff. The nonnegligent actor (Row in our case) neither gains nor loses from the decisions of its cogenerator (Column) to become negligent, because it bears none of the loss and receives none of the resulting benefits. The negligent actor, on the other hand, would capture the full additional benefits of generating more than the standard of care, but would pay for more than the additional damage. Since the standards of care are set so that social welfare is maximized when all the actors meet the standard of care, it follows that the additional benefit captured by Column is smaller than even the additional damage caused by its negligence. As a result, both actors choose to be nonnegligent and, therefore, generate at the level that maximizes social welfare. Negligence, if not addressed, does not necessarily provide the right incentives when it is coupled with nonjoint liability (see Kornhauser and Revesz 1989).

This argument about the more desirable properties of negligence in the context of our model of fully solvent actors is presented solely to underscore more clearly the problems with strict liability. Plausible reasons for not adopting a rule of negligence include lack of confidence in the decisionmaker’s ability to set the standard of care at the socially optimal level and the transaction costs necessary to assess the care taken by the various actors.

**Limited Solvency**

We assume here that each actor has a fixed solvency, which is available to pay the actor’s share of the social loss. We assume that the benefits that the actor derives from engaging in the activity leading to the production of hazardous wastes are not included in this solvency. We offer two interpretations for this assumption. First, one might think of an actor’s solvency as a bond that it must post in order to engage in the activity. Recourse against the actor is then restricted to the size of the bond. Alternatively, one might interpret the model as containing an implicit time structure. Benefits accrue to the actor in the present while the social loss occurs (and responsibility for it is apportioned) in the future. If current profits are distributed in the present (when they accrue), then the actor’s solvency has the traditional interpretation of the difference between its assets and liabilities.

To analyze the problem of limited solvency, we modify in one respect the model presented previously: we assume that the actors derive benefits from the level of hazardous wastes generated only up to a technological limit, which we call $m^t$. Beyond $m^t$, no further benefits accrue from additional waste generation. Let $m^f$ be equal to 9 units. We look only at the particular case in which Row’s solvency is zero and examine the properties of strict liability for different values of Column’s solvency. We restrict our inquiry in this fashion because it is sufficient to generate our central conclusion: that it is not possible to make general comparisons between joint-and-several liability and nonjoint liability.

**Joint-and-Several Liability Equilibria**

Recalling that Row’s solvency is zero, consider first a case in which Column is fully solvent. Under joint-and-several liability, Column will be responsible for the whole liability. If Row were generating $x^t$, Column would generate $x^s$ as well, so it would incur the full social cost of departing from $x^t$. (As in the prior section on full solvency, we defined $x^s$ as the socially optimal amount of waste generation; in our example, $x^s$ is equal to 5 units.) But because Row is generating at the technological limit of $m^t$, which is more than $x^s$, Column’s best response is to generate less than $x^s$—an amount that we shall call $a$. (The first symbol is Row’s level of waste generation and the second is Column’s.) Therefore, the resulting equilibrium is $(a, x^s)$. In our example, $a$ is the value of $y$ that maximizes $100 - 20y - (y + 9)^2$ and is equal to 1 unit. Column’s net benefits are therefore $20.

If Column is not fully solvent, there are two possible equilibria: $(a^t, x^s)$ or $(a^f, x^{sf})$. Column will generate $a$ (the equilibrium will be at $(a^t, x^s)$ if Column has sufficient solvency to pay for the liability attributable to it if it generated $m^t$, which is the full damage caused by both parties’ generating a total of $2m^t$. In contrast, the equilibrium is at $(a^f, x^{sf})$ if Column does not have sufficient solvency to pay for the lia-
bility attributable to it if it generated \( a \), which is the full damage caused when both parties generate a total of \( (b^2 + a) \).

But the equilibrium can be at \( (a^2, a^2) \) even if Column has sufficient solvency to pay the liability that results from the equilibrium \( (a^2, a^2) \). Column’s additional liability caused by generating more than \( a \) is greater than its corresponding additional benefit, up to the point at which it becomes insolvent. Beyond its point of insolvency, however, it continues to accrue benefits, but its liability does not increase.

We define Column’s critical solvency under a strict liability coupled with joint-and-several liability (given that Row is insolvent) as \( x^*(b) \): this is the lowest solvency for which Column would choose \( a \) (1 unit) rather than \( a^2 \) (9 units) in light of Row’s choice of \( a^2 \). In our example, if Column generates 9 units of wastes, its benefits are \$280. Provided that its solvency is less than \$260, its net benefits from generating 9 units are greater than its net benefits from generating 1 unit; \( x^*(b) \) is therefore equal to \$260 (\$280 minus \$20).

To understand more fully the impact on Column of Row’s solvency, we need to look at how Column’s solvency would have affected its decision if Row had been fully solvent. Recall that the full solvency equilibrium is \( (x^*(b), x^*(b)) \): in our example, Row and Column each generate 6.67 units of wastes; under this equilibrium, each actor derives net benefits of \$144.42.

If Row is generating 6.67 units of wastes, when would Column prefer to generate 9 rather than 6.67 units? Column would not do this if it were fully solvent, since it would derive \$280 in benefits, but would be responsible for a share of \( 9/15.67 \) of a total liability of \$15.67—it would have to pay \$141.03 and its net benefits would therefore be only \$138.97 rather than the \$144.42 that it would get by generating 6.67 units. On the other hand, if Column’s solvency were less than \$135.58, Column’s net benefits would be greater when it generated 9 rather than 6.67 units; Column would then obtain benefits of \$280 and pay only its solvency, thereby obtaining more than \$144.42. We define Column’s critical solvency under a strict liability coupled with joint-and-several liability, given that Row is fully solvent, as \( x^*(b) \). In this example, \( x^*(b) \) is thus equal to \$135.58 (\$280 minus \$144.42).

