Joint and Several Liability

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1. Introduction

The law and economics analysis of the comparison of joint and several liability with several only (non-joint) liability examines both the relative incentives for deterrence and for settlement generated by the two rules and their fairness. Part A provides a brief background of the legal regimes. Parts B and C compare, respectively, the settlement and deterrence effects of the two rules. Part D considers the fairness of the two regimes.

A. Legal Regimes

2. Legal Regimes

The rule of joint and several liability may apply to any situation in which the plaintiff’s injury arises from the actions of multiple parties. Under joint and several liability, if the plaintiff litigates against many defendants and prevails against only one, it can recover its full damages from that defendant; if the plaintiff prevails against all defendants but some are insolvent, it can recover its full damages from the solvent defendants; and if the plaintiff prevails against all defendants and all are solvent, it can nonetheless choose to recover its full judgment from any defendant or to recover a portion from each. In contrast, under several only (non-joint) liability, the plaintiff can recover from a losing defendant only the share of the damages attributable to that defendant.

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For joint and several liability, the legal regime needs to be specified further. As shown in Kornhauser and Revesz (1993), the various choices presented below can affect the economic analysis of the consequences of joint and several liability.

First, a right of contribution permits a defendant that has paid a disproportionately large share of the plaintiff's damages as a result of the application of joint and several liability to obtain compensation from a defendant that has paid a disproportionately small share of these damages. Absent a right of contribution, such reallocation is not possible. Second, contribution shares are usually determined either pro rata (equal division among the defendants) or by reference to comparative fault.

Third, the question of an appropriate set-off rule arises when the plaintiff settles with one defendant and litigates against another. Under the pro tanto set-off rule, the plaintiff's claim against the non-settling defendants is reduced by the amount of the settlement. In contrast, under the apportioned share set-off rule (sometimes referred to as a proportional set-off rule), the plaintiff's claim against the non-settling defendants is reduced by the share of the liability attributable to the settling defendants.

Fourth, under the pro-tanto set-off rule, when one defendant settles and the others litigate and ultimately lose, the question arises whether the settling defendant is protected from contribution actions by the losing litigants. Fifth, the legal regime must also specify whether settling defendants are entitled to bring contribution actions against defendants who settled for less than their share of the liability.

Sixth, under the pro-tanto set-off rule, if the plaintiff enters into an inadequately low settlement with one defendant, the other defendant is responsible for the shortfall if it litigates and loses. To protect the interests of non-settling defendants, courts sometimes require "good faith" hearings on the adequacy of settlements.

Seventh, if the plaintiff joins all the joint tortfeasors in a single suit, its claims against all of them will be adjudicated in the same proceeding. If the plaintiff chooses not to join all the tortfeasors as defendants, the question arises whether a named defendant can join another
tortfeasor as a third-party defendant. Otherwise, the named defendant would have to file a separate action for contribution after the adjudication of its liability to the plaintiff.

B. Settlement

3. Settlements

The basic framework for the analysis of the impact of joint and several liability on settlements is set forth in Kornhauser and Revesz (1994a), which deals with two, fully solvent defendants, and Kornhauser and Revesz (1994b), which deals with potentially insolvent defendants. The discussion here begins by reference to a numerical example, as in Kornhauser and Revesz (1993 and 1995), which serves to illustrate in a straightforward manner the game-theoretic interactions generated by the competing rules. The extension to n-defendants follows Kornhauser and Takeda (2007). As in these prior papers, we interpret the examples and the formalism in the context of firms who deposit waste at site. For the analysis of settlement, we assume that a release of the waste into the environment has occurred and the plaintiff (in the United States, generally the Environmental Protection Agency) initiates an action against the defendants to recover the costs of clean-up, which we normalize (without loss of generality) to 1.

We model the following rule of joint and several liability. First, there is a right of contribution among defendants found jointly and severally liable. Second, in contribution actions, the relevant shares are determined by reference to the amount of waste deposited at the site by the defendant. Third, following a settlement, the plaintiff's claim against the nonsettling defendants is reduced by the amount of the settlement (a pro tanto set-off rule); the effects of different formulations of the apportioned share set-off rule are analyzed in Kornhauser and Revesz (1993: 465-69) and Klerman (1996). Fourth, a settling defendant is protected from any contribution actions. Fifth, a settling defendant can bring contribution actions against non-settling defendants. Sixth, there is no detailed judicial supervision of the substantive adequacy of settlements. Seventh, the claims involving the joint tortfeasors are litigated together in a single proceeding. Kornhauser and Revesz (1993) shows that the results derived here are robust to many changes in the legal regime governing joint and several liability.
To perform the comparison between joint and several liability on the one hand, and non-joint liability on the other, we consider a situation in which the plaintiff 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 that they can satisfy the plaintiff's judgment. Later, 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 and the costs of litigation are zero. As shown in Kornhauser and Revesz (1994a), the results derived here hold even if the two defendants were not equally at fault, if the plaintiff's probability of success were not 50%, and if litigation costs are not zero.

