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Efficient Liability Assignment: Is Coupling a Necessity?

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Abstract

The paper, by providing example of an efficient liability assignment rule under which liabilities of interacting parties for accidental losses is not always coupled, demonstrates that decoupling is not inconsistent with efficient assignment of liabilities.

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1. Introduction

The problem of the presence of negative externalities resulting in inefficiencies has been extensively studied in economics and it is well known that imposition of appropriately designed taxes is one solution to the problem.[1] An alternative solution is the legal remedy of assignment of liabilities between the interacting parties. Efficient assignment of liabilities is one of the primary concerns of the law and economics literature.[2] In the framework which is now standard in this literature, the analysis is usually done in the context of interactions between two risk-neutral parties who are strangers to one another. It is assumed that the loss, in case of accident, falls on one of the parties called the victim. The other party is referred to as the injurer. The probability of accident and the actual loss in case of accident is assumed to depend on the care levels of the two parties. It is also assumed that the social objective is to minimize the total social costs which are defined as the sum of costs of care of the parties involved and the expected accident loss. A rule for the assignment of liabilities specifies the portions of the loss, in case of occurrence of accident, that the victim and the injurer have to bear for every possible combination of their levels of nonnegligence.[3] A rule for assignment of liabilities is said to be efficient if and only if it always induces both parties to choose care levels that minimize total social costs.

The assignment of liabilities corresponding to any combination of the levels of nonnegligence of the interacting parties is said to be *coupled* if and only if the interacting parties together are made to bear the full loss and is said to be *decoupled* if and only if the interacting parties together bear less or more than the loss. The standard rules used by courts are all examples of rules under which liabilities are coupled for all combinations of levels of nonnegligence of the parties.[4] The rule under which the injurer pays tax equal to the harm and the victim bears his loss is an example of a rule under which liabilities

[1]The problem of designing appropriate taxes to deal with negative externalities was formally analysed by Pigou (1920).

[2]See Calabresi (1961), Calabresi (1965), Calabresi (1970), Coase (1960), Brown (1973), Diamond (1974), Posner (1972), Posner (1973), Shavell (1980), Jain and Singh (2002) and Jain (2012). Brown was the first to present formal analysis of many of the important rules for assignment of liabilities. The subsequent literature is built upon Brown's formal model. A systematic treatment of the economic analysis of rules for the assignment of liabilities is contained in Jain (2015).

[3]Nonnegligence of a party is defined with respect to a court specified due care level. If there is a legally specified due care for a party and the party chooses a care level which is less than the due care specified for the party then the party is called negligent, otherwise the party is nonnegligent. The level of nonnegligence of a party is either 1 or the ratio of his actual level of care to the due care level legally specified for him, whichever is lower.

[4]The rules of *no liability*, *strict liability*, *negligence*, *strict liability with the defence of contributory negligence* and *negligence with the defence of contributory negligence* are among the rules which are most widely used by courts and extensively analyzed in the literature. The assignment of liabilities under these rules are as follows:

(i) *No liability*: the victim always bears the entire loss and injurer bears nothing.
(ii) *Strict liability*: the injurer is always liable for the entire loss and victim bears nothing.
(iii) *Negligence*: if the injurer is negligent then he has to bear the entire loss and victim bears nothing; if the injurer is not negligent then he bears nothing and the entire loss is borne by the victim.
(iv) *Strict liability with the defence of contributory negligence*: if the victim is negligent then he has to bear the entire loss and injurer bears nothing; if the victim is not negligent then he bears nothing and the entire loss is borne by the injurer.
(v) *Negligence with the defence of contributory negligence*: if the injurer is negligent and the victim is not then he has to bear the entire loss and victim bears nothing; otherwise he bears nothing and the entire loss is borne by the victim.

are decoupled for all combinations of levels of nonnegligence of the parties. It has been established in the literature that while there are efficient rules under which liabilities are always coupled,[5] rules under which liabilities are always decoupled are all inefficient.[6] Thus it appears that the notion of decoupled liability is inconsistent with efficiency.[7]

In this paper we consider a very general class of rules called *liability assignment rules* under which the assignment of liabilities can be coupled for some combinations of the levels of nonnegligence of the interacting parties and decoupled for other combinations, and explore the possibility of efficient assignment of liabilities in the presence of decoupling. We provide example of an efficient liability assignment rule which exhibits decoupling only when both parties are negligent and conclude that decoupling liability is not entirely inconsistent with efficiency.

