Effects of Court Errors on Efficiency of Liability Rules: ***When Individuals are Imperfectly Informed***

Ram Singh

1. Introduction

The liability rules concern accidents involving the strangers. A liability rule determines the proportions in which the parties are to bear the loss suffered from an accident as a function of whether and by how much their care levels were less than the legally required due levels of care. Accuracy in adjudication of the accident cases is considered to be very crucial for the efficiency of liability rules. The vast literature on the economic analysis of liability rules establishes that the accurate adjudication in the setting of suitable liability rules induces the injurers to take 'efficient' care - the level of care that is appropriate for the objective of minimizing the total social costs of accident.[1] But, because of the lack of relevant information courts generally make errors while adjudicating the accident cases. Courts can minimize the errors but only by incurring a cost. Illuminating analyses by Kaplow (1994 & 1998), point out the trade-off between the benefits and the costs of accurate adjudication, and discuss in detail the other issues involved in accurate adjudication. One of the issues central to the accuracy problem is the errors made by a court in assessing the harm, suffered by the victims, for the purpose of calculating the damages - the proportion of accident loss to be borne by the injurers. Kaplow (1994), and Kaplow and Shavell (1992 & 1996) in their important contributions have shown that if the injurers are required to pay a damage (liability payment) that is less than the harm they cause, then the injurers will take less than the socially optimal care. On the other hand, if the injurers are required to pay a damage that is greater than the harm caused, they will take too much care. It is also argued that the errors by courts in assessment of the harm may motivate the imperfectly informed parties to wastefully spend resources on buying the information about the magnitude of the court errors.[2] The aim of this paper is to study the effects of court errors in estimating the harm, on the parties' behaviour regarding the levels of care they take, and their decision to buy the information about the court errors. The analysis is carried out in a unified framework.

A party will buy the information about court errors if the private value of the information to the party - the expected reduction in the party's private costs, the cost of care taken by it plus its expected liability- exceeds the price of the information. The social value of the purchase of information by a party is the expected reduction in total social costs, including the cost of information, which will occur as a result of the party's decision to buy information. Errors by courts means that the harm assessed for the purpose

[1] Formal analysis of the efficient liability rules started with Brown (1973) and has been systematically advanced in Landes and Posner (1987), Shavell (1987), Posner (1992), Cooter & Ulen (1997), Miceli (1997), and Jain & Singh (2001) among others. In Jain & Singh (2001), we provide a complete characterization of efficient liability rules under the standard assumption of accurate adjudication by courts.

[2] Also, see Kaplow (1998), Kaplow and Shavell (1993), Polinsky and Shavell (1989), Tullock (1994) and Endres and Lüdeke (1998). Endres and Lüdeke study the affects of limited liability on product liability rules.

of determining the liability payment could be different from the actual harm so, given individuals uncertainty about errors, the private value of the information could be different from its social value. When the information is costly, from social point of view spending on the information by a party is desirable only if the consequent reduction in the total social costs is greater than the price of information. Again, from the objective of minimizing the total social costs, given the parties' decisions regarding the purchase of information, it is always desirable that the parties take the levels of care that minimize the sum of the costs of care and the expected loss. But, having decided whether to the buy information, depending upon the liability rule applicable, a party may or may not take the efficient level of care. Therefore, in the presence of court errors a liability rule may cause inefficiency on the following two counts. First, it may motivate the parties to spend on information when there are no net social gains to be held from such a spending. Second, it may motivate the parties to take inefficient levels of care.

In this paper we study the efficiency properties of a subclass of liability rules which we label as 'simple' liability rules, in the presence of court errors. A liability rule is defined to be a *simple liability rule* if under such a rule the liability is never shared between the parties. In the case of accidents involving two parties - one the injurer and other the victim- a simple liability rule can be defined as a rule which specifies the party, the victim or the injurer, which will be held to be fully liable for the accident loss, as a function of proportions of the two parties' (non)negligence.[3] The problem is considered in the standard framework of economic analysis of liability rules. That is, we consider accidents resulting from interaction of two risk-neutral parties who are strangers to each other. Care by both the parties can affect the expected loss of accident.[4] It is assumed that whenever a liability rule specifies the legally binding due level of care for a party, it is set at a level commensurate with the objective of minimizing of the sum of the costs of care plus the expected accident loss.[5]

Retaining most of the assumptions of the standard framework, the problem, however, is considered in a somewhat more general setting. No assumptions are made on the costs of care and expected loss functions, apart from assuming that they are such that minimum of the sum of costs of care and expected accident loss exists. Unlike the standard framework, we allow the possibility of the existence of more than one configuration of care levels at which this sum is minimized.

Our results show that court errors do change the characterization of efficient liability rules. We show that when court errors are lower-biased, no liability rule can motivate both the parties to take efficient

[3]Most of the rules discussed in the literature on the liability rules, such as the rules of negligence, negligence with the defense of contributory negligence, strict liability with the defense of contributory negligence, also the rules of no liability and strict liability are simple liabilty rules in that these rules do not require sharing of liability between the two parties. The rule of comparative negligence, on the other hand, is not a simple liability rule in this sense.

[4]Kaplow and Shavell (1992, 1996) have studied the efficiency properties of the rules of strict liability and negligence, when courts make unbiased errors, in the framework of unilateral care, where care only by the injurers can affect the probability of accident and, as a consequence, care by the victims is not an issue.

[5]For an analysis of effects of court errors in determination of efficient levels of due care and other related issues see Cooter and Ulen (1997) Craswell & Calfee(1986), Kahan (1989), Miceli (1997), Rasmusen (1995), Shavell (1987) etc.

levels of care, and they might spend on information. On the other hand, upper-biased court errors do not necessarily mean that the parties will take inefficient care and will spend on the information about court errors. We establish that when court errors are upper-biased, the necessary and sufficient condition for a simple liability rule to motivate both the parties to take efficient levels of care and *simultaneously* not to spend on the information is that it satisfies the condition of 'negligent injurer's liability'. The condition of *negligent injurer's liability* requires that a liability rule be such that (i) whenever the injurer is taking at least the due care, the entire loss in the event of an accident is borne by the victim irrespective of the level of care taken by the victim, and (ii) when the injurer is negligent and the victim is not, the entire loss in the event of an accident is borne by the injurer.

Specifically, Theorem 1 demonstrate that when courts make lower-biased errors no liability rule can motivate both the parties to take efficient levels of care in all accident contexts, irrespective of the parties decisions regarding the purchase of information. Theorem 2 and the other results, on the other hand, show that when court errors are upper-biased, various rules of negligence viz., the rule of negligence, comparative negligence, and negligence with the defense of contributory negligence not only ensure the efficient care by both the parties, but also motivate the parties to not to spend on the information about the court errors. Rules of no liability, strict liability, and strict liability with the defense of contributory negligence, on the contrary, do not.

2. Definitions and Assumptions

Courts generally make errors in estimating the harm suffered by the victims. We study the effects of these errors on parties' behaviour regarding the levels of care they take, and their decision to buy the information about court errors. The framework of the study is the standard framework of economic analysis of liability rules. That is, we consider the accidents resulting from interaction of two risk-neutral and stranger to each other parties. To start with, the entire loss falls on one party to be called the victim; the other party being the injurer. We denote by $c \geq 0$ the cost of care taken by the victim and by $d \geq 0$ the cost of care taken by the injurer. Cost of care of a party is assumed to be a strictly increasing function of its index of care, i.e., its care level. As a result, cost of care for a party will also represent the index of care for that party. Let $C = \{c \mid c \geq 0$ is the cost of some feasible level of care which the victim can take.$\}$ and $D = \{d \mid$ d ≥ 0 is the cost of some feasible level of care which the injurer can take.$\}$. Therefore, $C[D]$ is the set of the care levels which can be taken by the victim [injurer]. We assume that $0 \in C$ and $0 \in D$.

Let, π denote the probability that accident involving two parties will take place, and $H \geq 0$ denote the loss in case accident actually materializes. We assume π and H to be functions of c and d; $\pi = \pi(c, d)$, $H = H(c, d)$. Let, L denote the expected loss due to accident. $L = \pi H$ and is a function of c and d; $L = L(c, d)$. As $H \geq 0$, $L \geq 0$. Further, we assume that a larger care by either party, given the care level of the other party, results in lesser or equal expected accident loss. Formally, we assume:

Assumption A 1 $(\forall c \in C)$ $(\forall d \in D)$ $[[c > \acute{c} \rightarrow L(c, d) \leq L(\acute{c}, d)]$ *&* $[d > d' \rightarrow L(c, d) \leq L(c, d')]]$.

Decrease in L as result of increased care can take place because of decrease in H or π or both. Activity levels of both the parties are assumed to be given.