Not surprisingly, the critical solvency \( x^*(b) \) is greater than \( x^* \). Indeed, for a given level of waste generation, Column must bear a higher liability when Row has zero solvency and is therefore generating \( a^2 \) than when Row is solvent and is generating \( x^*(b) \). First, for any level of waste generation per Column, the total liability is greater when Row is generating \( a^2 \) than when it is generating \( x^*(b) \). Second, when Row has zero solvency, Column is responsible not only for its own share of the liability, but for Row’s share as well.

Thus, Column exhausts a given solvency at a lower level of waste generation when Row is insolvent, leaving Column with a greater range in which it can continue to expand its output with no corresponding increase in liability. As a result, there are instances in which Column would not become insolvent and would not expand its output to \( x^*(b) \) if Row were solvent, but where Column becomes insolvent and expands its output to \( x^*(b) \) if Row is insolvent. Under this "domino effect," the insolvency of the Row is the but-for cause of Column’s insolvency.

In our example, if Column’s solvency is less than \$135.58, Column will become insolvent regardless of Row’s solvency, and if Column’s solvency is greater than \$260, Column will remain solvent regardless of Row’s solvency. If, however, Column’s solvency is between \$135.58 and \$260 (that is, between \( x^*(b) \) and \( x^*(b) \)), it will remain solvent if Row also is solvent, but become insolvent if Row is insolvent.

Nonjoint Liability Equilibria

Under nonjoint liability, Column would only be responsible for its apportioned share of the liability, and the plaintiff would not be compensated for the share attributable to Row if Row is insolvent. Even under nonjoint liability, however, Row’s insolvency affects Column’s incentives. Where Row is insolvent and generates at the technological limit of \( a^2 \), Column faces higher costs than where Row is solvent and generates \( a^2 \). This result follows from the assumption that cleanup costs, as a function of the volume of wastes, increase more rapidly than linearly. Consequently, if Column were fully solvent, it would, in response to Row’s insolvency, restrict the amount of wastes that it generates to \( b \), which is less than \( x^*(b) \). In our example, Column is responsible for a share of \( x^*(b) \) of the total damages \( x^*(b) \). Then, the value of \( y \) that maximizes \( [100 + 2y - (80/(x^*(b)))]y + 92] \), is equal to 5.5 units. At this level of waste generation, Column accrues benefits of \$210 and must pay \$79.75; its net benefits are therefore \$130.25.

By analogy to the analysis performed for joint-and-several liability, it follows that under nonjoint liability, there is either an equilibrium at \( (x^*, b) \), where Column remains solvent, or \( (x^*, a^2) \), where Column is insolvent. Our example illustrates a general proposition: because for a given level of waste generation, Column bears less liability under nonjoint liability than under joint-and-several liability, it follows that \( b \) is always greater than \( a \).

We define Column’s critical solvency under strict liability, this time coupled with nonjoint liability, given that Row is insolvent, as \( x^* \). In our example, if Column generates 9 units, its benefits are \$280. Provided that Column’s solvency is less than \$149.75 (\$280 minus \$130.25), its net
benefits from generating 9 units are greater than its net benefits from generating 3.5 units; \( s_{c-} \) is therefore equal to $149.75.

This critical solvency is greater than \( s_{0} \). Column 4's critical solvency under a strict liability coupled with joint-and-several liability, given that Row is fully solvent. The "domino effect" discussed in the context of joint-and-several liability is therefore also present here: the insolvency of Row can be the but-for cause of Column's insolvency even under nonjoint liability.

The critical solvency \( s_{c-} \) is smaller than \( s_{c} \). Column 4's critical solvency (given that Row is insolvent) under strict liability coupled with joint-and-several liability. The reason is that if Row is insolvent and Column is solvent, Column faces a smaller liability under nonjoint liability, and the prospect of remaining solvent is correspondingly more attractive. Thus, there is a range of solvencies—the range between \( s_{c-} \) and \( s_{c} \)—between $149.75 and $260 in our example—in which Column would choose to remain solvent under nonjoint liability but would become insolvent under joint-and-several liability.

**Comparison of Equilibria under Joint-and-Several Liability and Nonjoint Liability**

Table 1 summarizes the equilibria generated by joint-and-several liability and nonjoint liability. Recall that Row's solvency is zero. This table defines three regions for different ranges of Column’s solvency. It reveals that in region A, the two rules perform identically, yielding an equilibrium at \((x^{a}, x^{a})\). In region B, joint-and-several liability produces an equilibrium at \((x^{b}, x^{b})\) whereas nonjoint liability does so at \((y^{b}, b)\). Finally, in region C, the equilibrium under joint-and-several liability is at \((x^{c}, a)\), whereas under nonjoint liability it is at \((y^{c}, b)\).

We use three measures to compare the performance of the two rules. We determine, first, which rule leads to higher social welfare; second, which rule results in less unfunded liability; and, third, which rule leads to the generation of less waste. Obviously, in region A, both rules produce identical results.

In region C, we ascertain whether an equilibrium at \((x^{c}, a)\) under joint-and-several liability is preferable to an equilibrium at \((y^{c}, b)\) under nonjoint liability. From a social welfare perspective, \((y^{c}, b)\) is preferable. Where one actor is generating \( x^{c} \), joint-and-several liability makes the other actor see the full social cost of its actions, whereas nonjoint liability does not. Thus, \( a \) is the optimal response by Column to Row's choice of \( x^{c} \).

Joint-and-several liability also results in less unfunded liability. When the equilibrium is at \((x^{c}, a)\), Column is solvent and pays the full liability, leaving no unfunded liability. At \((y^{c}, b)\), Column is also solvent, but under nonjoint liability, it pays only its share of the liability, leaving Row's share unfunded.

Finally, the \((y^{c}, b)\) equilibrium results in an amount \((x^{c} + a)\) of wastes, whereas the \((x^{c}, a)\) equilibrium results in \(2x^{c}\) of wastes. Because \( a \) is smaller than \( x^{c} \), joint-and-several liability is preferable to nonjoint liability. Thus, in region C, joint-and-several liability is preferable under all three criteria.