The paper is organized as follows: The model is presented in Section 2. All definitions and assumptions are stated here and are illustrated with appropriate examples. Section 3 contains the main result of the paper. Section 4 concludes the paper.

2. Model

We consider interactions, between two parties (generically called party i where $i \in \{1, 2\}$) assumed to be strangers to each other, which can result in an accidental harm falling on party 1. We'll refer to party 1 as the victim and party 2 as the injurer. It is assumed that the probability of accident and the magnitude of harm in case of an accident depends on the level of non-negative care that the parties might choose to take. Let $a_i \geq 0$ be the index of the level of care taken by party i and let $A_i = \{a_i \mid a_i \geq 0$ be the index of some feasible level of care which can be taken by party $i\}$. We assume that

$0 \in A_i$. (A1)

We denote by $c_i(a_i)$ the cost to party i of care level a_i. Let $C_i = \{c_i(a_i) \mid a_i \in A_i\}$. We assume

$c_i(0) = 0$. (A2)

We also assume that

c_i is a strictly increasing function of a_i. (A3)

In view of (A2) and (A3) it follows that $(\forall c_i \in C_i)(c_i \geq 0)$.

A consequence of (A3) is that c_i itself can be taken to be an index of the level of care

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[5]Rules under which the assignment of liabilities are always coupled are called liability rules. Jain and Singh (2002) establishes that a liability rule is efficient if and only if it satisfies the condition of negligence liability. The condition of negligence liability requires that whenever one party is negligent and the other is not the negligent party should bear the entire loss and the nonnegligent party should bear none of the loss.

[6]According to Shavell (2007) (footnote 8 in p. 147), the rule under which the injurer pays tax equal to the harm and the victim bears his losses, efficiency would obtain even when both care and activity levels can be varied: 'However, fully optimal behavior can readily be induced with tools other than liability rules. For example, if injurers have to pay the state for harm caused and victims bear their own losses, both victims and injurers will choose levels of care and of activity optimally'. Jain (2012) analyses the set of all rules under which the assignment of liabilities is either coupled always or decoupled always and demonstrates that every rule under which the liabilities are always decoupled is inefficient even in the case of fixed activity levels.

[7]It has been argued that efficient assignment of liabilities not only requires internalization of the harm by both parties but also the closure of the externality with respect to the interacting parties. Rules under which the liabilities are always coupled automatically satisfy the closure property by apportioning the full loss between the victim and the injurer and therefore efficiency for such rules depend on whether or not the parties are induced to internalize the harm. On the other hand, rules under which the liabilities are always decoupled necessarily lead to violation of the closure property and therefore result in inefficiency. See Jain (2012).

taken by party i.
Let $\pi : C_1 \times C_2 \mapsto [0,1]$ denote the probability of occurrence of accident and $H : C_1 \times C_2 \mapsto \Re_+$ the loss in case of occurrence of accident. Let $L : C_1 \times C_2 \mapsto \Re_+$ be defined as: $L(c_1, c_2) = \pi(c_1, c_2)H(c_1, c_2)$ for all $(c_1, c_2) \in C_1 \times C_2$. L is thus the expected loss due to accident.
We assume:
π and H are non-increasing in c_1 and c_2. (A4)
(A4) implies that L is non-increasing in c_1 and c_2.
We define the total social cost of the interaction between the two parties, $T : C_1 \times C_2 \mapsto \Re_+$, as: $T(c_1, c_2) = c_1 + c_2 + L(c_1, c_2)$ for all $(c_1, c_2) \in C_1 \times C_2$. Let $M = \{(c_1', c_2') \in C_1 \times C_2 \mid (\forall (c_1, c_2) \in C_1 \times C_2)[T(c_1', c_2') \leq T(c_1, c_2)\}$. Thus M is the set of all costs of care profiles (c_1', c_2') which are total social cost minimizing. It will be assumed that:
C_1, C_2, π and H are such that M is nonempty. (A5)