In the standard economic analysis of liability rules, generally, it is assumed that courts while deciding on the proportions of accident loss to be borne by the two parties can correctly measure the harm H suffered by the victim. The total social costs of the accident are the sum of costs of care taken by the parties and the expected loss due to accident; $c+d+L(c,d)$. On the other hand, when courts make errors in estimating the harm, the assessed harm, for the purpose of awarding the damages, will in general be different from the actual harm. Let, $H+\epsilon$ denote the assessed harm when actual harm is H, where ϵ denotes the error term. We assume that $\epsilon = 0$ when $H = 0$. Errors by the courts may be unbiased, i.e., $E(\epsilon) = 0$, in that case expected assessed harm, $E(H+\epsilon) = H + E(\epsilon) = H$, the actual harm. Or, errors may be biased, i.e., $E(\epsilon) \neq 0$, then $E(H+\epsilon) = H + E(\epsilon) \neq H$. Let $H+\epsilon = \alpha H$, or $\alpha = 1 + \epsilon/H$. $E(\alpha) = 1 + E(\epsilon)/H$, or $E(\alpha)H = H + E(\epsilon)$. Therefore, $E(\alpha)H$ also represents the expected assessed harm when actual harm is H.

Let, $E(\alpha) = \bar{\alpha}$. Clearly, $\bar{\alpha} \geq 1$ iff $E(\epsilon) \geq 0$, and $\bar{\alpha} < 1$ iff $E(\epsilon) < 0$. When a court makes errors while assessing the harm, not only the proportion of the loss a party is required to bear but also the magnitude of errors in estimation of H will affect the party's expected costs and therefore its behaviour, in general. Moreover, when court makes errors in assessing H, the parties may or may not have information about the expected errors made by the court, i.e., they may or may not know the value of $E(\epsilon)$ and hence $\bar{\alpha}$.[6] We consider the case when parties do not know $E(\epsilon)$ but have an option of buying the information about the exact value of $E(\epsilon)$ and, therefore, of $\bar{\alpha}$, by spending a fixed amount.[7] Let $\bar{c}_I > 0$ denote the cost of the information about $\bar{\alpha}$ for the victim, and $\bar{d}_I > 0$ for the injurer. When a party does not spend on information it will have its subjective estimates about $E(\epsilon)$ or $\bar{\alpha}$. Let, $\bar{\alpha}_v =\propto 1 + E(\epsilon_v)/H$ denote the expected value of $\bar{\alpha}$ as perceived by the victim in the absence of the information. That is, $\bar{\alpha}_v$ denotes the victim's subjective estimate of $\bar{\alpha}$ in the absence of the information. Similarly, let $\bar{\alpha}_i = 1 + E(\epsilon_i)/H$ denote the injurer's subjective estimate of $\bar{\alpha}$ in the absence of information.

A liability rule uniquely determines the proportions in which the two parties will bear the loss H, in case accident occurs, as a function of proportions of their negligence. Depending upon the liability rule and the information cost a party might or might not buy the information. Therefore, when parties have option of buying information total social costs (TSC) of an accident are the sum of costs of information, whenever undertaken, costs of care taken by the parties and the expected accident loss; TSC$= c_I + d_I + c + d + L(c,d)$, where, $c_I \in C_I = \{0, \bar{c}_I\}$ and $d_I \in D_I = \{0, \bar{d}_I\}$. $c_I = 0$ [$d_I = 0$] when the victim [injurer] does not

[6] In fact, individuals may have many types of uncertainty, for example about the harm their acts could cause or the due levels of care. On these and other related issues see Craswell & Calfee, Kahan, Miceli, Rasmusen etc. In this paper we will focus only on the individuals' uncertainty about the court errors in estimating the harm.

[7] This way of capturing imperfect information about the courts' errors is expounded by Kaplow (1998), and Kaplow & Shavell (1992, 1996). They consider imperfect information of injurers about the actual harm injurers might cause and the courts' errors in calculation of harm. As in Kaplow & Shavell (1992), if we assume that for certain categories of accidents $var(\epsilon) = 0$, by buying information a party will get to know ϵ or α, i.e., the true value of the error made by the court.

buy the information. Choices of $c_I \in \{0, \bar{c}_I\}$ and $d_I \in \{0, \bar{d}_I\}$ by the victim and injurer are in fact their choices of $\alpha_v \in \{\bar{\alpha}_v, \bar{\alpha}\}$ and $\alpha_i \in \{\bar{\alpha}_i, \bar{\alpha}\}$, respectively. Let $M = \{(\acute{c}, \acute{d}) \mid \acute{c} + \acute{d} + L(\acute{c}, \acute{d})$ is a minimum of $\{c + d + L(c,d) \mid c \in C, d \in D\}\}$. Thus, M is the set of all costs of care configurations $(\acute{c}, \acute{d})$ which are total social cost minimizing, given the parties' decisions regarding the purchase of information. We assume that C, D, L are such that M is non empty:[8]

Assumption A 2 *C, D, and L are such that* $\sharp M \geq 1$.

For expositional simplicity we will assume that when a party does not buy the information, though it does not know the exact value of $\bar{\alpha}$, it does know whether the errors are upper-biased or lower-biased, i.e., whether $\bar{\alpha} > 1$ or < 1. To put formally, we assume:[9]

Assumption A 3 *When* $c_I = 0$, $[(\bar{\alpha} > 1 \rightarrow \bar{\alpha}_v > 1)\ \&\ (\bar{\alpha} < 1 \rightarrow \bar{\alpha}_v < 1)]$; *and when* $d_I = 0$, $[(\bar{\alpha} > 1 \rightarrow \bar{\alpha}_i > 1)\ \&(\bar{\alpha} < 1 \rightarrow \bar{\alpha}_i < 1)]$.

Implications of the case $\bar{\alpha} = 1$, i.e., when courts make unbiased errors will be considered in between. Let I denote the closed unit interval $[0,1]$. Given C, D, L, $(c^*, d^*) \in M$ and $\bar{\alpha}$, we define functions $p : C \rightarrow I$ and $q : D \rightarrow I$ such that:

$p(c) = c/c^*$ if $c < c^*$,

$= 1$ otherwise; and

$q(d) = d/d^*$ if $d < d^*$

$= 1$ otherwise.

A liability rule may specify the due care levels for both the parties, or for only one of them, or for none.[10] If a liability rule specifies the due care levels for both the parties, c^* and d^* used in the definitions of functions p and q will be taken to be identical with the legally specified due care levels for the plaintiff and the defendant respectively. If the liability rule specifies the due care level for only the injurer, d^* used in the definition of function q will be taken to be identical with the legally specified due care level for the the defendant and c^* used in the definition of p will be taken as any element of $\{c \in C \mid (c, d^*) \in M\}$. Similarly, if the liability rule specifies due care level for only the victim, c^* used in the definition of function p will be taken to be identical with the legally specified due care level and d^* used in the definition of q will be any element of $\{d \in D \mid (c^*, d) \in M\}$ [11]. If the liability rule does not specify due care level for any party then any element of M can be used in the definitions of p and q. In other words, we are making the assumption that legal due care standard for a party, wherever applicable, is set at a level appropriate for the objective of minimization of total social cost of the accident. This standard assumption is very crucial

[8] This assumption must be compared with the standard assumption that C, D and L are such that M is a singleton.

[9] We are assuming that from preliminary and largely costless investigation parties get to know the direction of bias in courts' errors. Kaplow and Shavell (1992, 1996) make similar assumption about courts.

[10] To give few examples, the rule of negligence with the defense of contributory negligence specifies the due care levels for both the parties, the rule of negligence specifies the due care level for only one party, namely, the injurer, and the rules of strict liability and no liability, on the other hand, specify the due care level for neither of the parties.

[11] As we are allowing the possibility that there might be more than one configuration of care levels which are total social cost minimizing, $\{c \in C \mid (c, d^*) \in M\}$ and $\{d \in D \mid (c^*, d) \in M\}$ may contain more than one element.

for efficiency of a liability rule.

Given the above definitions of p and q, $q(d) = 1$ would mean that the injurer is taking at least the due care and he will called nonnegligent. $q(d) < 1$ would mean that the injurer is taking less than the due care, i.e., he is negligent. $1 - q(d)$ will be his proportion of negligence and $q(d)$ would be his proportion of nonnegligence. Similarly for the victim.

A liability rule can be defined as a rule which specifies the proportions in which the victim and the injurer will bear the loss in the event of an accident, as a function of proportions of two parties' (non)negligence. Formally, a liability rule is a function f: $[0,1]^2 \to [0,1]^2$, such that:

$$f(p(c), q(d)) = (x, y) = (x[p(c), q(d)], y[p(c), q(d)])$$

where, $x \geq 0$, $y \geq 0$ and $x + y = 1$. $x[y]$ is the proportion of loss which the victim [injurer] will be required to bear.