The comparison between the equilibria in region B follows by analogy. From a social welfare perspective, the equilibrium under nonjoint liability, \((y^{b}, b)\), is preferable to the equilibrium under joint-and-several liability, \((x^{c}, y^{b})\), because, as indicated, given that Row has chosen \( x^{c} \), the socially optimal response by Column is \( a \); of course, \( b \) is closer to \( a \) than is \( x^{c} \). In terms of amount of waste generated, the \((x^{c}, y^{b})\) equilibrium is also preferable, as \((x^{c} + a)\) is smaller than \(2x^{c}\).

With respect to unfunded liability, if Column’s solvency is only \( s_{c-} \), which is the lower bound of the range defined in region B, the equilibrium under nonjoint liability, \((y^{b}, b)\), will result in less unfunded liability. Indeed, as Column expands its production of wastes from \( y^{b} \) to \( x^{c} \), the total liability increases, but Column's contribution to that liability does not, as its full solvency is consumed at the \((x^{c}, y^{b})\) equilibrium. Where Column has a solvency higher than \( s_{c-} \), however, it is not possible to make any general comparison between the rules: the equilibrium under nonjoint liability, \((y^{b}, b)\), will result in less unfunded liability for certain benefit-and-loss functions, but in more unfunded liability for other functions.

In summary, neither rule dominates the other. In region C, joint-and-several liability is always preferable under all three criteria. In region B, nonjoint liability is always preferable under two criteria—social welfare and waste generated—but is only sometimes preferable under the criterion of unfunded liability. Table 2 summarizes these results.

The result—that when one of the defendants has limited solvency, neither rule dominates the other—does not depend upon the assumption that cleanup costs are convex. If they were concave (or linear), it would nonetheless be the case (from a social welfare perspective)
Table 2. Comparison of Joint-and-Severable Liability with Nonjoint Liability

<table>
<thead>
<tr>
<th>Region</th>
<th>Column's solvency</th>
<th>Preferred rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$x - x_s$</td>
<td>Joint-and-several</td>
</tr>
<tr>
<td>B</td>
<td>$x_s - x_h$</td>
<td>Nonjoint*</td>
</tr>
<tr>
<td>C</td>
<td>$x_h - x_c$</td>
<td>Joint-and-several</td>
</tr>
</tbody>
</table>

*For a certain portion of the range, and for certain beta and loss functions, joint-and-several liability is preferable to the standpoint of unlimited liability.

joint-and-several liability would be preferable, because it would show Column the full cost of its actions, as long as it did not cause Column to become insolvent as well. (Note, however, that if cleanup costs are concave, the benefits of waste generation must be even more concave or else the socially desirable amount of waste would be infinite.) In contrast, if the existence of joint-and-several liability is the but-for cause of Column’s insolvency, nonjoint liability would be preferable.

SETTLEMENT-INDUCING PROPERTIES

To evaluate the effects of joint-and-several liability on settlements, we need to specify with care the relevant elements of the regime established by the original Superfund statute, the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

First, the courts apply joint-and-several liability when the harm is indivisible. Second, a right of contribution exists among defendants found jointly-and-severally liable. Third, in contribution actions, the relevant shares are determined by reference to comparative fault; for generators, this determination is typically made on the basis of the amount of waste generated. Fourth, following a settlement, the plaintiff’s claim against the nonsettling defendants is reduced by the amount of the settlement (a pro tanto setoff rule). Fifth, a settling defendant is protected from any contribution actions. Sixth, a settling defendant can bring contribution actions against nonsettling defendants. Seventh, there is no detailed judicial supervision of the substantive adequacy of settlements. Eighth, in general, the claims involving the joint tortfeasors, including contribution claims, are sometimes litigated together in a single proceeding, although other times the contribution actions are severed and stayed (that is, tried after the plaintiff’s case against the original defendants).

This regime applies when the plaintiff is either EPA or a state, rather than a private party. The first and seventh elements have been fashioned by the courts as federal common law; the second through sixth are specified in SARA, and the eighth stems from the application of the Federal Rules of Civil Procedure. In contrast, when the plaintiff is a private party, the statute does not define the fourth through sixth elements, and some courts have fashioned federal common law rules that are different from the statutory rules that apply when EPA or a state is the plaintiff.

A regime of nonjoint liability can be defined, more straightforwardly, by reference to only two elements. In performing our comparison of the relative settlement-inducing effects, we shall first assume that, under nonjoint liability, the plaintiff’s claim against each defendant is equal to that defendant’s comparative fault. Thus, under nonjoint liability, EPA can recover the full cleanup costs only if it can locate all the defendants and if none of them are insolvent. Second, if the plaintiff settles with one defendant for more than that defendant’s apportioned share of the liability, it can nonetheless recover the apportioned share of the other defendants. In this way, it is possible for the plaintiff to recover more than its damages. In contrast, under joint-and-several liability coupled with a pro tanto setoff rule, the plaintiff can never recover more than its damages when it settles with some defendants and litigates against others.

To perform the comparison between joint-and-several liability, on the one hand, and nonjoint liability, on the other, we specify a simple model, under which EPA has a claim of $100 against two defendants, Row and Column, each equally at fault. All the parties are risk neutral. We assume initially that the defendants are sufficiently solvent so they can satisfy the plaintiff’s judgment. In a later section of this discussion, we consider the effects of limited solvency.

The probability that the plaintiff will prevail against each defendant is 50%. All the parties have accurate information about this value. We assume initially that the costs of litigation are zero and then examine how the results are affected by the presence of litigation costs.

With respect to the relationship between the plaintiff’s probabilities of success in litigation against the two defendants, we consider two polar situations. In one, these probabilities are independent. Thus, the plaintiff’s probability of success against one defendant is 50% regardless of whether the plaintiff has prevailed against, lost to, or settled with, the other defendant. For example, if the issue in a case is whether two separate defendants sent hazardous wastes to a site, EPA’s probabilities of success will be independent. The fact that one defendant sent hazardous wastes makes it no more or less likely that the other did so as well.