With respect to the relationship between the plaintiff's probabilities of success against the two defendants, we consider two polar situations. In the first, 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.

In the second case, the probabilities are perfectly correlated. Thus, if the plaintiff litigates against both defendants, it either prevails against both (with a probability of 50%) or loses to both (also with a probability of 50%).

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. (The effects of different offer structures are examined in Donohue 1994; the effects of "Mary Carter" agreements between the plaintiff and a subgroup of defendants is analyzed in Bernstein and Klerman 1995). We assume that costs of coordinating their actions are sufficiently high that they act non-cooperatively. The plaintiff then litigates against the non-settling 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 non-joint 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 several only 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. Earlier analyses had focused, implicitly, only on perfectly correlated probabilities (Easterbrook, Landes, and Posner 1980; Polinsky and Shavell 1981).

3.1. Several Only Liability

The analysis of the choice between settlement and litigation under several only liability is straightforward. The plaintiff's expected recovery from litigation is $50: it has a 50% probability of obtaining $50 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, the plaintiff's expected recovery from litigation would be only $20 and each defendant's expected loss would be $30. The plaintiff and each defendant would prefer any settlement between $20 and $30 to litigation.

The result that under several only liability the parties are indifferent between settlement and litigation in the absence of litigation costs and prefer to settle for any level of litigation costs does not change if the defendants have limited solvency. Say, for example, that Row's solvency is only $20. Then, in the absence of litigation costs, the plaintiff and Row are indifferent between litigation and a settlement for the plaintiff's expected recovery of $10 (a 50% probability of recovering Row's solvency of $20). For any level of litigation costs, the parties prefer to settle. Thus, while limited solvency affects the expected value of the plaintiff's claim as well as amount at which the case would settle, it does not affect the choice between settlement and litigation.

3.2 Joint and Several Liability with Two Defendants
3.2.1. 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 to 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 to Column, that the plaintiff prevails against Column and loses to Row, and that the plaintiff loses to 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.

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 the other defendant accept it as well? Column would accept the settlement only if its expected loss from litigation is at least $37.50. Under the pro tanto set-off rule, Column's exposure in the event of litigation is reduced to $62.50: the plaintiff's damages of $100 minus Row's settlement of $37.50. But Column faces only a 50% probability of losing the litigation. Thus, in light of Row's settlement, its expected loss from litigation is only $31.25.

It therefore follows that if the plaintiff were to make offers of $37.50 to each defendant, at least one of them would reject the offer. The plaintiff's expected recovery would then be $68.75 (Row's settlement of $37.50 plus an expected recovery of $31.25 from litigating against Column). This amount is lower than the plaintiff's expected recovery from litigating against both defendants. Thus, the plaintiff would never make offers of $37.50 to each defendant.
Similar logic establishes that no other pair of offers would give the plaintiff an expected recovery of at least $75 and yet be acceptable to the two defendants. Also, there is no scenario under which the plaintiff would receive an expected recovery of at least $75 by settling with one defendant and litigating against the other.

This phenomenon has two sources (1) the surplus that the plaintiff obtains from litigation as a result of joint and several liability when its probabilities of success against the defendants are independent, and (2) the benefit that a non-settling defendant receives from the set-off created by the plaintiff's settlement with the other defendant.

If the plaintiff were litigating against only one defendant rather than two, its expected recovery from litigation would be $50 rather than $75: it would have a 50% probability of recovering from that defendant its full damages of $100. Similarly, as we have indicated, if the plaintiff were litigating against two defendants under non-joint liability, its expected recovery would also be $50: it has a 50% probability of recovering $50 from each of the defendants. Finally, if the plaintiff were litigating against two defendants under joint and several liability but its probabilities of success against the defendants were perfectly correlated, it would also have an expected recovery of only $50 (a 50% probability of recovering its full damages if it prevails against both defendants).