When courts make errors, parties will decide about not only the care levels but also whether to buy information. In the presence of court errors, an accident context is described by the specification of C_I, C, D_I, D, L, and M. And, an application of a liability rule involves specification of the accident-context as also the due care standards, (c^*, d^*). That is an application of a liability rule involves specification of C_I, C, D_I, D, L, and $(c^*, d^*) \in M$. Let C_I, C, D_I, D, L, $(c^*, d^*) \in M$ and $\bar{\alpha}$ be given. Now, if an accident takes place and loss of H materializes, when court made no errors it will require the injurer to bear $y[p(c), q(d)]H(c, d)$. But, if the court makes error then, from the injurer's point of view it will assess the harm to be equal to $\alpha_i H$, and will require him to bear the expected liability equal to $y[p(c), q(d)]\alpha_i H(c, d)$, $\alpha_i \in \{\bar{\alpha}_i, \bar{\alpha}\}$. As, the entire loss is suffered by the victim initially, $y[p(c), q(d)]\alpha_i H(c, d)$ represents the expected liability payment (from the injurer's point of view) to be made by the injurer to the victim. Similarly, from the victim's point of view the expected assessed harm will be $\alpha_v H$, where $\alpha_v \in \{\bar{\alpha}_v, \bar{\alpha}\}$. Therefore, the expected liability payments will be perceived to be equal to $y[p(c), q(d)]\alpha_i H(c, d)$ and $y[p(c), q(d)]\alpha_v H(c, d)$ by the injurer and the victim respectively. Given its decision regarding the purchase of information, the expected costs of a party are the sum of the cost of care taken by it plus its expected liability. Thus, given their decision regarding the purchase of information, expected costs of the injurer and the victim are $d + y[p(c), q(d)]\pi(c, d)\alpha_i H(c, d)$ or $d + y[p(c), q(d)]\alpha_i L(c, d)$, and $c + L(c, d) - y[p(c), q(d)]\alpha_v L(c, d)$ respectively.

In the terminology of this paper:
The rule of negligence is defined by:
$(q < 1 \to x = 0)$ and $(q = 1 \to x = 1)$.
The rule of negligence with the defense of contributory negligence is defined by:
$(p < 1 \to x = 1)$ and $(p = 1 \ \& q < 1 \to x = 0)$ and $(p = 1 \ \& \ q = 1 \to x = 1)$.
The rule of comparative negligence is defined by:
$(q = 1 \to x = 1)$ and $(p = 1 \ \& \ q < 1 \to x = 0)$ and $(p < 1 \ \& \ q < 1 \to 0 < x < 1)$.

The rule of strict liability is defined by:
$x = 0$, for all $p, q \in [0, 1]$.
The rule of strict liability with the defense of contributory negligence is defined by:
$(p < 1 \rightarrow x = 1)$ and $(p = 1 \rightarrow x = 0)$.
The rule of no liability is defined by:
$x = 1$, for all $p, q \in [0, 1]$.

When parties are imperfectly informed about the court errors, depending upon the liability rule and the cost of information a party may or may not buy the information.[12] The social value of the purchase of the information by a party is the resultant reduction in TSC. As mentioned above, errors by a court means that the private value of the information might be different from its social value. When the information is costly, from social point of view spending on information by a party is desirable only if the consequent reduction in TSC is greater than the price of the information. Further, having decided whether to buy the information, depending upon the liability rule applicable a party may or may not take efficient level of care. Therefore, a liability rule may cause inefficiency on the following two counts. First, it may motivate the parties to buy information when there are no net social gains to be held from such spending. Second, it may motivate the parties to take inefficient care levels. From the objective of minimization of TSC, given the parties' decisions regarding the purchase of the information, it is always desirable that both the parties opt for levels of care that minimize the sum $c + d + L(c, d)$.

Efficient Liability Rules:
With the standard assumption of full information, a liability rule f is said to be efficient in a given accident context, or for given C, D, L, and $(c^*, d^*) \in M$, iff it motivates both the parties to take levels of care that minimize the sum $c+d+L(c, d)$. Formally, given C, D, L, and $(c^*, d^*) \in M$, f is efficient iff (i) every Nash equilibrium (N.E.) is total social cost minimizing and (ii) there exists at least one Nash equilibrium.[13] A liability rule is said to be ***efficient*** iff it is efficient in every possible accident context.

Let F be the set of those liability rules which, irrespective of the parties' decisions regarding the purchase of information, motivate both the parties to take the levels of care that minimize the sum $c + d + L(c, d)$, in all accident contexts. In other words, $f \in F$ iff under f parties might or might not decide to buy the information but they will always take efficient levels of care. Formally, $f \in F$ iff, for every C, C_I, D, D_I, L, and $(c^*, d^*) \in M$:
$(\forall(\bar{c}, \bar{d}) \in C \times D)$ $[(\bar{c}, \bar{d})$ is a NE $\rightarrow (\bar{c}, \bar{d}) \in M]$ & $(\exists(\bar{c}, \bar{d}) \in C \times D)[(\bar{c}, \bar{d})$ is a NE$]$.
Now, suppose that a liability rule is such that in every possible accident context it motivates both the parties to not to spend on information and simultaneously to take efficient levels of care. Let F' be the set of such rules. That is, $f \in F'$ iff for every C, C_I, D, D_I, L, and $(c^*, d^*) \in M$:

[12]For example, if the liability rule is of no liability, no party will buy information and if the rule is of strict liability then at least one party, namely, the injurer will buy information provided $\bar{\alpha} \neq 1$ and information is not too costly.

[13]We consider only the pure strategy Nash Equilibria. Further, if C, D, and L are such that $\sharp M = 1$, f will be efficient iff (c^*, d^*) is the unique N.E.

$c_I = 0$ & $d_I = 0$ & $(\forall(\bar{c},\bar{d}) \in C \times D)$ $[(\bar{c},\bar{d})$ is a NE $\rightarrow (\bar{c},\bar{d}) \in M]$ & $(\exists(\bar{c},\bar{d}) \in C \times D)[(\bar{c},\bar{d})$ is a NE$]$. Clearly, no liability rule can be more efficient than the rules in F'. Also, $F' \subset F$. In the next section we show that when court errors are lower biased both the sets F and F' are empty. On the other hand, unbiased or upper biased court errors do not mean that these sets are necessarily empty. We will study the conditions under which these sets are non-empty.

3. Characterization of Efficient Liability Rules when Courts make Errors

3.1 When Errors are Lower-biased

When court errors are biased, i.e., when $E(\epsilon) \neq 0$, and $E(\alpha) = \bar{\alpha} \neq 1$, we assume that $\bar{\alpha} \geq 0$. With $E(\epsilon) \neq 0$, court errors may be upper-biased, i.e., $E(\epsilon) > 0$, in that case we have $\bar{\alpha} > 1$, or errors may be lower-biased, i.e., $E(\epsilon) < 0$, in that case we have $\bar{\alpha} < 1$. Below, we show that when court errors are lower-biased, irrespective of the magnitude of the bias, and irrespective of the parties decision regarding the purchase of information, no liability rule can motivate both the parties to take efficient levels of care in every accident context. That is, in the case of lower-biased errors, the set F is empty. Formally, with $E(\epsilon) < 0$, we have the following result.

Theorem 1 *A liability rule belongs to F, only if $\bar{\alpha} \geq 1$.*

Proof: Suppose not. This implies that there exists a liability rule such that $0 \leq \bar{\alpha} < 1$ and for every possible choice of C_I, C, D_I, D, L, and $(c^*, d^*) \in M$, the rule motivates both the parties to take efficient care. Let f be the rule.

Take any $\bar{\alpha} \in [0, 1)$. Let $f(p(c), q(d)) = (x[p(c), q(d)],\ y[p(c), q(d)])$, where $x + y = 1$. Let t be a positive number. $\bar{\alpha} < 1$ implies that $\alpha_v < 1$ and $\alpha_i < 1$.[14] As, $\alpha_i < 1$, $\alpha_i t < t$. Choose $r > 0$ such that $\alpha_i t < r < t$. Let $C_I = \{0, \bar{c}_I\}$ and $D_I = \{0, \bar{d}_I\}$.

Now, consider the following specification of C, D, and L;

$C = \{0, c_0\}$, where $c_0 > 0$,

$D = \{0, \alpha_i d_0, d_0\}$, where $d_0 = r/(1 - \alpha_i)$,

$L(0, 0) = t + \alpha_i d_0 + c_0 + \delta$, where $\delta > 0$, $\quad L(0, \alpha_i d_0) = t + c_0 + \delta$,

$L(0, d_0) = c_0 + \delta$, $L(c_0, 0) = t + \alpha_i d_0$, $L(c_0, \alpha_i d_0) = t$ and $L(c_0, d_0) = 0$.

It is clear that (c_0, d_0) is a unique configuration of efficient care levels. Also, (A1)-(A3) are satisfied. Let $(c^*, d^*) = (c_0, d_0)$. Now, given c_0 opted by the victim, if the injurer chooses d_0 his expected costs are d_0. If he opts $\alpha_i d_0$, his expected costs (net of d_I) are $\alpha_i d_0 + y[p(c_0), q(\alpha_i d_0)]\alpha_i t$. But, $d_0(1 - \alpha_i) > \alpha_i t$ as $r > \alpha_i t$. Thus, $d_0 > \alpha_i d_0 + \alpha_i t$. Therefore, $d_0 > \alpha_i d_0 + y[p(c_0), q(\alpha_i d_0)]\alpha_i t$ as $y[p(c_0), q(\alpha_i d_0)] \leq 1$.