In the other situation, the probabilities of success in litigation are perfectly correlated. Thus, if the plaintiff litigates against both defendants, it either prevails against both (with a probability of 50%) or loses.
against both (also with probability of 50%). For example, if the defendants argue that EPA's costs were inconsistent with the national contingency plan, the plaintiff's probabilities of success are perfectly correlated; if the defendants establish lack of consistency they will both prevail; otherwise, they will both lose.

The parties may either litigate or settle the claim. Settlement negotiations have the following structure. The plaintiff makes settlement offers to the two defendants, Row and Column decide simultaneously whether to accept these offers. We assume that costs of coordinating their actions are sufficiently high that they act noncooperatively. The plaintiff then litigates against the nonsettling defendants, if any. We adopt the convention that, if a party is indifferent between settlement and litigation, it settles.

The central conclusion of our analysis is that the comparison of the settlement-inducing properties of joint-and-several liability and nonjoint liability depends critically on the correlation of the plaintiff's probabilities of success. When these probabilities of success are independent, joint-and-several liability unambiguously discourages settlements, relative to nonjoint liability. When, in contrast, these probabilities are perfectly correlated, joint-and-several liability has a more complex effect: it encourages settlement when the litigation costs are low but may discourage settlements when these costs are high. A more detailed treatment of these issues can be found in Kornhauser and Revesz 1993, 1994a, 1994b.

We first examine the choice between settlement and litigation under nonjoint liability. We then perform the same analysis under joint-and-several liability for zero litigation costs and full solvency. Finally, we study for joint-and-several liability the effects of positive litigation costs and limited solvency.

Nonjoint Liability

The analysis of the choice between settlement and litigation under nonjoint liability is straightforward. The plaintiff's expected recovery from litigation is $50: it has a 50% probability of obtaining $30 from each defendant; each defendant's expected loss is therefore $25. Absent litigation costs, the plaintiff and the defendants are indifferent between litigation and settlement. For any level of litigation costs, settlement becomes preferable. For example, if each party's litigation costs were $5 (for the plaintiff, $5 against each of the defendants), the plaintiff's expected recovery from litigation would be only $20 from each defendant and each defendant's expected loss would be $30. The plaintiff and each defendant would prefer any settlement between $20 and $30 to litigation.

Joint-and-Several Liability

As discussed above, the likelihood and nature of settlement under joint-and-several liability is determined by the correlation of the plaintiff's probabilities of success against the defendants. We consider the cases of independent and perfectly correlated probabilities.

Independent Probabilities. As a consequence of joint-and-several liability, the plaintiff recovers its full damages not only if it prevails against both defendants but also if it prevails against one and loses against the other. When the plaintiff's probabilities of success against the two defendants are independent, each of four different scenarios carries a probability of 25% that the plaintiff prevails against both defendants, that the plaintiff prevails against Row and loses against Column, that the plaintiff prevails against Column and loses against Row, and that the plaintiff loses against both defendants. In the first three cases, carrying an aggregate probability of 75%, the plaintiff recovers its full damages of $100. Thus, its expected recovery from litigating with both defendants is $75.

In turn, each defendant's expected loss is $37.50. Row has a 50% probability of prevailing, and, therefore, of not having to pay anything. There is a probability of 25% that Row will lose and Column will win. In this case, Row has to pay the plaintiff's full damages of $100. Finally, there is a probability of 25% that Row and Column will both lose. Row then has to pay its share of $50, with Column paying the rest. A risk-neutral plaintiff will not accept a settlement with both defendants that yields less than $75, but would find acceptable an aggregate settlement for $75 or more. What would happen if the plaintiff made settlement offers to the two defendants for $37.50 each, so that its aggregate recovery was equal to the expected recovery of litigating against both defendants? If one defendant, say Row, accepted the offer, would...
independent, the plaintiff will not accept from one defendant a settlement that is too low even if it intends to litigate against the other. Say, for example, that the plaintiff accepted a settlement of $0 from Row and litigated against Column. Its expected recovery would then be only $50 (a 50% probability of recovering $100); the settlement with Row will have reduced its expected recovery by $25. If the plaintiff accepted a settlement of $10 from Row, its expected recovery from litigating with Column would be $45 (a 50% probability of recovering $90); for a total expected recovery of $55, the loss from the low settlement with Row is $20.

So as not to lose its surplus, the plaintiff would thus have to demand a sufficiently high settlement from Row. But a settlement that is sufficiently desirable for the plaintiff to accept contains a benefit upon Column. If, for example, the plaintiff were to settle with Row for $25, Column’s expected loss from litigation would be $37.50—the same expected loss as if Row litigated. Any higher settlement with Row, reduces Column’s expected loss. We have already shown that a settlement with Row for $37.50 reduces Column’s expected loss from $37.50 to $31.25, giving it a benefit of $6.25. In order to recover $75, the plaintiff would have to obtain from Row a settlement of $50 (which would leave an expected recovery from Column of $25 and confer upon Column a benefit of $12.50). Row, however, would not agree to such a settlement because, given that Column litigates, it is better off litigating as well and facing an expected loss of only $37.50.

We have thus illustrated why the plaintiff cannot capture the full benefit of Row’s settlement if its probabilities of success are independent. Part of this settlement confers an external benefit upon Column. It is this externality that stands in the way of settlement. Indeed, the only way that the plaintiff can obtain the full benefit of a defendant’s payment is by litigating, because if it settles, part of the benefit accrues to the other defendant, reducing the plaintiff’s expected recovery from litigation.

Perfectly Correlated Probabilities. The problem changes considerably when the plaintiff’s probabilities of success against both defendants are perfectly correlated. If the plaintiff litigates against both defendants, it either prevails against both (with a probability of 50%) or loses against both (also with a probability of 50%). Its expected recovery from litigation is $50 rather than $75; each defendant’s expected loss is then $25.