As a result of the surplus that the plaintiff obtains from litigating under joint and several liability when the probabilities of prevailing are 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 would 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 would be $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 confers 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.

The role of joint and several liability in discouraging settlements is not limited to the case in which litigation costs are zero. The externality described above also impairs the possibility of settlement when litigation when litigation costs are positive but lower than a particular threshold.

3.2.2. 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. Unlike the case of several only liability, where the parties are indifferent between settlement and litigation when litigation costs are zero, here there is a positive surplus that the plaintiff and a defendant can divide if a settlement takes place.

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 would therefore 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 1994a).

3.2.3. The Effects of Limited Solvency
As indicated above, under several only liability, the limited solvency of the defendants does not affect the choice between settlement and litigation. 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. 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 only against Column and recovers $100; 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 non-joint 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 1994b) 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 non-joint liability. The relevant results are summarized in Table I.

[Insert Table I here]

3.3 Joint and Several Liability with \( n > 2 \) Defendants

Joint and several liability governs many situations in which more than two tortfeasors contribute to a harm suffered by a single individual. In the antitrust context, a price-fixing conspiracy may often involve more than two companies. Often, more than two generators deposit waste at a site that subsequently suffers a release of hazardous substances into the environment. Even a typical malpractice litigation may include a surgeon, an anaesthiologist, several nurses, and the hospital. It is therefore important to analyze the case \( n > 2 \).

The cases of perfect positive correlation and independence among \( n \) defendants extend relatively straightforwardly. An extension to the general case, however, presents significant analytic problems.

The case \( n=2 \) is simple because we may parameterize the space of 2x2 correlation matrices by the correlation in the closed interval \([-1,1]\). The problem is thus one-dimensional. As \( n \) increases, however, the dimensionality of the problem apparently increases exponentially (at a rate roughly of \( n(n-1)/2 \)). Further difficulties arise because characterizing the space of \( nxn \) correlation matrices is difficult. Indeed, as suggested by Budden et al 2007, one cannot easily determine which positive hermitian \( nxn \) matrices are valid correlation matrices; the degree of correlation between plaintiff’s prospects of success against defendants 1 and 2 may constrain the correlations between defendants 1 and 3 and defendants 2 and 3.
Chang and Sigman (2000) introduced a special correlation structure which we, following Kornhauser and Takeda (2007), will call group correlation. In this structure the $n$ defendants fall into $l$ $m$ $n$ groups. Plaintiff’s prospects of success against defendants within a group are perfectly correlated but plaintiff’s prospects of success against defendants in different groups are independent. This correlation structure may capture those situations in which a common set of facts is establishes the liability of one group of defendants while another, independent set of facts establishes the liability of a second group. In the hazardous waste context, for example, one group of defendants may have used firm X to transport and deposit the waste while a second set of defendants used firm Y. The records of firm X will provide evidence that the first group of defendants deposited at the site and the records of firm Y will provide evidence on the second group.

Within this correlation structure and when each defendant has an equal share of liability, Chang and Sigman showed that plaintiff’s return from settling with all defendants exceeded her return from litigating against all defendants. Unfortunately, settling with all defendants, each of whom has an equal share, does not appear to be an equilibrium of this game when plaintiff’s prospects of success against a single defendant falls in a wide range.

Kornhauser and Takeda (2007) provide a more complete analysis of the grouped correlation structure. They show that, when plaintiff’s prospects of success against any given group is sufficiently high, the plaintiff litigates against the member of each group with the smallest share and settles with all other defendants. The two-defendant case provides a reasonable intuition for this result. The grouped correlation structure combines the two extreme cases of independence and perfect correlation. Plaintiff’s expected return from litigation rises with the number of groups against which she litigates. Litigating against more than one member of each group, however, does not increase her expected return from litigation. It thus pays for her to settle with all but one member of each group.

As $p$, plaintiff’s prospects of success against a single defendant, declines, however, this intuition misleads and additional equilibria are possible. Plaintiff reduces the number of groups
against which she litigates from $m$ to a smaller number. For sufficiently small $p$ and for some distributions of shares, settlement with all may be optimal. In other cases, the plaintiff litigates against one member of some groups but settles with all members of remaining groups. Her return from settlement with additional parties outweighs the marginal increase in her expected return from litigation. The exact equilibrium depends not only plaintiff’s probability of success against each group but also on the number of groups, the number of defendants, and the distribution of shares among the defendants.