Hence, the unique pair of efficient care levels, (c_0, d_0), is not a N.E. Therefore, f does not motivate both the parties to take efficient care for the above specification. This, in turn, implies that when $\bar{\alpha} < 1$, it is not the case that f motivates both the parties to take efficient care for every C_I, C, D_I, D, L, and $(c^*, d^*) \in M$.

[14] We know that $\alpha_i = \bar{\alpha}_i$ or $\bar{\alpha}$. When $\alpha_i = \bar{\alpha}_i$, $\alpha_i < 1$ by (A3), and when $\alpha_i = \bar{\alpha}$, $\alpha_i < 1$ as $\bar{\alpha} < 1$. Similarly for α_v.

Hence, $f \notin F$. As f is an arbitrary liability rule this implies that when $\bar{\alpha} \in [0,1)$, $F = \phi$. •

An intuitive explanation of Theorem 1 is as follows. In the presence of lower biased court errors, whenever required to do so the injurers will bear only a fraction of the actual harm H. On the other hand, if they reduce their level of care all the benefits of the reduced cost of care will accrue to them. With this backdrop, consider the accident contexts such that (i) $L(c^*, d^*) = 0$, (ii) $\alpha_i d^* < d^*$ is an element of choice set of the injurer, and (iii) $L(c^*, \alpha_i d^*) - L(c^*, d^*) = L(c^*, \alpha_i d^*) > (1-\alpha_i)d^* > \alpha_i L(c^*, \alpha_i d^*)$. In the accident contexts satisfying (i)-(iii), suppose (c^*, d^*) is the unique configuration of efficient care levels and the victim is taking care at c^*. Now, consider a shift from the care level d^* to $\alpha_i d^*$ by the injurer. It is clear from (iii) that even if the liability rule concerned holds the injurer to be liable, i.e., even if $y[p(c^*), q(\alpha_i d^*)] = 1$, the expected costs of the injurer at $\alpha_i d^*$ are strictly less than at d^*, i.e., (c^*, d^*) is not a NE. Therefore, in such accident contexts even if the victim takes the efficient care injurer will not. Moreover, such contexts can be constructed for any $\alpha_i = \bar{\alpha}_i$ or $\bar{\alpha}$ as long as $\alpha_i < 1$.

When $\bar{\alpha} < 1$, following corollary is immediate.

Corollary 1 $\bar{\alpha} < 1 \rightarrow F' = \phi$.

$F' = \phi$ follows from the fact that $F' \subset F$, and $F = \phi$ when $\bar{\alpha} < 1$.

3.2 When Errors are Unbiased

Under the standard assumption that the courts can calculate the harm H, correctly we have the following result about the efficiency characteristics of liabilty rules.
Theorem (Jain & Singh): A liabilty rule f is efficient for every C, D, L, and $(c^*, d^*) \in M$ iff, whenever one party is negligent and the other is not then the negligent party will bear all the loss, i.e., iff:[15]
$(\forall p \in [0,1))[f(p,1) = (1,0)]$ and $(\forall q \in [0,1))[f(1,q) = (0,1)]$.

Now, when court errors are unbaised, i.e., $E(\epsilon) = 0$ and $\mathrm{E}(\alpha) = \bar{\alpha} = 1$, if we assume that $\bar{\alpha}_i = \bar{\alpha}_v = \bar{\alpha} = 1$, the following corollaries can be stated.

Corollary 2 *When errors made by courts are unbaised, i.e.,* $E(\epsilon) = 0$, *a liability rule* $f \in F$, *iff:*
$p < 1 \rightarrow [f(p,1) = (1,0)]$ *and* $p < 1 \rightarrow [f(1,q) = (0,1)]$.

For an explanation see Appendix.

Corollary 3 *When errors made by courts are unbaised, the rules of negligence, negligence with the defense of contributory negligence, comparative negligence, and strict liability with the defense of contributory negligence motivate both the parties to take efficient care in every accident context. On the other hand, the rules of no liability and strict liability do not.*

[15] See, Jain S.K. & Singh R. (2001)

3.3 When Errors are Upper-biased

Condition of Negligent Injurer's Liability (NIL):
A liability rule f is said to satisfy the condition of negligent injurer's liability (NIL) iff its structure is such that (i) whenever the injurer is nonnegligent, i.e., he is taking at least the due care, the entire loss in case of occurrence of accident is borne by the victim irrespective of the level of care taken by the victim, and (ii) when the injurer is negligent and the victim is not, the entire loss in case of occurrence of accident is borne by the injurer. Formally, a liability rule f satisfies NIL iff:

$$(\forall p \in [0,1])[f(p,1) = (1,0)] \;\;\&\;\; (\forall q \in [0,1))[f(1,q) = (0,1)].$$

Above we demonstrated that when $\bar{\alpha} < 1$, regardless of the parties decisions about the purchase of information no liability rule can motivate both the parties to take efficient levels of care. With upper-biased errors by courts, however, this is not the case. Below we establish that if a simple liability rule satisfies the condition NIL, it will motivate both the parties to take optimum levels of care irrespective of their decisions regarding the purchase of information. In the case of accidents involving two parties, a simple liability rule can be defined as a rule which specifies the party- the victim or the injurer- which will be held fully liable for the loss in case of occurrence of accident as a function of proportions of the two parties' negligence. In other words, under a simple liability rule the liability is never be shared between the parties. Formally,

Simple Liability Rules: A liability rule f is a simple liability rule, iff $f : [0,1]^2 \rightarrow \{0,1\}^2$ such that;

$$(\forall p, q \in [0,1])[f(p,q) = (0,1) \;\; or \;\; (1,0)].$$

The rule of comparative negligence is not a simple liability rule in the sense defined above. We will consider this rule separately. When court errors are upper-biased, i.e., when $E(\epsilon) > 0$, we have the following results about the efficiency of liability rules.

Proposition 1 *If a liability rule satisfies condition NIL then for every C_I, C, D_I, D, L, $(c^*, d^*) \in M$ and $\bar{\alpha} > 1$, (c^*, d^*) a N.E.*

Proof: Let the liability rule f satisfy condition NIL. Take any C_I, C, D_I, D, L, $(c^*, d^*) \in M$ and $\bar{\alpha} > 1$. $\bar{\alpha} > 1$ and (A3) imply that $\alpha_v > 1$ and $\alpha_i > 1$. Suppose, (c^*, d^*) is not a N.E. (c^*, d^*) is not a N.E.$\rightarrow$

$$(\exists d' \in D)[d' + y[p(c^*), q(d')]\alpha_i L(c^*, d') < d^* + y[p(c^*), q(d^*)]\alpha_i L(c^*, d^*)] \tag{1}$$

or

$$(\exists c' \in C)[c' + L(c', d^*) - y[p(c'), q(d^*)]\alpha_v L(c', d^*) < c^* + L(c^*, d^*) - y[p(c^*), q(d^*)]\alpha_v L(c^*, d^*)], \tag{2}$$

where $\alpha_v \in \{\bar{\alpha}_v, \bar{\alpha}\}$ and $\alpha_i \in \{\bar{\alpha}_i, \bar{\alpha}\}$.[16]

Suppose (1) holds. As $y[p(c^*), q(d^*)] = 0$ by condition NIL, (1) $\rightarrow$

$(\exists d' \in D)[d' + y[p(c^*), q(d')]\alpha_i L(c^*, d') < d^*]$.

First, consider the case: $d' > d^*$:

$d' > d^*$ and condition NIL imply $y[p(c^*), q(d')] = 0$. Therefore, from (1) we get $d' < d^*$, contradicting the hypothesis that $d' > d^*$. Hence, we show that

$$d' > d^* \rightarrow (1) \textit{ can not hold} \tag{3}$$

Now, consider the case: $d' < d^*$:

$d' < d^*$ and condition NIL $\rightarrow$y[p(c*), $q(d')] = 1$. Therefore, (1) $\rightarrow d' + \alpha_i L(c^*, d') < d^*$, or

$c^* + d' + \alpha_i L(c^*, d') < c^* + d^*$. But, $d' < d^* \rightarrow L(c^*, d') > 0$.[17] This with $\alpha_i > 1 \rightarrow$

$c^* + d' + L(c^*, d') < c^* + d' + \alpha_i L(c^*, d')$. Therefore,

$c^* + d' + L(c^*, d') < c^* + d^* \leq c^* + d^* + L(c^*, d^*)$. That is accident costs (minus information cost) at (c^*, d') are less than accident costs at (c^*, d^*). Which is a contradiction as $(c^*, d^*) \in M$.

This contradiction establishes that

$$d' < d^* \rightarrow (1) \textit{ can not hold.} \tag{4}$$

Similarly, we can show that

$$(2) \textit{ can not hold.} \tag{5}$$

Finally, (3) $-$ (5) $\rightarrow$ (c*, d^*) is a N.E. •

Lemma 1 *If a simple liability rule satisfies condition NIL then for every C_I, C, D_I, D, L, $(c^*, d^*) \in M$ and $\bar{\alpha} > 1$, $(\forall(\bar{c}, \bar{d}) \in C \times D)[\ \bar{d} < d^* \rightarrow (\bar{c}, \bar{d})$ is not a N.E.$]$*

That is, when $\bar{d} < d^*$ for every $(\bar{c}, \bar{d}) \in C \times D$ at least one party will find it advantageous to switch over to some other strategy. For formal proof see the Appendix.