In the case of perfectly correlated probabilities, the plaintiff will settle with both defendants. It is easy to see that the plaintiff will settle with at least one of the defendants. Say that the plaintiff settles with Row for $10; it faces a 50% probability of recovering $90 from Column, and its total expected recovery is $55—$5 higher than its recovery from
litigating against both defendants. The effect of this settlement is to give the plaintiff $10 with certainty, but reduce its expected recovery from litigation by $5. As a result, settlement with one defendant and litigation against the other is always more attractive to the plaintiff than litigation against both defendants.

It is also easy to show that, for the example that we are analyzing, the plaintiff in fact settles with both defendants, for $25 and $37.50, respectively. Given that Row settles for $25, Column’s expected loss through litigation is $37.50 (a 50% probability of paying the plaintiff’s damages of $100 minus Row’s settlement of $25), and would therefore accept a settlement for that amount. Moreover, given that Column settles for $37.50, Row’s expected loss through litigation is $31.25 (a 50% probability of paying the plaintiff’s damages of $100 minus Column’s settlement of $37.50), and therefore Row would prefer to settle for $25. The same argument establishes that the plaintiff would be no better off settling with one defendant and litigating against the other.

We show elsewhere that, for perfectly correlated probabilities, the plaintiff settles with both defendants if their shares of the liability are sufficiently similar and settles with one defendant—the one with the larger share of the liability—and litigates against the other if the defendant’s shares of the liability are sufficiently different (Kornhauser and Revesz 1993).

The Effects of Litigation Costs

So far, for analytical clarity, we have dealt with the case in which litigation costs are zero. Litigation costs always have the effect of making settlement relatively more attractive because the plaintiff and the defendants can save these outlays and divide them among each other in some fashion if they choose not to litigate. The question is whether the presence of litigation costs affects the relative settlement-inducing properties of joint-and-several liability and nonjoint liability.

When litigation costs are sufficiently low the conclusions derived in the prior section (on the choice between settlement and litigation in joint-and-several liability situations) remain unchanged. When the plaintiff’s probabilities of success are independent, the savings that can be realized by eliminating litigation costs will be insufficient to eliminate the effects of the externality that stands in the way of settlements. When the plaintiff’s probabilities of success are perfectly correlated, joint-and-several liability will retain its settlement-inducing advantage for litigation costs below a given threshold.

When litigation costs are sufficiently high, however, the analysis is different. One feature of the pro tanto settor, as we have already explained, is that when the plaintiff settles with one defendant and litigates against the other, it cannot recover more than its full damages. Under nonjoint liability, in contrast, the plaintiff’s recovery is not constrained in this manner. When the plaintiff makes a take-it-or-leave-it offer and litigation costs are sufficiently high, a defendant under nonjoint liability will be willing to pay more than its apportioned share of the liability in order to avoid litigation. For this level of litigation costs, the plaintiff obtains larger settlements under nonjoint liability than under joint-and-several liability.

At the same time, however, the plaintiff’s recovery from litigating against both defendants is higher under joint-and-several liability than under nonjoint liability when the plaintiff’s probabilities of success are independent and is equal under both rules when the probabilities are perfectly correlated. If a defendant were able to make take-it-or-leave-it offers, it would offer the plaintiff the smallest amount that would make the plaintiff indifferent between settling and litigating. The amount thus offered is higher under joint-and-several liability than under nonjoint liability when the plaintiff’s probabilities of success are independent and is equal under both rules when the probabilities are perfectly correlated.

In the real world, none of the parties can make take-it-or-leave-it offers; instead, the parties must engage in bargaining. One can think of the case in which the plaintiff makes a take-it-or-leave-it offer as defining the upper bound of the settlement range: the plaintiff captures the full surplus of settlement. Similarly, one can think of the case in which one of the defendants makes a take-it-or-leave-it offer as defining the lower bound of the settlement range: here, the defendant captures the full surplus of settlement. For sufficiently high litigation costs, the settlement range is greater under nonjoint liability. It is true that in this situation, risk-neutral parties with accurate information about the plaintiff’s probabilities of success will settle under both joint-and-several liability and nonjoint liability.

In contrast, sufficiently optimistic parties will litigate under both rules. The higher settlement range for nonjoint liability implies that for an intermediate range of optimism, there will be settlements under nonjoint liability but not under joint-and-several liability.

In summary, joint-and-several liability deters settlements when the plaintiff’s probabilities of success are independent not only when litigation costs are low but also when they are high. In contrast, when the plaintiff’s probabilities of success are perfectly correlated, joint-and-several liability promotes settlements when litigation costs are low, but deters settlements when they are high. These results of this part of our analysis are summarized in Table 3.
Table 3. Effects of Joint-and-Several Liability on Settlements under Different Levels of Litigation Costs (High Solvencies Relative to Nonjoint Liability)

<table>
<thead>
<tr>
<th></th>
<th>Low litigation costs</th>
<th>High litigation costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent probabilities</td>
<td>Discourages settlement</td>
<td>Discourages settlement</td>
</tr>
<tr>
<td>Perfectly correlated probabilities</td>
<td>Encourages settlement</td>
<td>Discourages settlement</td>
</tr>
</tbody>
</table>

The Effects of Limited Solvency

As we indicated previously, the limited solvency of the defendants does not affect the choice between settlement and litigation under nonjoint liability. The situation is different under joint-and-several liability. We consider first how limited solvency would affect the choice between settlement and litigation if the plaintiff's probabilities of success are independent (we assume for this discussion that litigation costs are zero). If one of the defendants, say Row, has limited solvency, the plaintiff nonetheless litigates against both defendants if this solvency is above a threshold. For example, if Row's solvency is $80 and the plaintiff litigates against both defendants, its expected recovery is $37.50 from Column but only $32.50 from Row (with a probability of 25%, the plaintiff prevails against both defendants and recovers $50 from Row, and, also with a probability of 25%, the plaintiff prevails only against Row and recovers Row's solvency of $80 rather than its full damages of $100). In contrast, if the plaintiff settled with Column for $37.50, Row's expected loss from litigation, and consequently the maximum settlement that it would offer, would be only $31.25 (a 50% probability of paying the plaintiff's damages of $100 minus Column's settlement of $37.50).