* * *

In sum, the analysis of settlement reveals that, with a pro tanto set-off rule, the value of a claim under joint and several liability is higher under than the value of a claim under several only liability. When plaintiff’s prospects of success against multiple defendants are not perfectly positively correlated, the value of a claim under joint and several liability exceeds its value under several only liability even with an apportioned set-off rule (that reduces the plaintiff’s claim against litigating defendants by the shares of settling defendants). This conclusion implies that joint and several liability will have a greater deterrent effect than several only liability.

4. Deterrence: Opening Remarks

We compare here the deterrence effects of joint and several liability and several only liability, when coupled with both rules of negligence and strict liability. We perform the comparison first for cases in which the defendants are fully solvent (Kornhauser and Revesz 1989), then consider the effects of exogenously given, limited solvency (Kornhauser and Revesz 1990) and conclude with a brief discussion of the effects of endogenously given, but limited solvency.
We continue to develop our argument by reference to a model in which two firms, Row and Column, deposit hazardous wastes at a single landfill. The actors benefit from this dumping because the wastes are the by-product of profitable economic activity. At some time in the future, these wastes may leak into the environment and cause serious damage; we think of this damage as the cost of cleaning up the landfill and the surrounding area affected by the release. We take the damage function to be convex (the additional damage caused by one unit of waste increases with increasing amounts of waste in the landfill).

The expected damage of a release is a "social" loss because it does not fall directly on the dumpers absent a legal provision shifting the liability to them. Instead, it falls on the victim that would have legal responsibility for the cleanup, or, alternatively, that would suffer the consequences if the problem were left unattended. Under our model, each dumper chooses the amount of waste that it will dump.

The socially desirable amount of waste is that which maximizes the social objective function: the sum of the benefits derived by the actors minus the social loss. An economically rational firm, however, does not make this decision based on the social objective function. Instead, it seeks to maximize its private objective function: the benefit that she derives from the activity that leads to the production of the waste minus whatever share of the social loss the legal regime allocates to her.

We model a joint and several liability regime with contribution shares determined by reference to the amount of waste dumped. (Other rules are considered in Landes and Posner 1980, Kornhauser and Revesz 1989, Tietenberg 1989, and Wright 1988: 1169-79.) We assume that a plaintiff, say for example the government, sues both defendants in the same proceeding.

Our analysis of settlement in Part B has already established an important, perhaps the most important, difference in the deterrent effects of joint and several liability and several-only liability. We saw that, regardless of the degree of correlation between plaintiff’s prospects of success against the two defendants, the value of a claim under joint and several liability exceeds the value of corresponding claims under a regime of several-only liability. As a first
approximation, then, joint and several liability sets a higher price on malfeasance and consequently should have a greater deterrent effect than several only liability.

Two early papers that extended the work of Kornhauser and Revesz, Kahan (1996) and Spier (1994), noted this effect and some subtleties of it but it has not received adequate attention in the literature. Both Kahan and Spier restrict their attention to the case of perfect, positive correlation of probabilities. Spier assumes that the probability that plaintiff prevails is independent of the level of care (or activity) in which the defendants engage. She finds that the ratio of the value of a claim under joint and several liability to the value of a claim under several-only liability is inversely proportional to plaintiff’s (joint) prospects of success against the two defendants. For two defendants, when $p = 1$, the value of the claims is identical but as $p$ goes to zero the ratio of the values goes to 2.

Kahan, by contrast, considers the case in which defendants’ actions (either of care or activity level) affect both the probability of an accident and the probability $p$ that the plaintiff will prevail at trial. When $p = 0$ and $p = 1$, the value of plaintiff’s claims against the defendants are, for perfect positive correlation, identical under the two legal regimes. For all other $p$, however, the value of plaintiff’s claims under joint and several liability exceed the value under several only liability. Deterrence, however, is determined by the marginal effects not the total effect and, in Kahan’s model, joint and several liability might either over- or under-deter relative to several only liability.

Our analysis of settlement in Part B concluded that the value of plaintiff’s claims are always higher under joint and several liability than under several only liability. Consequently, Spier’s conclusion that joint and several liability induces more deterrence than several only liability applies broadly when the plaintiff’s prospects of success against each defendant are not influenced by the defendants’ ex ante choices of care and activity levels. For the case of independence, the ratio of the two values is highest when $p=0$ and equals 1 when $p = 1$.