Proposition 2 *If a simple liability rule satisfies condition NIL then for every C_I, C, D_I, D, L, $(c^*, d^*) \in M$ and $\bar{\alpha} > 1$, $(\forall(\bar{c}, \bar{d}) \in C \times D)[(\bar{c}, \bar{d})$ is a N.E.$\rightarrow (\bar{c}, \bar{d}) \in M]$.*

Proof: Let the simple liability rule f satisfy condition NIL. Take any arbitrary C_I, C, D_I, D, L, $(c^*, d^*) \in M$ and $\bar{\alpha} > 1$. As before, $\bar{\alpha} > 1 \rightarrow (\alpha_v > 1$ and $\alpha_i > 1)$, where $\alpha_v \in \{\bar{\alpha}_v, \bar{\alpha}\}$, and $\alpha_i \in \{\bar{\alpha}_i, \bar{\alpha}\}$. Suppose, $(\bar{c}, \bar{d}) \in C \times D$ is a N.E. $(\bar{c}, \bar{d})$ is a N.E.$\rightarrow$

$$(\forall c \in C)[\bar{c} + L(\bar{c}, \bar{d}) - y[p(\bar{c}), q(\bar{d})]\alpha_v L(\bar{c}, \bar{d}) \leq c + L(c, \bar{d}) - y[p(c), q(\bar{d})]\alpha_v L(c, \bar{d})] \tag{6}$$

[16] $\alpha_v = \bar{\alpha}_v$ when the victim does not buy the information and $\alpha_v = \bar{\alpha}$ when he does. Similarly, about α_i. Note that we are not making any assumption about parties' decisions to buy the information.

[17] $L(c^*, d' < d^*) > 0$ is easy to see, as $L(c^*, d' < d^*) \geq 0$ and $L(c^*, d' < d^*) = 0$ would imply that $(c^*, d^*) \notin M$, a contradiction.

and

$$(\forall d \in D)[\bar{d} + y[p(\bar{c}), q(\bar{d})]\alpha_i L(\bar{c}, \bar{d}) \leq d + y[p(\bar{c}), q(d)]\alpha_i L(\bar{c}, d)] \tag{7}$$

Now, (6), in particular, $\rightarrow$

$$\bar{c} + L(\bar{c}, \bar{d}) - y[p(\bar{c}), q(\bar{d})]\alpha_v L(\bar{c}, \bar{d}) \leq c^* + L(c^*, \bar{d}) - y[p(c^*), q(\bar{d})]\alpha_v L(c^*, \bar{d}) \tag{8}$$

and (7)$\rightarrow$

$$\bar{d} + y[p(\bar{c}), q(\bar{d})]\alpha_i L(\bar{c}, \bar{d}) \leq d^*, \tag{9}$$

as condition NIL implies $y[p(\bar{c}), q(d^*)] = 0$. Adding (8) and (9),

$$\bar{c} + \bar{d} + L(\bar{c}, \bar{d}) + (\alpha_i - \alpha_v)y[p(\bar{c}), q(\bar{d})]L(\bar{c}, \bar{d}) \leq c^* + d^* + L(c^*, \bar{d}) - y[p(c^*), q(\bar{d})]\alpha_v L(c^*, \bar{d}) \tag{10}$$

Case 1: First, consider the case: $\bar{d} \geq d^*$: When $\bar{d} \geq d^*$ from (10) we get
$\bar{c} + \bar{d} + L(\bar{c}, \bar{d}) \leq c^* + d^* + L(c^*, \bar{d})$, because $\bar{d} \geq d^*$ and condition NIL imply $y[p(c), q(\bar{d})] = 0$. Also, $\bar{d} \geq d^* \rightarrow L(c^*, \bar{d}) \leq L(c^*, d^*)$. That is,
$\bar{c} + \bar{d} + L(\bar{c}, \bar{d}) \leq c^* + d^* + L(c^*, d^*)$. But, as $(c^*, d^*) \in M$ it must be the case that accident costs at $(\bar{c}, \bar{d})$ are at least as large as at (c^*, d^*), i.e., $\bar{c} + \bar{d} + L(\bar{c}, \bar{d}) \geq c^* + d^* + L(c^*, d^*)$. Therefore, $\bar{c} + \bar{d} + L(\bar{c}, \bar{d}) = c^* + d^* + L(c^*, d^*)$. Which, in turn, means that $(\bar{c}, \bar{d}) \in M$. Thus,

$$(\bar{c}, \bar{d}) \textit{ is a N.E. and } \bar{d} \geq d^* \rightarrow (\bar{c}, \bar{d}) \in M. \tag{11}$$

Case 2: $\bar{d} < d^*$:
In this case from Lemma 1 we know that

$$\bar{d} < d^* \rightarrow (\bar{c}, \bar{d}) \textit{ is not a N.E.} \tag{12}$$

Finally, (11) & (12) establish that $(\bar{c}, \bar{d})$ *is a N.E.* $\rightarrow (\bar{c}, \bar{d}) \in M$.•

Remark 1 *In the case of simple liability rules,* (c, d) *is a N.E.*$\rightarrow d = d^*$.

For an explanation see Appendix. It should be noted that while proving Proposition 2 the fact that f is a simple liability rule is used only in the Case 3 of Lemma 1. Therefore, we have the following remark about Proposition 2.

Remark 2 *If a (general) liability rule satisfies condition NIL then for every* C_I, C, D_I, D, L, $(c^*, d^*) \in M$ *and* $\bar{\alpha} > 1$, *when* $\bar{d} \geq d^*$, *or when* $\bar{d} < d^*$ & $\bar{c} \geq c^*$, $(\bar{c}, \bar{d})$ *is a N.E.*$\rightarrow (\bar{c}, \bar{d}) \in M$.

Remark 3 $(\bar{c}, \bar{d})$ *is a N.E. with* α_i *and* $\alpha_v \rightarrow (\bar{c}, \bar{d})$ *is a N.E. with* $\acute{\alpha}_i \in \{\bar{\alpha}_i, \bar{\alpha}\}$ *and* $\acute{\alpha}_v \in \{\bar{\alpha}_v, \bar{\alpha}\}$.

As is clear from the definition of the rule of comparative negligence when $p < 1$ & $q < 1$, $x[p(c), q(d)] \in (0, 1)$. When $p < 1$ & $q < 1$, i.e., when $c < c^*$ and $d < d^*$, if the rule specifies x and y as follows[18]

$$x = \frac{c^* - c}{(c^* + d^*) - (c + d)} \;\&\; y = \frac{d^* - d}{(c^* + d^*) - (c + d)},$$

then we have the following claim about the rule.

[18] The rule infact is specified in this way, see Cooter and Ulen (1997) p 278.

Lemma 2 *Under the rule of comparative negligence, for every C_I, C, D_I, D, L, $(c^*, d^*) \in M$, and $\bar{\alpha} > 1$, $(\forall(\bar{c}, \bar{d}) \in C \times D)[(\bar{c}, \bar{d})$ is a N.E. $\rightarrow (\bar{c}, \bar{d}) \in M]$.*

Proof: See Appendix.

The following proposition shows that if a simple liabilty rule motivates both the parties to take efficient levels of care in every accident context then this rule necessarily satisfies the condition NIL. First, consider the following lemma.

Lemma 3 *If for a simple liability rule f, $[(\exists p \in [0,1))[f(p,1) = (0,1)]$, or $(\exists q \in [0,1))[f(1,q) = (1,0)]]$ holds then there exist a specification of C_I, C, D_I, D, L $(c^*, d^*) \in M$ and $\bar{\alpha} > 1$ satisfying A1-A3, such that (c^*, d^*) is not a N.E.*

For a formal proof see Appendix. Intuitively the claim of Lemma 3 is obvious. Suppose, for some level of care by the victim which is less than the due level of care, a liability rule is such that it holds a nonnegligent injurer fully liable, i.e., $f(p, 1) = (0, 1)$ for some $p \in [0, 1)$. Under such a liability rule, irrespective of its value at (c^*, d^*) whenever $pc^* \in C$ it is always advantageous for the victim to not to opt for c^*- that is (c^*, d^*) is not a N.E. Similary, if $f(1, q) = (1, 0)$ for some $q \in [0, 1)$, whenever $qd^* \in D$ it is always advantageous for the injurer to not to opt d^*, again (c^*, d^*) is not a N.E.