When Row's solvency is sufficiently low, however, the plaintiff settles with both defendants. Consider the case in which Row's solvency is $40. If the plaintiff litigates against both defendants, its expected recovery is $60 (with a probability of 25%, it prevails against both and recovers $40 from Row and $60 from Column; and with a probability of 25%, it prevails only against Row and recovers $40). In turn, Row's expected loss is $20 and Column's expected loss is $40.

If the plaintiff offered Row a settlement of $20, its expected recovery from Column is $40 (a 50% probability of recovering its damages of $100 minus Row's settlement of $20), and Column would be willing to settle for this amount. In turn, if the plaintiff offered Column a settlement of $40, its expected recovery from Row is $20 (a 50% probability of recovering its solvency of $40), and Row would be willing to settle for this amount. Thus, as in the case of nonjoint liability, when the solvency of one of the defendants is sufficiently low and litigation costs are zero, the parties are indifferent between settling and litigating.

In summary, the result that joint-and-several liability discourages settlements when the plaintiff's probabilities of success are independent holds over a range of solvencies. A similar analysis (see Kornhauser and Revesz 1996) establishes that, when the plaintiff's probabilities of success are perfectly correlated, joint-and-several liability promotes settlements over a range of solvencies. For solvencies below a given threshold, however, joint-and-several liability has the same settling-inducing properties as nonjoint liability. The relevant results of this part of our analysis are summarized in Table 4.

Implications of the Analysis

The preceding analysis illustrates the difficulties of making categorical statements about the settlement-inducing properties of joint-and-several liability. Even under the simple formulation of our model, whether joint-and-several liability promotes or deters settlements depends crucially upon three factors: the degree of correlation of the plaintiff's probabilities of success, the level of litigation costs, and the solvencies of the defendants.

Of course, an extensive empirical study might reveal that, for the Superfund scheme as a whole, joint-and-several liability is having one effect rather than the other. Relevant questions would include the extent to which the plaintiff's probabilities of success are correlated, the relative levels of litigation costs, and the solvencies of PRPs. But for now, given that such an inquiry has not taken place, one ought to be agnostic about the settlement-inducing properties of joint-and-several liability.

One might complain that we have dealt only with a highly stylized model that makes quite restrictive assumptions. Elsewhere (Kornhauser and Revesz 1996), we have shown that our central results persist even when many of the assumptions are relaxed. We are quite confident that there is no realistic scenario under which joint-and-several liability would either always promote or always deter settlements.

Table 4. Effects of Joint-and-Several Liability on Settlements under Different Levels of Solvency (Low Litigation Costs Relative to Nonjoint Liability)

<table>
<thead>
<tr>
<th></th>
<th>High solvency</th>
<th>Low solvency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent probabilities</td>
<td>Discourages settlement</td>
<td>Neutral effect</td>
</tr>
<tr>
<td>Perfectly correlated probabilities</td>
<td>Encourages settlement</td>
<td>Neutral effect</td>
</tr>
</tbody>
</table>
FAIRNESS IN ALLOCATING LIABILITY

While opponents of joint-and-several liability in the Superfund context have complained about the unfairness of joint-and-several liability, they have not attempted to define with care the yardstick against which they measure fairness (see National Commission on Superfund 1994, 16-20). We believe that the most plausible fairness objective is that each generator should pay for its share of the harm. (The allocation between generators and site owners raises more difficult issues that we do not address here.) This fairness objective is compromised not only when a generator pays more than its share of the harm, but also when the converse is true, if a generator pays less than its share, either another generator must cover the shortfall, or EPA is not going to recover the full cost of the cleanup. The unfunded portion would then be financed through the Hazardous Substance Superfund (the CERCLA-established trust fund)—three separate taxes levied on chemicals, petroleum products, and general corporate profits. An assessment of fairness then depends on the fairness of the tax measures.

Four Fairness Issues

The comparison of the relative fairness of joint-and-several liability and nonjoint liability raises four principal issues. Three fairness issues arise when the defendants are fully solvent: the size of the plaintiff’s expected recovery when it litigates against the defendants; the division of the plaintiff’s recovery among litigating defendants; and the effects of settlements. A fourth issue arises when the defendants have limited solvency: the division of the burden of insolvency between the plaintiff and the solvent defendant.

A question relevant to all four issues is whether one should assess fairness ex ante (in terms of the parties’ expected payments) or ex post (in terms of the actual payments in particular cases). We largely confine our remarks here to ex ante assessments.

Size of the Plaintiff’s Recovery. First, as indicated in the previous discussion on settlement-inducing properties, except when the plaintiff’s probabilities of success against the defendants are perfectly correlated, joint-and-several liability leads to a higher expected recovery than nonjoint liability. Recall the example in which the plaintiff’s damages are $100 and its probabilities of success against each of the defendants are 50%, and the defendants are equally at fault and fully solvent. The plaintiff’s expected recovery is $50 under nonjoint liability, $50 under joint-and-several liability when the plaintiff’s probabilities of success are perfectly correlated, and $75 under joint-and-several liability when the plaintiff’s probabilities of success are independent (in the range between independence and perfect correlation, the plaintiff’s recovery is between $50 and $75.)

Thus, except when the plaintiff’s probabilities of success are perfectly correlated, an effect of joint-and-several liability is to transfer resources from the defendants to the plaintiff. The fairness consequence of this transfer depends upon why the plaintiff’s probability of success against each of the defendants is only 50%. It could be that the defendants are in fact liable but that the plaintiff has difficulty in proving their liability. In this case, joint-and-several liability is attractive on fairness grounds because it brings a defendant’s expected liability closer into line with the harm that it caused.

Alternatively, it could be that there is true uncertainty about whether the defendants are liable, and that this uncertainty is captured by the 50% probability. Then, joint-and-several liability is undesirable because it increases a defendant’s expected liability beyond the level of the harm the defendant caused.