In what follows, however, we make the counterfactual assumption that the value of plaintiff’s claims against defendants are uninfluenced by the liability rule. From this
perspective we find additional causes of variation in the deterrent effects of the two legal regimes.

4.1. Full Solvency

4.1.1. Negligence

We assume in the case of negligence that the standard of care will be chosen at the level that maximizes social welfare; departures from the social optimum in setting the standard of care are considered in Kornhauser and Revesz (1989): 862-70. For expositional convenience, we assume that negligent actors are liable only for the losses that would have been prevented through due care (in this example, for the additional losses that result if a firm dumps more than the socially optimal amount, rather than the socially optimal amount). We show in Kornhauser and Revesz (1989) that essentially the same results hold if negligent actors are responsible for the full losses (even ones that would have occurred with due care). This argument shows that, under standard regularity conditions, it is a Nash equilibrium for each actor to meet its standard of care. As the standards of care are set at the socially optimal levels, this Nash equilibrium is efficient. We now show that this efficient Nash equilibrium is unique.

Under these circumstances, joint and several liability will produce the socially optimal result. If one of the actors, say Row, is non-negligent, it would not be rational for Column to be negligent. If this actor were contemplating dumping more than the standard of care, she would face liability for the full increase in the resulting damage. If the standard of care is set at the social optimum, the increased benefits that this actor would obtain through negligent conduct would be less than the increase in the damage for which she would be liable. Thus, assuming that one of the actors is non-negligent, the remaining actor will be non-negligent as well. Thus, an equilibrium in which both agents are negligent is not possible.
Now consider whether it would be rational for both actors to be negligent. These actors will, jointly, face liability equal to the full increase in the resulting damage. If negligent action on the part of these actors were preferable to non-negligent action for each of them, then the total social welfare would exceed that attainable when all actors meet the standard of care, which, once again is not possible if the standard of care is set at the social optimum. Thus, regardless of how the increased damage were allocated between the defendants, at least one of them would have to pay more than the increased benefit that it obtained by acting negligently.

The analysis is different for a several only liability rule, under which a negligent defendant would not be liable for the share of the damage attributable to the non-negligent defendant. Instead, the negligent defendant would be liable for an amount proportional to waste that it had dumped. Assume that Row is non-negligent and that Column is contemplating dumping more than the standard of care. Column would then pay only a fraction of the increase in damage. Under this apportionment rule, the remainder of the increase would be attributable to Row and would be unrecoverable by the plaintiff as a result of Row's lack of negligence. Thus, in this situation, several only liability leads to under-deterrence.

4.1.2. Strict Liability

The analysis is different for strict liability. Under strict liability, as long as both actors are fully solvent, there is no difference between joint and several liability and several only liability. Strict liability ensures that the victim is compensated for the full damage, and thus the question whether the victim will have to bear the share of the damage caused by the actions of non-negligent defendants does not arise.

Assume that Row is dumping the optimal amount of waste (the amount that would have met the standard of care if a rule of negligence had been in effect) and that Column is contemplating whether to dump more than this amount. Such a decision on the part of the Column would, of course, increase the damage to the victim. Column would, in turn, be liable
for a larger share of the damage, as it would pay in proportion to the amount of waste that it dumped. As long as the damage function is convex, however, the increase in Column's liability is less than the increase in the social loss. Thus, Column's decision to dump more than the socially optimal amount has the effect of increasing Row's liability as well.

As a result of this externality, strict liability leads to under-deterrence, regardless of whether it is coupled with joint and several liability or several only liability.

Miceli and Segerson (1991) consider a modification of the strict liability rule that does in fact lead to efficiency both in terms of the level of care adopted and of entry into the activity. Under their formulation, each actor is responsible for the marginal damage it causes. This rule, coupled with the assumption of convex costs implies that total payments from two parties would exceed actual damages.

4.2. Limited, Exogenously Determined Solvency

Here, each defendant is defined not only by its benefit function (the rate at which its generation of waste is transformed into net benefits) but also by a fixed solvency, which represents the actor's available amount of assets to offset her share of the social loss. Under this formulation of the problem, the actors cannot shed their solvencies over time. We present here the analysis for strict liability, which makes it possible to explain the basic intuitions. The comparison of joint and several liability and several only liability under negligence when the actors have limited solvency is presented in Kornhauser and Revesz (1990).