Proposition 3 *If a simple liability rule is such that for every C_I, C, D_I, D, L, $(c^*, d^*) \in M$, and $\bar{\alpha} > 1$, $(\forall(\bar{c}, \bar{d}) \in C \times D)[(\bar{c}, \bar{d})$ is a N.E. $\rightarrow (\bar{c}, \bar{d}) \in M]$ & $(\exists(\bar{c}, \bar{d}) \in C \times D)[(\bar{c}, \bar{d})$ is a N.E. $]$ holds, then it satisfies NIL.*

Proof: Suppose not. That is, suppose there exists a simple liabilty rule such that for every possible choice of C_I, C, D_I, D, L $(c^*, d^*) \in M$ and $\bar{\alpha} > 1$ satisfying A1-A3, it motivates both the parties to take efficient levels of care and at the same time it violates NIL. Let f be the simple liabilty rule.
f violates NIL implies that

$(\exists p \in [0, 1])[f(p, 1) \neq (1, 0)]$, or $(\exists q \in [0, 1))[f(1, q) \neq (0, 1)]$. This and f is a simple liability rule imply that

$$(\exists p \in [0, 1])[f(p, 1) = (0, 1)], \tag{13}$$

or

$$(\exists q \in [0, 1))[f(1, q) = (1, 0)]. \tag{14}$$

Case 1: Suppose, (13), i.e., $(\exists p \in [0, 1])[f(p, 1) = (0, 1)]$ holds.
Subcase 1: p=1:
$p = 1$& (13)$\rightarrow f(1, 1) = (0, 1)$.
Let, $\bar{\alpha} > 1$. As before $\bar{\alpha} > 1$ and (A3) $\rightarrow \alpha_i > 1$ and $\alpha_v > 1$. Take any $\alpha_i > 1$. Let, $t > 0$. Clearly, $\alpha_i t > t$. Let r, be such that $\alpha_i t > r > t$.
Take any C_I and D_I. Now consider the following specification of C, D, and L:

$C = \{0, c_0\}, c_0 > 0,$
$D = \{0, d_0, \alpha_i d_0\}$, where $d_0 = r/(\alpha_i - 1)$
$L(0,0) = t + \alpha_i d_0 + c_0 + \delta$, where $\delta > 0$,
$L(c_0, 0) = t + \alpha_i d_0$, $L(0, d_0) = t + c_0 + \delta$,
$L(0, \alpha_i d_0) = c_0 + \delta$, $L(c_0, d_0) = t$, $L(c_0, \alpha_i d_0) = 0$.
Obviously, (c_0, d_0) is the unique total social cost minimizing configuration and the specificaton satisfies (A1)-(A3). Let $(c^*, d^*) = (c_0, d_0)$. Given c_0 opted by the victim if injurer chooses $\alpha_i d_0$ his expected costs are $\alpha_i d_0$. On the other hand, if chooses d_0 his expected costs are $d_0 + \alpha_i t$, as $y[p(c^*), q(d^*)] = y[1, 1] = 1$. But, $\bar{\alpha} d_0 < d_0 + \alpha_i t$, by construction. Thus, his expected costs of choosing $\bar{\alpha} d_0$ are strictly less that of choosing d_0. Which means, (c_0, d_0) is not a N.E. Thus, there exist a configuration of C_I, C, D_I, D, L, $(c^*, d^*) \in M$, and $\bar{\alpha} > 1$ satisfying A1-A3, such that

$$(13) \ \& \ p = 1 \rightarrow (c^*, d^*) \ \textit{is not a N.E.} \tag{15}$$

Subcase 2: $p < 1$:
In this case $p < 1$ & (13) $\rightarrow f(p, 1) = (0, 1)$.
From Lemma 3 (Case 1), there exist a configuration of C_I, C, D_I, D, L, $(c^*, d^*) \in M$, and $\bar{\alpha} > 1$ satisfying A1-A3, such that

$$p < 1 \ \& \ (13) \rightarrow (c^*, d^*) \ \textit{is not a N.E.} \tag{16}$$

Case 2: Suppose (14), i.e., $(\exists q \in [0, 1))[f(1, q) = (1, 0)]$ holds.
Again from Lemma 3 (Case 2), there exist a specifications of C_I, C, D_I, D, L, $(c^*, d^*) \in M$, and $\bar{\alpha} > 1$ satisfying A1-A3, such that

$$(14) \rightarrow (c^*, d^*) \ \textit{is not a N.E.} \tag{17}$$

Finally, (15) - (17) imply that if f violates the condition NIL then there exists at least one specification of C_I, C, D_I, D, L $(c^*, d^*) \in M$, and $\bar{\alpha} > 1$, satisfying A1-A3, such that (c^*, d^*) is not a N.E. This in conjunction with the fact that (c^*, d^*) is the unique configuration of efficient care levels in the above specifications implies that it is not the case that f violates NIL and it motivates both the parties to take efficient levels of care for every possible choice of C_I, C, D_I, D, L $(c^*, d^*) \in M$, and $\bar{\alpha} > 1$, satisfying A1-A3. Or, if f violates NIL then for every possible choice of C_I, C, D_I, D, L $(c^*, d^*) \in M, \bar{\alpha} > 1$, satisfying A1-A3,
$(\forall \bar{c}, \bar{d} \in C \times D)[(\bar{c}, \bar{d})$ is a N.E. $\rightarrow (\bar{c}, \bar{d}) \in M]$ & $(\exists (\bar{c}, \bar{d}) \in C \times D)[(\bar{c}, \bar{d})$ is a N.E.] does not hold. •

Proposition 3 establishes the necessity of NIL for f to be an element of F or to motivate both the parties to take efficient care for every possible choice of C_I, C, D_I, D, L $(c^*, d^*) \in M, \bar{\alpha} > 1$, satisfying (A1) -(A3). The following theorem shows that when courts make upper-biased errors, the condition NIL is both necessary and sufficient for a liability rule to motivate both the parties to take efficient levels.

Theorem 2 $\bar{\alpha} > 1 \rightarrow$ [*A simple liability rule f belongs F iff f satisfies the condition of Negligent Injurer's Liabilty*].

Proof: Let simple liability rule f satisfy NIL. Propositions 1 and 2 show that for every possible choice of C_I, C, D_I, D, L, $(c^*, d^*) \in M$, and $\bar{\alpha} > 1$, satisfying A1-A3,
$(\exists(c,d) = (c^*, d^*) \in C \times D)[(c,d)$ is a N. E.] & $(\forall(\bar{c}, \bar{d}) \in C \times D)[(\bar{c}, \bar{d})$ is a N.E. $\rightarrow (\bar{c}, \bar{d}) \in M]$. Therefore, $f \in F$.

On the other hand, if $f \in F$, i.e., if for every possible choice of C_I, C, D_I, D, L, $(c^*, d^*) \in M$, and $\bar{\alpha} > 1$, satisfying A1-A3,
$(\forall(\bar{c}, \bar{d}) \in C \times D)[(\bar{c}, \bar{d})$ is a N.E. $\rightarrow (\bar{c}, \bar{d}) \in M]$ & $(\exists(\bar{c}, \bar{d}) \in C \times D)[(\bar{c}, \bar{d})$ is a N.E.] holds, then by Proposition 3, f satisfies NIL. •

Following corollary follows immediately from Theorem 2.

Corollary 4 *When courts make upper-biased errors in assessment of the harm and parties are imperfectly informed about the courts' errors, the rules negligence and negligence with the defence of contributory negligence motivate both the parties to take efficient levels of care in all accident contexts irrespective of their decision to buy information. On the other hand, rules of no liability, strict liability, and strict liability with the defence of contributory negligence do not.*

Example 1 *Consider the following specification:*
Let, $\bar{\alpha} > 1, C_I = \{0, \bar{c}_I\}, D_I = \{0, \bar{d}_I\}, where, c_I > 0$ *and* $d_I > 0$,
C={0, .9, 1},
D={0, .1, 1},
L(0, 0)=2.4, L(0, .1)=2.3, L(0, 1)=1.2, L(.9, 0)=1.35, L(.9, .1)=1.25, L(.9, 1)=0.25, L(1, 0)= 1.2, L(1, .1)=1.1, L(1, 1)=0. Let, $\bar{\alpha}_v = 1.70$ *and* $\bar{\alpha}_i = 1.01$.

Now, consider the following liability rule f such that
$f(0,0) = (1/2, 1/2)$, $f(0,.1) = (1/2, 1/2)$, $f(0,1) = (1,0)$, $f(.9,0) = (0,1)$, $f(.9,.1) = (2/5, 3/5)$, $f(.9,1) = (1,0)$, $f(1,0) = (0,1)$, $f(1,.1) = (0,1)$, $f(1,1) = (1,0)$.
Clearly, f satisfies NIL, and for the specification in Example 1, $(1,1)$ is the unique profile of efficient care levels. But, when neither of the parties buy information it is easy to see that $(.9,.1)$ which is not an efficient configuration is also a N.E.[19] Therefore, $f \notin F$.

The example 1 shows that Theorem 2 can not be stated in the case of general liability rules satisfying NIL. For the general liability rules satifying NIL, however, in the following proposition we show that if the liability rule concerned and $\bar{c}_I$ and $\bar{d}_I$ are such that both the parties buy information then this rule will motivate both the parties to take efficient levels of care.