Negligence. Legal assignment of liabilities for the losses may depend on negligence or otherwise of the parties. A party is considered negligent iff she is found to have taken less than the care due from her. In order to identify a reference point for the specification of due care levels and to formalize the notion of negligence of the parties we take $(c_1^*, c_2^*) \in M$ and define functions $p_i : C_i \mapsto [0,1]$ as follows:

$$\begin{aligned} p_i(c_i) &= \tfrac{c_i}{c_i^*} \quad \text{if } c_i < c_i^* \\ &= 1 \quad \text{otherwise.} \end{aligned}$$

$p_i(c_i)$ would be interpreted as the proportion of nonnegligence of party i. $p_i(c_i) = 1$ would mean that party i is taking at least the due care and $p_i(c_i) < 1$ as meaning that party i is taking less than due care. If $p_i(c_i) = 1$, party i would be called nonnegligent; and if $p_i(c_i) < 1$, party i would be called negligent.

If there is a legally specified due care level for party i then c_i^* used in the definition of p_i would be taken to be identical with the legally specified due care level. If no due care level is legally specified for party i then c_i^* used in the definition of p_i can be taken to be any $c_i^* \in C_i$ subject to the requirement that $(c_1^*, c_2^*) \in M$. Therefore in all cases, for each party i, c_i^* would denote the legally binding due care level for party i whenever the idea of legally binding due care level for party i is applicable. [8]

Liability Assignment Rule. A liability assignment rule is a function $g : [0,1]^2 \mapsto [0,\infty)^2$, such that: $g(p_1, p_2) = (x_1, x_2)$, where x_1 is the portion of loss to be borne by the victim and x_2 is the portion of the loss to be borne by the injurer. In other words, a liability assignment rule is a rule which specifies, for every possible configuration of the levels of nonnegligence of the two parties, the portions of the loss, in case of accident, to be borne by each of the two parties.

A liability assignment rule g is called (i) a liability rule iff $x_1 + x_2 = 1$ for all $(p_1, p_2) \in [0,1]^2$ and (ii) a hybrid liability rule iff $x_1 + x_2 = k$ for all $(p_1, p_2) \in [0,1]^2$; where $k \in \Re_+$.[9] The liability assignment under a liability rule is such that the victim and the injurer together bear the exact amount of the loss. Thus, by definition, the assignment of liabilities under a liability rule is always coupled. The same is not true about a hybrid liability rule or a liability assignment rule in general. While the assignment of liabilities under any

[8]Thus, implicitly it is being assumed that the legally specified due care levels are in all cases consistent with the objective of total social cost minimization.
[9]While liability rules have been extensively studied in the literature, Jain (2012) was the first to introduce and analyze the notion of a hybrid liability rule. The notion of a liability assignment rule was also introduced by Jain (2012).

hybrid liability rule which does not belong to class of liability rules is always decoupled; the assignment of liabilities under a liability assignment rule can be coupled for some configurations of nonnegligence of the parties and decoupled for other configurations.[10]

Example 1. *Consider the following liability assignment rules:*

(i) g_1 *(The standard negligence rule): If the injurer is negligent then he has to bear the entire loss and victim bears nothing; if the injurer is not negligent then he bears nothing and the entire loss is borne by the victim.*

$$\begin{aligned} g_1(p_1, p_2) &= (0,\ 1) \quad \text{if } p_2 < 1 \\ &= (1,\ 0) \quad \text{otherwise.} \end{aligned}$$