Consider a situation under which Row's solvency is zero and Column's solvency is infinite, and that both firms are otherwise identical. The liability rule thus transmits no deterrence incentive to Row. Thus, Row will dump to the point at which any additional benefit (in terms of reduced costs of production) from additional dumping becomes zero. This amount, which we call \( x^{H} \), is greater than \( x(\infty) \), the amount that Row would have dumped if both
defendants had been infinitely solvent. Note that, as a result of the under-deterrence caused by
strict liability, discussed above, \( x(\infty) \) is in turn larger than \( x^* \), the socially optimal amount.

Under joint and several liability, because Row has no solvency, Column will be
responsible for the whole liability and will dump an amount \( a \) (smaller than \( x^* \)), which is the
optimal amount of dumping by Column conditional on Row being insolvent. The equilibrium is
thus \( (x^H,a) \). If Column is not infinitely solvent, there are two possible equilibria: \( (x^H,a) \), if
Column's solvency is greater than a critical solvency which we call \( s_j \) or \( (x^H,x^H) \), if Column's
solvency is lower.

In contrast, under several only liability, Column is not responsible for the whole liability,
but only for its proportional share. If Column has infinite solvency, it will dump \( b \), an amount
larger than \( a \), though smaller than \( x^* \). Here, too, there are two possible equilibria if Column is
not infinitely solvent: \( (x^H,b) \), if Column's solvency is greater than a critical solvency which we
call \( s_{nj} \) or \( (x^H,x^H) \), if Column's solvency is lower. Note that \( s_{nj} \) is smaller than \( s_j \). Because for any
level that it dumps Column faces less liability under a rule of several only liability, over a larger
range of solvencies it chooses to act as if it were infinitely solvent rather than wholly insolvent.
Table II summarizes the relevant equilibria.

[Insert Table II here]

From a social welfare perspective, an equilibrium at \( (x^H,a) \), which occurs in certain
instances under joint and several liability is preferable to an equilibrium at \( (x^H,b) \), which is
sometimes the product of several only liability. When one actor is generating \( x^H \), joint and
several liability makes the other actor see the full social cost of its actions, whereas several only
liability does not. Thus, a is the optimal response by Column to Row's choice of \( x^H \). In region C in Table I, joint and several liability is therefore preferable to several only liability.

In region B, however, the reverse is true. Joint and several liability induces Column to act in the same manner that it would if it were wholly insolvent, dumping \( x^H \), whereas several only liability induces Column to act in the same manner that it would if it were infinitely solvent, dumping \( b \). Thus, in this region, several only liability has better social welfare properties. (Of course, in region A, both rules have the same properties.)

This discussion illustrates that, when solvency is exogenously given and limited, neither rule dominates the other. (The same is true under negligence (Kornhauser and Revesz 1990).) The intuition behind this result is that Row's insolvency creates a "domino" effect, leading Column, under certain circumstances to act as if it were insolvent as well. Because under joint and several liability, Column is responsible for a greater proportion of the total harm, the range under which this "domino" effect occurs is greater.

The analysis here and in Watts (1998) considers joint tortfeasors who are not in a contractual relationship with each other. Segerson (1994) considers the effect of joint and several liability on a landowner’s level of discharge onto a piece of land when the owner may potentially sell the land to a third party. Both the initial landowner and the potential buyer are potentially insolvent with insolvency modeled, as in Watts (1998) as a probability of having no assets whatsoever. She finds that joint and several liability provides incentives to reduce contamination at least as great, and usually greater, than several only liability.

4.3 Endogenous Solvency

The analysis of insolvency in Kornhauser and Revesz (1994b), Watts (1998), and Segerson (1994) is not fully satisfying because insolvency is given exogenously. In fact,
economic theory suggests that firms will adjust their solvency in response to the legal rule. Indeed, Ringleb and Wiggens (1990) presents evidence that firms, faced with potentially high tort liability reduce are less capital intensive than firms that do not face such liability.

Three articles have sought to make the solvency decision endogenous when tortfeasors have no contractual relation. Two of these, Yahya (2000) and Colpitts (2005) adopt a finance approach. They ask how the capital structure of the firm changes in the presence of joint and several liability. The third article, Klee and Kornhauser (2007) considers how joint and several liability influences the scale of the firm.

Consider first the finance models. Tort victims are involuntary creditors of the firm whose priority lies above equity but below secured credit. Clearly, in the case of a single, corporate tortfeasor, substituting debt for equity allows the firm to externalize some of the cost of the accidents the firm causes. Colpitts shows that the extent of potential liability influences the effects of joint and several liability on the firm’s capital structure. When exogenously given, expected tort damages are low relative to the costs of bankruptcy, firms choose a capital structure that assures compensation for tort victims when firm projects have high returns. As the expected costs of tort liability increase, however, firms increase the share of debt in their capital structures thereby increasing the risk of insolvency.