Proposition 4 *If a liability rule f satisfies NIL then for every possible choice of* $C_I, C, D_I, D, L, (c^*, d^*) \in M, and\ \ \bar{\alpha} > 1, [c_I = \bar{c}_I \ \&\ d_I = \bar{d}_I \rightarrow f \in F]$.
Proof: See Appendix.

[19]Given, 0.9 opted by the victim, expected costs of the injurer of choosing 0.1, $(0.1 + 0.6 \times 1.01 \times 1.25 = 0.8575)$ are strictly less than that of choosing 1 or 0. Similarly, given 0.1 opted by the injurer expected costs of the victim of choosing 0.9, $(0.9 + 1.25 - 0.6 \times 1.7 \times 1.25 = 0.875)$ are strictly less than that of choosing 1 or 0.

Proposition 5 *If a simple liability rule satisfies NIL then for every C_I, C, D_I, D, L, $(c^*, d^*) \in M$, and $\bar{\alpha} > 1$, not buying information is a strictly dominant strategy for each party.*

Proof: Let the simple liabilty rule f satisfy NIL. Take any $C_I, C, D_I, D, L, (c^*, d^*) \in M$, and $\bar{\alpha} > 1$. From Propositions 1 and 2 we know that (c^*, d^*) is a N.E. and $(c, d) \in C \times D$ is a N.E. $\rightarrow (c, d) \in M$. Further, from Remark 1 we have, (c, d) is N.E $\rightarrow d = d^*$. Therefore,
(c, d) is N.E $\rightarrow c + d + L(c, d) = c + d^* + L(c, d^*)$.
But, $c + d^* + L(c, d^*) = c^* + d^* + L(c^*, d^*)$, as (c, d) is N.E $\rightarrow (c, d) \in M$ and $(c^*, d^*) \in M$. So,

$$c + L(c, d^*) = c^* + L(c^*, d^*) \tag{18}$$

In view of the above, if (c, d) is N.E , for $\alpha_i \in \{\bar{\alpha}_i, \bar{\alpha}\}$, expected costs of the injurer are
$d + y[p(c), q(d)]\alpha_i L(c, d) = d^* + y[p(c), q(d^*)]\alpha_i L(c, d^*)$, as $d = d^*$. But, $d^* + y[p(c), q(d^*)]\alpha_i L(c, d^*) = d^*$, as $y[p(c), q(d^*)] = 0$ by condition NIL. Therefore, (c, d) is N.E implies that the expected costs of the injurer are d^*.
Similarly, for $\alpha_v \in \{\bar{\alpha}_v, \bar{\alpha}\}$, when (c, d) is N.E, the expected costs of the victim are
$c + L(c, d) - y[p(c), q(d^*)]\alpha_v L(c, d^*) = c + L(c, d^*)$. From (18), (c, d) is N.E $\rightarrow$
the expected costs of the victim are $c^* + L(c^*, d^*)$.
Thus, we have demonstrated that (c^*, d^*) is a N.E. and the expected costs of the injurer and the victim viz. d^* and $c^* + L(c^*, d^*)$, remain invariant irrespective of the resulting N.E. Moreover, whether parties buy information or not, i.e., whether $\alpha_i = \bar{\alpha}$ or $\alpha_i = \bar{\alpha}_i$, and $\alpha_v = \bar{\alpha}$ or $\alpha_v = \bar{\alpha}_v$ has no effect on expected costs of the parties.[20]

But, if the injurer buys information his total costs, $\bar{d}_I + d^*$, are strictly greater than his total costs when he does not, i.e., d^*. Therefore, not buying information is a strictly dominant strategy for the injurer. Similarly, not buying information is a strictly dominant strategy for the victim.•

The following proposition shows that with the upper-biased court errors, the rule of comparative negligence motivates both the parties to take efficient levels of care and at the same time not to buy the information, in all accident contexts.

Proposition 6 $\bar{\alpha} > 1 \rightarrow$ [*The rule of comparative negligence belongs to F'*].

Proof: See Appendix.

Finally, the following theorem shows that NIL ensures both the efficient care and also no spending on the information about court errors.

Theorem 3 $\bar{\alpha} > 1 \rightarrow$ [*A simple liability rule belongs to F' iff it satisfies the condition of Negligent Injurer's Liabilty*].

[20]In fact, in view of Remark 3 if (c, d) is N.E with α_v and α_i , then (c, d) is N.E with $(\alpha'_v, \alpha'_i) \in \{\bar{\alpha}_v, \bar{\alpha}\} \times \{\bar{\alpha}_i, \bar{\alpha}\}$. In other words, existence of N.E. does not depend upon whether the parties are buying information or not.

Proof: Let $\bar{\alpha} > 1$ and the simple liability rule f satisfy NIL. Now, Proposition 1, 2 and 5 in conjunction imply that $f \in F'$. On the other hand, if $f \in F'$, then $f \in F$, as $F' \subset F$. Proposition 3 and $f \in F$ imply that f satisfies NIL. •

Corollary 5 *When courts make upper-biased errors and parties are imperfectly informed about the court errors, the rules negligence, and negligence with the defence of contributory negligence motivate both the parties to take efficient levels of care and at the same time to not to buy the information, in all accident contexts. On the other hand, the rules of no liability, strict liability, strict liability with the defence of contributory negligence do not.*

4. Concluding Remarks

Theorem 3 establishes that in the setting of upper-bised errors by courts; (I) if a simple liability rule f satisfies the condition NIL then in every accident context it is efficient in that it motivates both the parties to take efficient levels of care, and at the same time to not to spend on the information about court errors, (II) if f violates NIL then in some accident contexts it will not motivate both the parties to take efficient levels of care (From the proof of Proposition 3 it should be noted that in principle one can construct infinitely many such contexts.), (III) if f violates NIL then depending upon f and the cost of information, parties might spend on the information about the court errors and still not take efficient levels of care, for example under the rule of strict liability. On the other hand, from Corollary 2 we know that when courts do not make errors or make unbiased errors, the necessary and sufficient condition for a liabilty to be efficient is that it be such that whenever one party is negligent and the other is not then the negligent party should bear all the loss. Therefore, biased court errors affect the efficiency characterization of simple liability rules. In particular, the rule of strict liability with the defence of contributory negligence which otherwise is efficient is not so when courts make biased errors.

Finally, from the proofs in the paper it should be noted that the claims of the thoerems will not change even if instead of (A2), i.e, C, D and L are such that $M \geq 1$ we make the standard assumption that C, D and L are such that $M = 1$. In the latter case sufficiency of NIL follows immediately. Necessity of NIL follows from the fact that in all the necessity proofs C, D and L in addition to being consistent with (A2) are also such that $M = 1$.

Appendix

Explanation of Corollary 2

When $\bar{\alpha}_i = \bar{\alpha}_v = \bar{\alpha} = 1$ the injurer's expected costs are:
d+y[p(c),q(d)]$\alpha_i L(c,d) = d + y[p(c), q(d)]L(c,d)$, as $\alpha_i = 1$;
and, similarly, victim's expected costs are:

c + L(c,d) - $y[p(c), q(d)]L(c, d)$, as $\alpha_v = 1$ Therefore, with $E(\epsilon) = 0$ expected costs of the parties are equal to their respective expected costs when courts made no error. As both parties are assumed to be risk-neutral, unbaised errors by courts will not affect their choices of levels of care. As result, efficiency characterization of liability rules will also not change.

Explanation of Remark 1

From the proof of Lemma 1 we note that in the case of simple liability rules (c, d) can be a N.E. only if $d \geq d^*$. When $d \geq d^*$, expected costs of the injurer are $d + y[p(c), q(d \geq d^*)]\alpha_v L(c, d) = d$, as NIL implies $y[p(c), q(d \geq d^*)] = 0$. Obviously, expected costs of the injurer are strictly less if he chooses $d = d^*$ rather than any $d > d^*$, irrespective of the c chosen by the victim. It means, $(c, d > d^*)$ can not be a N.E. Therefore, (c, d) is a N.E.→d=d*.

Explanation of Remark 3

Let, $(\bar{c}, \bar{d})$ be a N.E. with α_i and α_v. In view of Remark 1, for any $\acute{\alpha}_i \in \{\bar{\alpha}_i, \bar{\alpha}\}$, $(\bar{c}, \bar{d})$ is a N.E.$\rightarrow \bar{d} = d^*$. Also, from (6) $(\bar{c}, \bar{d})$ is a N.E. with α_i & α_v $\rightarrow$

$$(\forall c \in C)[\bar{c} + L(\bar{c}, d^*) - y[p(\bar{c}), q(d^*)]\alpha_v L(\bar{c}, d^*) \leq c + L(c, d^*) - y[p(c), q(d^*)]\alpha_v L(c, d^*)],$$

as $\bar{d} = d^*$. But, this inequality is true for any $\acute{\alpha}_v \in \{\bar{\alpha}_v, \bar{\alpha}\}$, as $y[p(c), q(d^*)] = 0$. Therefore, $(\bar{c}, \bar{d})$ is a N.E. $\forall(\alpha_i,\ \alpha_v) \in \{\bar{\alpha}_i, \bar{\alpha}\} \times \{\bar{\alpha}_v, \bar{\alpha}\}$.