Division of the Plaintiff’s Recovery. The second issue concerns the allocation of expected liability among litigating defendants. From this perspective, joint-and-several liability performs badly; it places a disproportionate burden on the defendant with the smaller share of the liability, except when the plaintiff’s probabilities of success are perfectly correlated. Consider an example in which, instead of being equally at fault, Row and Column are 25% and 75% at fault, respectively; the plaintiff’s probabilities of prevailing against each of the defendants remains at 50%, and these probabilities are independent. There are then four possible scenarios, each carrying a probability of 25%:

- The plaintiff prevails against both defendants and collects $25 from Row and $75 from Column.
- The plaintiff prevails against Row and loses to Column, and collects $100 from Row.
- The plaintiff loses to Row and prevails against Column, and collects $100 from Column.
- The plaintiff loses to both defendants and does not recover anything.

Thus, Row pays $25 with probability 25% and $100 with probability 25%; its expected liability is then $31.25. In turn, Column pays $75 with probability 25% and $100 with probability 25%, and its expected liability is $42.75. Thus, while Row’s contribution to the harm is only one-third that of Column’s, its expected liability is about three-quarters that of Column’s.
The preceding example shows that this disproportionate effect stems exclusively from the fact that under joint-and-several liability the plaintiff might prevail against the defendant with the lower responsibility for the harm but lose against the other defendant, and that the defendant with the lower responsibility is then required to pay the plaintiff’s full damages. In contrast, under nonjoint liability (and under joint-and-several liability when the plaintiff’s probabilities of success are perfectly correlated), each defendant’s expected liability is proportional to its responsibility for the harm.

The Effects of Settlements. The possibility of settlements introduces the third fairness issue, that of the effects of settlements. This possibility places (as did the issue of the division of a plaintiff’s recovery) a disproportionate burden on the defendant with the smaller share of the liability. Indeed, for the legal regime that is analyzed in this chapter’s section on settlement-inducing properties, and which employs a pro tanto setoff rule, each defendant settles for the same amount, even when their shares of the harm are different. Consider the example in which the litigation costs are sufficiently high that they induce the parties to settle, and in which the plaintiff makes take-it-or-leave-it offers to the defendants.

The largest settlement that Row will accept, \( S_R \), conditional on Column settling for \( S_C \) (which is less than the plaintiff’s damages \( D \)), is given by

\[
S_R = p(D - S_C) + t
\]

where \( p \) is the plaintiff’s probability of success against each defendant, and \( t \) is each defendant’s litigation costs. Similarly, the largest settlement that Row will accept, \( S_C \), conditional on Column’s settling for \( S_C \) (which is less than the plaintiff’s damages \( D \)), is given by

\[
S_C = p(D - S_C) + t
\]

Thus,

\[
S_R = S_C = (Dp + t)(1 + p)
\]

Thus, when litigation costs are sufficiently high that the parties settle despite the independence of the plaintiff’s probabilities of success, the plaintiff extracts from each defendant an equal settlement, regardless of the differences in the defendants’ shares of the harm. In contrast, recall that under nonjoint liability, each defendant’s expected liability is proportional to its responsibility for the harm. The plaintiff, if it made take-it-or-leave-it offers, could extract from each defendant in settlement this amount plus the defendant’s litigation costs. If each defendant’s litigation costs are independent of their share of the liability, the defendant with the smaller share will pay a disproportionate amount, but it will be less disproportionate than what it would have paid under joint-and-several liability.

Division of the Burden of Insolvency. The fourth fairness issue arises if one of the defendants has limited solvency. Our assessment of fairness here is neither fully ex ante nor fully ex post. A fully ex ante perspective would consider the likelihood that each defendant would become insolvent; instead our discussion assumes that one defendant is already insolvent. On the other hand, our discussion is not fully ex post because we assess fairness in terms of expected litigation (and settlement) outcomes. We hope to consider fairness issues more fully in a subsequent article.

We have studied elsewhere how the shortfall caused by the limited solvency of one defendant is allocated between the plaintiff and the remaining solvent defendant under joint-and-several liability (Kornhauser and Revesz 1994b). That study revealed that, over a broad range of solvencies, and for less-than-perfectly correlated probabilities, the plaintiff bears the full shortfall, and it is never the case that the full shortfall is borne by the solvent defendant. This conclusion challenges the accepted wisdom that, under joint-and-several liability, the burden of one defendant’s insolvency falls exclusively on its codefendants (Sugarman 1992, 1180).

The reason for the entrenchment of this erroneous view may be that judges and commentators implicitly consider only the situation in which the plaintiff’s probabilities of success are perfectly correlated and the plaintiff litigates against both defendants. Then, any shortfall caused by one defendant’s limited solvency is borne by the other defendant. If, however, the correlation of the probabilities is less than perfect, the plaintiff’s expected recovery is reduced because it might prevail only against the defendant with limited solvency. Moreover, the focus on litigation overlooks two important facts: the plaintiff often is better off settling, and the amount that it can recover in settlement is a function of the solvency of the defendants.

Nonetheless, under joint-and-several liability, the shortfall caused by one defendant’s limited solvency is generally shared between the solvent defendant and the plaintiff. In contrast, under nonjoint liability, the full shortfall is borne by the plaintiff. Thus, nonjoint liability puts additional pressure on the Hazardous Substance Superfund. Which is a fairer way of meeting the shortfall? The full answer to this question would have to include an analysis of the distribution of orphan shares.
CONCLUSION

Our analysis reveals that along three important dimensions— incentives for waste reduction and care, incentives for settlement, and fairness—one cannot make categorical claims about the relative desirability of joint-and-several liability and nonjoint liability. Neither rule performs consistently better than the other.

We do, however, identify the factors that determine which of the rules is more desirable in particular situations. These factors include the solvency of the defendants, the correlation of the plaintiff’s probabilities of success, the relative level of litigation costs, and the incidence of the taxes used to cover unfunded liabilities. Extensive empirical work concerning these factors (for example, attempting to estimate the correlation of the plaintiff’s probabilities of success at a typical Superfund site) might suggest that, on the whole, one of the liability rules is better than the other. Such work, however, has not been done and will not be done in time to inform the reauthorization debate; moreover, our analysis provides a framework for the performance of such empirical work. If the burden is to be placed on those urging departure from the status quo, as it probably should be, the proponents of abandoning joint-and-several liability have fallen short.