In the simple model in Yahya (2000) the firm chooses both its capital structure and a risk of tort injury. He argues that negligence regimes dominate strict liability regimes because, at least for some levels of damage, negligence induces the firms to adopt more care. Neither regime – joint and several liability with negligence or several only liability with negligence, however, dominates the other.
In Klee and Kornhauser (2007), firms first choose their scale and then they choose their “capital intensity.” Thus, in this model, the legal regime, influences the “solventy” of the firm in two ways: first it may influence the firms scale, the total amount of money it has available for payment to creditors in general and tort creditors in particular. Second, it may influence the probability that the firm goes insolvent as this probability depends on the firm’s capital intensity. Kornhauser and Klee show that both effects apply: firms are smaller in scale under joint and several liability than under several only liability and, for given scale, they generate more waste. The net effect, however, remains open. Because firms under joint and several liability are smaller, it is logically possible that the industry causes less damage under joint and several liability than under several only liability.

Boyd and Ingberman (1997, 2003) have analyzed the problem when the originator of the threat is in contractual relations with another party. They reach similar conclusions. As in the prior case, joint and several liability encourages firms to externalize the risks they impose. As a consequence, under joint and several liability, firms have a lower capitalization and may increase output. An additional problem, however, arises. Firms now care about the capitalization of their partners; this concern might yield vertical integration. Nevertheless, in many instances, the greater incentives for care created by joint and several liability outweigh these costs and joint and several liability will yield higher welfare than several only liability.

D. Fairness

5. Fairness: Several Remarks

The comparison of the relative fairness of joint and several liability and several only liability raises four principal issues (Kornhauser and Revesz 1995). Three of these issues arise when the defendants are fully solvent: (1) the size of the plaintiff’s expected recovery when she
litigates against the defendants; (2) the division of the plaintiff’s recovery among litigating defendants; and (3) 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 (Wright 1992). 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.

6. Size of the Plaintiff’s Recovery

First, as indicated in Part C, 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 several only liability. Recall the example in which the plaintiff’s damages are $100 and her probabilities of success against each of the defendants are 50 percent, and the defendants are equally at fault and fully solvent. The plaintiff’s expected recovery is $50 under several only 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 percent. 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 is 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 percent probability. Then, joint and several liability is undesirable because it increases a defendant’s expected liability beyond the level of harm the defendant caused.
7. 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 percent and 75 percent at fault, respectively; the plaintiff’s probabilities of prevailing against each of the defendants remains at 50 percent and these probabilities are independent. There are then four possible scenarios, each carrying a probability of 25 percent:

1. the plaintiff prevails against both defendants and collects $25 from Row and $75 from Column;
2. the plaintiff prevails against Row and loses to Column, and collects $100 from Row;
3. the plaintiff loses to Row and prevails against Column, and collects $100 from Column; and
4. the plaintiff loses to both defendants and does not recover anything

Thus, Row pays $25 with probability 25 percent and $100 with probability 25 percent; her expected liability is then $31.25. In turn, Column pays $75 with probability 25 percent and $100 with probability 25 percent, and her expected liability is $42.75. Thus, while Row’s contribution to harm is only one-third that of Column’s, her 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 several only 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.
8. **The Effects of Settlements**

The possibility of settlements introduces a third fairness issue, also by placing a disproportionate burden on the defendant with the smaller share of the liability. Indeed, for the legal regime analyzed in Part C, which employs a protanto set-off 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, $t$ is each defendant’s litigation costs, and $D$ are the plaintiff’s damages. Similarly, the largest settlement that Row will accept, $S_c$, conditional on Column settling for $S_r$ (which is less than the plaintiff’s damages $D$) is given by

$$S_c = p(D - S_r) + t$$

Thus,

$$S_r = S_c = (Dp + t) (1 + p)$$

As a result, 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 defendant’s shares of the harm.

In contrast, recall that under several only liability, each defendant’s expected liability is proportional to its responsibility for the harm. The plaintiff, if she 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 she would have paid under joint and several liability.

9. 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 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, 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 co-defendants (Sugarman 1992).