(ii) g_2 *(The rule under which the injurer pays tax equal to the harm and the victim bears his losses): The injurer and the victim both bear the full loss individually.*

$$g_2(p_1, p_2) = (1,\ 1) \quad \text{for all } (p_1, p_2).$$

(iii) g_3*: If the injurer is not negligent then he bears nothing and the entire loss is borne by the victim; if the injurer is negligent and the victim is not then the injurer has to bear the entire loss and victim bears nothing; and if both are negligent then each one has to individually bear the entire loss.*

$$\begin{aligned} g_3(p_1, p_2) &= (1,\ 1) \quad \text{if } p_1, p_2 < 1 \\ &= (0,\ 1) \quad \text{if } p_1 = 1, p_2 < 1 \\ &= (1,\ 0) \quad \text{if } p_2 = 1. \end{aligned}$$

Note that g_1 is a liability rule; g_2 is a hybrid liability rule (with $k = 2$) always resulting in a decoupled assignment of liabilities and under g_3 the assignment is decoupled if and only if both parties are negligent.

An application, ω of a liability assignment rule is a specification of C_1, C_2, π, H and $(c_1^*, c_2^*) \in M$. Let Ω denote the set of all applications which satisfy assumptions (A1) - (A5).

Let g be any liability assignment rule and $\omega \in \Omega$ be any application of g. If the victim chooses c_1, the injurer chooses c_2 and the accident occurs then the actual loss will be $H(c_1, c_2)$. According to g the victim will be made to bear $x_1(p_1(c_1), p_2(c_2))H(c_1, c_2)$ and the injurer will be liable for $x_2(p_1(c_1), p_2(c_2))H(c_1, c_2)$. $E_1 : C_1 \times C_2 \mapsto \Re_+$ defined as: $E_1(c_1, c_2) = c_1 + x_1(p_1, p_2)L(c_1, c_2)$ for all $(c_1, c_2) \in C_1 \times C_2$ is the expected cost to the victim and $E_2 : C_1 \times C_2 \mapsto \Re_+$ defined as: $E_2(c_1, c_2) = c_2 + x_2(p_1, p_2)L(c_1, c_2)$ for all $(c_1, c_2)c \in C_1 \times C_2$ is the expected cost to the injurer. We assume that for all $(c_1, c_2), (c_1', c_2') \in C_1 \times C_2$, the victim considers (c_1, c_2) to be at least as good as (c_1', c_2') iff $E_1(c_1, c_2) \leq E_1(c_1', c_2')$ and the injurer considers (c_1, c_2) to be at least as good as (c_1', c_2') iff $E_2(c_1, c_2) \leq E_2(c_1', c_2')$. Thus an application of a liability assignment rule is a two-player simultaneous move game in which the strategies are the feasible levels of care and the payoffs are the expected costs.[11]

[10] Note that the class of all liability rules is a proper subclass of the class of all hybrid liability rules and the class of all hybrid liability rules is a proper subclass of the class of all liability assignment rules.

[11] It has to be noted that the payoffs are non-positive.

A liability assignment rule, g is said to be efficient for ω iff (i) there exists a Nash equilibrium and (ii) every Nash equilibrium minimizes T.[12] A liability assignment rule, g is said to be efficient for Ω iff it is efficient for every $\omega \in \Omega$.