We end by underscoring that our study has compared joint-and-several liability with nonjoint liability on the basis of only three criteria. There are, of course, other relevant criteria, such as the effects of these alternative rules on the availability of insurance or on the level of litigation costs. With respect to insurance availability, joint-and-several liability is problematic because the probability of liability is determined by the actions of nonpolicyholders, whom the insurer cannot identify in advance; thus, it is thought to significantly decrease the availability of insurance (Abraham 1988, 595–640).

The comparison on the basis of litigation costs is less straightforward. On the one hand, joint-and-several liability raises the stakes whenever orphan shares must be allocated to solvent parties; if litigation costs rise with the stakes of the litigation, joint-and-several liability will increase the level of these costs. On the other hand, as we have shown above, under some circumstances joint-and-several liability promotes settlements, thereby reducing litigation costs.

ACKNOWLEDGMENTS

This work was funded by a grant from EPA’s Office of Exploratory Research (contract #818460-01-1). We also acknowledge the generous financial support of the Filomen D’Agostino Greenberg and Max E. Greenberg Research Fund at the New York University School of Law. Vicki Been, Colleen Shannon, and Richard Stewart gave us valuable comments. The views presented in this chapter are those of the authors and not those of EPA.

ENDNOTES

1 Traditionally, the academic literature distinguishes between activity levels and levels of care. The amount of wastes generated would typically be thought of as an activity level. The two concepts, though, are analytically analogous. It may be, however, that the legal system does not have much experience administering a negligence rule triggered by activity levels. This distinction, however, in no way affects the illustration of the comparative effects of joint-and-several liability and nonjoint liability presented in the text.

2 This discussion assumes that the liability of the defendants is proportional to the amount of wastes generated. If, instead, the defendants could be charged for the marginal cost of their actions, this problem would not arise. In this example, generating 6 units rather than 5 would cost Column an additional $21 under the marginal cost approach—the full increase in total damages. Such a rule, however, is difficult to administer, because it requires courts to make determinations about marginal costs, and it is not used by the courts.

3 Of course, this feature makes settlement relatively less attractive to the defendant with the smaller share of the liability. In the Superfund context, EPA generally makes settlement offers that are proportional to a PRB’s volumetric contribution, even though EPA’s recovery would be greater if it made disproportionate offers.

REFERENCES

6

Evaluating the Impact of Alternative Superfund Financing Schemes

Katherine N. Probst

The Superfund debate thus far has focused on the strengths and weaknesses of the current liability standards and, to a much lesser extent, of alternative approaches (Probst and Portney 1991). A subject that gets much less attention is the question of who will pay for the increased trust fund that would be necessitated by any revision to the current liability scheme and who will benefit by changes to the liability scheme. Any decrease in liability requires a correlative increase in one or more of the current Superfund taxes, or the levy of a new tax.

Any evaluation of “who pays” for Superfund cleanups requires an assessment of who pays under the liability scheme and who is paying the Superfund taxes. Needless to say, the first task is far more difficult than the second. This is due in large part to the fact that the law does not require responsible parties (RPs) to report to the U.S. Environmental Protection Agency (EPA) how much they are actually spending on site studies and cleanup. Without information on the expenditures of RPs at each site and on how much the individual RPs are paying for cleanups, it is difficult to know how much is actually being spent, much less which companies and sectors of the economy are bearing the burden.

Very little is known about who bears the brunt of cleanup costs under the current liability scheme, let alone how the distribution of these costs would change under alternative liability approaches. Yet, this information is of critical importance to any evaluation of the economic impact of Superfund liability, as well as to discussions of what kind of tax mechanism should be used to raise additional trust fund revenues should the liability scheme be revised. (The trust fund, formally known as the Hazardous Substance Response Fund, may be used by EPA to finance cleanups.) Each liability alternative releases a differ-
ties. In those cases, it would be more appropriate to consider the number of parties at the cutoff. The full analysis of this question would require the examination of the waste in lists, which are almost never appended to the settlements.

It might also be appropriate to consider, instead, the total number of parties at a site. We attempted to do this, using a database prepared by EPA that contains, for each site, the number (and identity) of the parties that received formal notice of their potential liability. We noticed, however, that in several cases this number was smaller than the number of parties offered a de minimis settlement, indicating that EPA does not send notices to all PRPs. We are currently attempting to resolve this problem.

We also had difficulty, in some cases, in distinguishing between the number of parties that were offered the settlement and the number that accepted the settlement. In some cases, an appendix to the settlement lists all the parties below the cutoff and there is therefore no ambiguity. In other cases, however, the body of the settlement contains the identity of the settling parties. It is possible, in these cases, that other parties may have been offered the settlement as well and rejected it, but there is no way to tell from the settlement documents. In those cases, we used the number mentioned in the settlement. This problem is present primarily in cases involving a small number of parties.

One of these instances involved two settlements with parties having limited solvency. Perhaps this factor accounts for the different treatment of these settlements. The exclusion in the other instance is less easily discernible.

At one site (in Region 7), information about the use of a premium was missing for two settlements, a premium was charged in four settlements, and no premium was charged in two settlements.

It is possible, of course, that in the former case the premium is computed on the future cost component only, but that it is then expressed as a percentage of total costs. There is nothing in the settlements, however, to indicate that EPA is following such an approach. In fact, the settlements in which the premium is based on the total costs generally do not separate the future cost component.

This large premium might be explained, at least in part, by the fact that the settlement applied only to a party with a minuscule contribution and that the party's total payment was only $570. The next highest premium in this category was 18%.

It is possible, though we could not tell from the text of the settlement, that this premium includes a 100% premium for failing to have settled earlier. Indeed, this settlement is the third at a site, and the previous two were charged a premium of 110%. Even if this were the case, however, the range would not change dramatically; the next highest premium is 20%.

REFERENCES