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 the limited solvency. Moreover, the focus on litigation overlooks the fact that settlement might occur. Thus, 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, as shown in Part C, under several only liability, the full shortfall is borne by the plaintiff.

D. Insurance
10. Insurance Under Joint and Several Liability

The discussion thus far has ignored the existence of markets for insurance. Though commentators have asserted that joint and several liability undermines the market for insurance, particularly for environmental damage, there has been no systematic, economic analysis of the interaction of joint and several liability with insurance and insurance markets.

Critiques of joint and several liability from an insurance perspective (Abraham (1988), Berkamp (2001) and Trebilcock (1987)) take two forms. The commentators argue first that joint and several liability creates legal uncertainty about the size of the prospective claim; consequently, joint and several liability increases the cost of insurance or prevents the market from forming. They argue second that joint and several liability is unfair because it may impose large amounts of liability upon parties who have had a relatively minor responsibility for the damage done.

We have addressed this latter complaint in the prior section and the presence of an insurance market does not alter our analysis. In this section, we offer some tentative remarks about three questions concerning how a regime of joint and several liability interacts with insurance markets: (1) How, if at all, would the presence of an insurance market, affect the incentives of tortfeasors? (2) Would tortfeasors purchase insurance? And (3) Does joint and several liability reduce the likelihood that insurance markets will form? Our discussion is both cursory and tentative. As the prior analysis shows, the effects of joint and several liability may, as in the settlement context, depend on very subtle details of the actual regime. Without careful analysis, we cannot confidently assert how specific regimes of joint and several liability will function. Similarly, the interaction of joint and several liability will depend on the nature of the market for insurance and again the literature is largely silent about these details.

Consider first the effect of insurance on the incentives of tortfeasors. The literature on insurance for single tortfeasors shows that perfect, fair insurance has no effect on the incentive effects of liability rules. Insurance is far when the premium equals the expected losses. Insurance is perfect when the insurer knows the precise risk that the insured poses; neither
adverse selection or moral hazard undermines the market. Of course, in real markets insurance is neither perfect nor fair and the premium schedule will not perfectly communicate the incentives of the liability scheme. As risks will be pooled, some agents will be underdeterred and others overdetered.

Consider next whether tortfeasors will purchase insurance. Again, the answer depends on the timing and size of the expected losses. If, as in the hazardous waste context, the potential loss is large and distant in time, the tortfeasor has little, if any, incentive to purchase insurance. Rather, she would rather take the money and run; that is, she would rather distribute the profits from the enterprise and leave no assets available to pay any subsequent tort claims. For smaller claims that occur contemporaneously with (or prior to) the accrual of profits from the enterprise, this strategy is not feasible and the tortfeasor has incentives to insure.

Finally, consider whether joint and several liability increases barriers to the formation of insurance markets. As the Abraham (1988) and Trebilcock (1987) note, joint and several liability increases uncertainty about the size of the award that will be paid. As a consequence, one might expect the price of insurance to rise.

11. Conclusions

In sum, from the perspectives of inducing deterrence and inducing settlements, and promoting fairness, there is no dominant relationship between joint and several liability and several only liability. From a deterrence perspective, the comparison between the two rules turns on the levels of solvency of the defendants. In contrast, from settlement and fairness perspectives, the comparison turns on the correlation of the plaintiff’s probabilities of success against the defendants.

Acknowledgements

REFERENCES


Colpitts, Jeffrey (2005), ‘Tort Liability and Capital Structure,’ mimeo, Sauder School of Business, University of British Columbia.


Table I:
Effects of Joint and Several Liability on Settlements Under Different Levels of Solvency Relative to Several only Liability

<table>
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<th></th>
<th>High Solvency</th>
<th>Low solvency</th>
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<td>Independent probabilities</td>
<td>Discourages settlement</td>
<td>Neutral effect</td>
</tr>
<tr>
<td>Perfectly correlated probabilities</td>
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<td>Neutral effect</td>
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Table II: Equilibria Under Joint and Several Liability and Several Only Liability

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<thead>
<tr>
<th>Region</th>
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<th>Equilibria</th>
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<tr>
<td></td>
<td>Joint and Several</td>
<td>Several only</td>
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<tr>
<td></td>
<td>Liability</td>
<td>Liability</td>
</tr>
<tr>
<td>A</td>
<td>0 - s_{nj}</td>
<td>(x^H,x^H)</td>
</tr>
<tr>
<td>B</td>
<td>s_{nj} - s_j</td>
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</tr>
<tr>
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