Example 2. *Consider an application such that* $C_1 = C_2 = \{0, 5, 10\}$ *and the expected loss is as given in Table I.*

Table I. Expected loss function

		c_2: 0	5	10
c_1	0	30	20	19
	5	20	10	9
	10	19	9	2

Note that $M = \{(5, 5)\}$*. Let* $(c_1^*, c_2^*) = (5, 5)$*.*

Consider the above as an application of g_1*. The payoff matrix of the game induced by* g_1 *is given in Table II.*

Table II. Payoff matrix under g_1

		c_2: 0	5	10
c_1	0	$(\underline{0}, 30)$	$(20, \underline{5})$	$(19, 10)$
	5	$(5, 20)$	$(\underline{15}, \underline{5})$	$(14, 10)$
	10	$(10, 19)$	$(19, \underline{5})$	$(\underline{12}, 10)$

$(5, 5)$*, the unique total social cost minimizing configuration of care levels, is also the unique Nash equilibrium of this game. Therefore* g_1 *is efficient for the given application.*[13] *Now consider the application in Table I as an application of* g_2*.The payoff matrix of the game induced by* g_2 *is given in Table III.*

Table III. Payoff matrix under g_2

		c_2: 0	5	10
c_1	0	$(30, 30)$	$(20, \underline{25})$	$(19, 29)$
	5	$(\underline{25}, 20)$	$(\underline{15}, \underline{15})$	$(14, 19)$
	10	$(29, 19)$	$(19, 14)$	$(\underline{12}, \underline{12})$

$(10, 10)$ *is a Nash equilibrium of this game but* $(10, 10) \notin M$*. Therefore* g_2 *is not efficient for the given application.*

Finally consider the application in Table I as an application of g_3*.The payoff matrix of the game induced by* g_3 *is given in Table IV.*

$(5, 5)$*, the unique total social cost minimizing configuration of care levels, is also the unique Nash equilibrium of this game. Therefore* g_3 *is efficient for the given application.*[14]

[12] Only pure strategy Nash equilibria are considered in this paper.
[13] It follows from the main result of Jain and Singh (2002) that g_1 is efficient for every application in Ω.
[14] Theorem 1 establishes that g_3 is efficient for every application in Ω.

Table IV. Payoff matrix under g_3

		c_2: 0	5	10
c_1	0	$(30, 30)$	$(20, \underline{5})$	$(19, 10)$
	5	$(\underline{5}, 20)$	$(\underline{15}, \underline{5})$	$(14, 10)$
	10	$(10, 19)$	$(19, \underline{5})$	$(\underline{12}, 10)$

3. Result: g_3 is an efficient rule

Proposition 1. *Let $\omega \in \Omega$ be any application of g_3. (c_1^*, c_2^*) is a Nash equilibrium.*

Proof. Consider any application $\omega \in \Omega$ of g_3. Suppose (c_1^*, c_2^*) is not a Nash equilibrium. (c_1^*, c_2^*) is not a Nash equilibrium implies that there exists $c_1' \in C_1$ such that $E_1(c_1', c_2^*) < E_1(c_1^*, c_2^*)$ or there exists $c_2' \in C_2$ such that $E_2(c_1^*, c_2') < E_2(c_1^*, c_2^*)$.
Suppose there exists $c_1' \in C_1$ such that $E_1(c_1', c_2^*) < E_1(c_1^*, c_2^*)$. $E_1(c_1', c_2^*) = c_1' + L(c_1', c_2^*)$ and $E_1(c_1^*, c_2^*) = c_1^* + L(c_1^*, c_2^*)$ by definition of g_3. Therefore, $E_1(c_1', c_2^*) < E_1(c_1^*, c_2^*)$ implies $T(c_1', c_2^*) < T(c_1^*, c_2^*)$ which contradicts the fact that $(c_1^*, c_2^*) \in M$.
Suppose there exists $c_2' \in C_2$ such that $E_2(c_1^*, c_2') < E_2(c_1^*, c_2^*)$. Note that, by definition of g_3, $E_2(c_1^*, c_2^*) = c_2^*$. Also, by definition of g_3, if $c_2' < c_2^*$ then $E_2(c_1^*, c_2') = c_2' + L(c_1^*, c_2')$. Therefore, if $c_2' < c_2^*$ then $E_2(c_1^*, c_2') < E_2(c_1^*, c_2^*)$ implies $T(c_1', c_2^*) < T(c_1^*, c_2^*)$ which contradicts the fact that $(c_1^*, c_2^*) \in M$. If $c_2' > c_2^*$ then $E_2(c_1^*, c_2') = c_2'$. Therefore $E_2(c_1^*, c_2') < E_2(c_1^*, c_2^*)$ cannot happen.
Thus (c_1^*, c_2^*) is a Nash equilibrium. □

Proposition 2. *Let $\omega \in \Omega$ be any application of g_3. If $(\bar{c}_1, \bar{c}_2) \in C_1 \times C_2$ is a Nash equilibrium then $(\bar{c}_1, \bar{c}_2) \in M$.*

Proof. Consider any $\omega \in \Omega$ and take any $(\bar{c}_1, \bar{c}_2)$ which is a Nash equilibrium. $(\bar{c}_1, \bar{c}_2)$ is a Nash equilibrium implies $E_1(\bar{c}_1, \bar{c}_2) \leq E_1(c_1^*, \bar{c}_2)$ and $E_2(\bar{c}_1, \bar{c}_2) \leq E_2(\bar{c}_1, c_2^*)$ and, therefore, $E_1(\bar{c}_1, \bar{c}_2) + E_2(\bar{c}_1, \bar{c}_2) \leq E_1(c_1^*, \bar{c}_2) + E_2(\bar{c}_1, c_2^*)$ which, in view of the fact that $x_2(\bar{p}_1, 1) = 0$, further implies

$$\bar{c}_1 + \bar{c}_2 + (\bar{x}_1 + \bar{x}_2)L(\bar{c}_1, \bar{c}_2) \leq c_1^* + c_2^* + x_1(1, \bar{p}_2)L(c_1^*, \bar{c}_2). \tag{3.1}$$

If $\bar{c}_1 < c_1^*$ and $\bar{c}_2 < c_2^*$ then $\bar{x}_1 = \bar{x}_2 = 1$ and $x_1(1, \bar{p}_2) = 0$, and thus $T(\bar{c}_1, \bar{c}_2) \leq \bar{c}_1 + \bar{c}_2 + (\bar{x}_1 + \bar{x}_2)L(\bar{c}_1, \bar{c}_2)$ and $c_1^* + c_2^* + x_1(1, \bar{p}_2)L(c_1^*, \bar{c}_2) = c_1^* + c_2^* \leq T(c_1^*, c_2^*)$. Therefore (2.1) implies $T(\bar{c}_1, \bar{c}_2) \leq T(c_1^*, c_2^*)$.
If $\bar{c}_1 \geq c_1^*$ and $\bar{c}_2 < c_2^*$ then $\bar{x}_1 = 0$, $\bar{x}_2 = 1$ and $x_1(1, \bar{p}_2) = 0$ and thus $T(\bar{c}_1, \bar{c}_2) = \bar{c}_1 + \bar{c}_2 + (\bar{x}_1 + \bar{x}_2)L(\bar{c}_1, \bar{c}_2)$ and $c_1^* + c_2^* + x_1(1, \bar{p}_2)L(c_1^*, \bar{c}_2) = c_1^* + c_2^* \leq T(c_1^*, c_2^*)$. Therefore (2.1) implies $T(\bar{c}_1, \bar{c}_2) \leq T(c_1^*, c_2^*)$.
Finally, if $\bar{c}_2 \geq c_2^*$ then $\bar{x}_1 = 1$, $\bar{x}_2 = 0$, $x_1(1, \bar{p}_2) = 1$ and $L(c_1^*, \bar{c}_2) \leq L(c_1^*, c_2^*)$ and thus $T(\bar{c}_1, \bar{c}_2) = \bar{c}_1 + \bar{c}_2 + (\bar{x}_1 + \bar{x}_2)L(\bar{c}_1, \bar{c}_2)$ and $c_1^* + c_2^* + x_1(1, \bar{p}_2)L(c_1^*, \bar{c}_2) = c_1^* + c_2^* + L(c_1^*, \bar{c}_2) \leq c_1^* + c_2^* + L(c_1^*, c_1^*) = T(c_1^*, c_2^*)$. Therefore (2.1) implies $T(\bar{c}_1, \bar{c}_2) \leq T(c_1^*, c_2^*)$.
Thus in all cases (2.1) implies $T(\bar{c}_1, \bar{c}_2) \leq T(c_1^*, c_2^*)$. This, in view of the fact that $(c_1^*, c_2^*) \in M$, implies $(\bar{c}_1, \bar{c}_2) \in M$. □

Theorem 1. *Liability assignment rule g_3 is efficient.*

Proof. Immediate from Propositions 1 and 2. □

4. Conclusion

Assignment of liabilities for accidental losses could be decoupled when (i) a part of the amount imposed on the injurer is allocated to some state or court administered fund or (ii) the victim is compensated out of some special fund set up for this purpose. Several states in the United states have split recovery statues which require mandatory state sharing of damages. In many jurisdictions, victims are often compensated by the state if the injurer is insolvent and judgement-proof.[15]

This paper demonstrates the existence of an efficient liability assignment rule, g_3, under which the assignment of liabilities is decoupled in case both parties are negligent and it is coupled in all other cases. Thus it follows that the coupling of liabilities for all possible nonnegligence profiles is not required for efficiency. It is not very difficult to see that g_3 is not the only efficient liability assignment rule which exhibits decoupling for some nonnegligence profiles. It would be interesting to find a set of conditions which are necessary and sufficient for efficiency of liability assignment rules and to examine the extent to which the coupling of liabilities is relevant for efficiency.

References

Brown, J. P. (1973). Toward an economic theory of liability. *Journal of Legal Studies*, 2:323–350.

Calabresi, G. (1961). Some thoughts on risk distribution and the law of torts. *Yale Law Journal*, 70:499–553.

Calabresi, G. (1965). The decision for accidents: An approach to non-fault allocation of costs. *Harvard Law Review*, 78:713–745.

Calabresi, G. (1970). *The Costs of Accidents: A Legal and Economic Analysis*. Yale University Press, New Haven.

Coase, R. H. (1960). The problem of social cost. *Journal of Law and Economics*, 3:1–44.

Diamond, P. A. (1974). Accident law and resource allocation. *Bell Journal of Economics*, 5:366–405.

Jain, S. K. (2012). Decoupled liability and efficiency: An impossibility theorem. *Review of Law and Economics*, 8:697–718.

Jain, S. K. (2015). *Economic Analysis of Liability Rules*. Springer India.

Jain, S. K. and Singh, R. (2002). Efficient liability rules: Complete characterization. *Journal of Economics (Zeitschrift für Nationalökonomie)*, 75:105–124.

Pigou, A. C. (1920). *The Economics of Welfare*. Macmillan.

Polinsky, A. M. and Che, Y.-K. (1991). Decoupling liability: Optimal incentives for care and litigation. *The RAND Journal of Economics*, 22(4):562–570.

Posner, R. A. (1972). A theory of negligence. *Journal of Legal Studies*, 1:29–96.

Posner, R. A. (1973). Strict liability: A comment. *The Journal of Legal Studies*, 2:205–221.

Sharkey, C. M. (2003). Punitive damages as societal damages. *The Yale Law Journal*, 113(2):347–453.

Shavell, S. (1980). Strict liability versus negligence. *The Journal of Legal Studies*, 9:1–25.

Shavell, S. (2007). Liability for accidents. In Polinsky, A. M. and Shavell, S., editors, *Handbook of law and economics*, volume 1, pages 139–182. Elsevier.

[15]See Polinsky and Che(Polinsky and Che, 1991) and Sharkey(Sharkey, 2003).