Proof of Lemma 1

Let the simple liability rule f satisfy condition NIL. Take any arbitrary C_I, C, D_I, D, L, $(c^*, d^*) \in M$ and $\bar{\alpha} > 1$. As before, $\bar{\alpha} > 1 \rightarrow (\alpha_v > 1$ and $\alpha_i > 1)$, where $\alpha_v \in \{\bar{\alpha}_v, \bar{\alpha}\}$, and $\alpha_i \in \{\bar{\alpha}_i, \bar{\alpha}\}$. Suppose, $(\bar{c}, \bar{d}) \in C \times D$ is a N.E. $(\bar{c}, \bar{d})$ is a N.E.$\rightarrow$

$$(\forall c \in C)[\bar{c} + L(\bar{c}, \bar{d}) - y[p(\bar{c}), q(\bar{d})]\alpha_v L(\bar{c}, \bar{d}) \leq c + L(c, \bar{d}) - y[p(c), q(\bar{d})]\alpha_v L(c, \bar{d})] \tag{19}$$

and

$$(\forall d \in D)[\bar{d} + y[p(\bar{c}), q(\bar{d})]\alpha_i L(\bar{c}, \bar{d}) \leq d + y[p(\bar{c}), q(d)]\alpha_i L(\bar{c}, d)] \tag{20}$$

Now, (19), in particular, $\rightarrow$

$$\bar{c} + L(\bar{c}, \bar{d}) - y[p(\bar{c}), q(\bar{d})]\alpha_v L(\bar{c}, \bar{d}) \leq c^* + L(c^*, \bar{d}) - y[p(c^*), q(\bar{d})]\alpha_v L(c^*, \bar{d}) \tag{21}$$

and (20)$\rightarrow$

$$\bar{d} + y[p(\bar{c}), q(\bar{d})]\alpha_i L(\bar{c}, \bar{d}) \leq d^*, \tag{22}$$

as condition NIL implies $y[p(\bar{c}), q(d^*)] = 0$.

When $\bar{d} < d^*$ there are three possible cases.

Case 1: $\bar{c} > c^*$:

When $\bar{c} > c^*$, we have $L(\bar{c}, \bar{d}) \leq L(c^*, \bar{d})$. Which means $(1-\alpha_v)L(\bar{c}, \bar{d}) \geq (1-\alpha_v)L(c^*, \bar{d})$, as $(1-\alpha_v) < 0$. This further implies $\bar{c} + (1-\alpha_v)L(\bar{c}, \bar{d}) > c^* + (1-\alpha_v)L(c^*, \bar{d})$, as $\bar{c} > c^*$.

But, $\bar{d} < d^*$, $\bar{c} > c^*$ and $(\bar{c}, \bar{d})$ is a N.E., through (21), $\rightarrow$

$\bar{c} + (1-\alpha_v)L(\bar{c}, \bar{d}) \leq c^* + (1-\alpha_v)L(c^*, \bar{d})$, as $\bar{d} < d^*$, $\bar{c} > c^*$ and condition NIL imply that $y(p(c^*), q(\bar{d})) = 1$ and $y(p(\bar{c}), q(\bar{d})) = 1$. Thus, the assumption $(\bar{c}, \bar{d})$ is a N.E. leads to contradiction in this case. Therefore,

$$\bar{d} < d^* \ \& \ \bar{c} > c^* \rightarrow (\bar{c}, \bar{d}) \ is \ not \ a \ N.E. \tag{23}$$

Case 2: $\bar{c} = c^*$:

$\bar{d} < d^*$, $\bar{c} = c^*$, and $(\bar{c}, \bar{d})$ is a N.E., through (22), $\rightarrow$

$\bar{d} + \alpha_i L(\bar{c}, \bar{d}) \leq d^*$, as $y[p(\bar{c} = c^*), q(\bar{d} < d^*)] = 1$, by condition NIL. Or,

$c^* + \bar{d} + \alpha_i L(\bar{c} = c^*, \bar{d}) \leq c^* + d^* + L(c^*, d^*)$.

But, $\bar{d} < d^* \rightarrow L(\bar{c} = c^*, \bar{d}) > 0$. Further, $L(c^*, \bar{d}) > 0$ and $\alpha_i > 1 \rightarrow$

$c^* + \bar{d} + L(c^*, \bar{d}) < c^* + \bar{d} + \alpha_i L(c^*, \bar{d}) \leq c^* + d^* + L(c^*, d^*)$.

That is, $c^* + \bar{d} + L(c^*, \bar{d}) < c^* + d^* + L(c^*, d^*)$, a contradiction as $(c^*, d^*) \in M$. Therefore,

$$\bar{d} < d^* \ \& \ \bar{c} = c^* \rightarrow (\bar{c}, \bar{d}) \ is \ not \ a \ N.E. \tag{24}$$

Case 3: $\bar{c} < c^*$: In this case $\bar{c} < c^* \& \bar{d} < d^*$.

As f is a simple liability rule, $y[p(\bar{c}), q(\bar{d})] = 0$ or 1. Let, $y[p(\bar{c}), q(\bar{d})] = 0$.

From (21), $(\bar{c}, \bar{d})$ is a N.E.$\rightarrow$ $\bar{c} + L(\bar{c}, \bar{d}) \leq c^* + L(c^*, \bar{d}) - \alpha_v L(c^*, \bar{d})$, as $y[p(\bar{c}), q(\bar{d})] = 0$ and $y[p(c^*), q(\bar{d} < d^*)] = 1$, by condition NIL. Therefore,

$\bar{c} + L(\bar{c}, \bar{d}) < c^*$, as $\alpha_v > 1$ and $L(c^*, \bar{d} < d^*) > 0$. Or $\bar{c} + \bar{d} + L(\bar{c}, \bar{d}) < c^* + d^*$, as $\bar{d} < d^*$, a contradiction. Similarly, we get a contradiction when $y[p(\bar{c}), q(\bar{d})] = 1$. Thus

$$\bar{d} < d^* \ \& \ \bar{c} < c^* \rightarrow (\bar{c}, \bar{d}) \ is \ not \ a \ N.E. \tag{25}$$

Finally, (23) - (25) establish that $\bar{d} < d^* \rightarrow (\bar{c}, \bar{d})$ *is not a N.E.*•

Proof of Lemma 2

Take any arbitrary C_I, C, D_I, D, L, $(c^*, d^*) \in M$ and $\bar{\alpha} > 1$, satisfying A1-A3. Let, $(\bar{c}, \bar{d})$ be a N.E. In view of the fact that the rule of comparative negligence satisfies NIL and Remark 2, under the rule in all the cases when $\bar{d} \geq d^*$, or when $\bar{d} < d^* \& \bar{c} \geq c^*$, the following holds:

$$(\bar{c}, \bar{d}) \ is \ a \ N.E. \rightarrow (\bar{c}, \bar{d}) \in M. \tag{26}$$

Now, consider the remaining case, i.e., when $\bar{d} < d^*$ & $\bar{c} < c^*$:

From (9), $(\bar{c}, \bar{d})$ is a N.E. $\rightarrow$

$(\forall d \in D)[\bar{d} + y[p(\bar{c}), q(\bar{d})]\alpha_i L(\bar{c}, \bar{d}) \leq d + y[p(\bar{c}), q(d)]\alpha_i L(\bar{c}, d)]$.

Or, in particular, $\bar{d} + y[p(\bar{c}), q(\bar{d})]\alpha_i L(\bar{c}, \bar{d}) \leq d^*$, or
$y[p(\bar{c}), q(\bar{d})]\alpha_i L(\bar{c}, \bar{d}) \leq d^* - \bar{d}$, or

$$\frac{d^* - \bar{d}}{(c^* + d^*) - (\bar{c} + \bar{d}\ )}\alpha_i L(\bar{c}, \bar{d}) \leq d^* - \bar{d}, \quad as \quad y[p(\bar{c}), q(\bar{d})] = \frac{(d^* - \bar{d})}{(c^* + d^*) - (\bar{c} + \bar{d})}$$

under the rule, by assumption. Therefore, $(\bar{c}, \bar{d})$ is a N.E. $\rightarrow$
$\alpha_i L(\bar{c}, \bar{d}) \leq (c^* + d^*) - (\bar{c} + \bar{d})$, or
L$(\bar{c}, \bar{d}) < (c^* + d^*) - (\bar{c} + \bar{d})$, as $\alpha_i > 1$ and $L(\bar{c} < c^*, \bar{d} < d^*) > 0$. Or,
$\bar{c} + \bar{d} + L(\bar{c}, \bar{d}) < c^* + d^* \leq c^* + d^* + L(c^*, d^*)$, which is a contradiction. Therefore,

$$\bar{c} < c^* \ \& \ \bar{d} < d^* \rightarrow (\bar{c}, \bar{d}) \ is \ not \ a \ N.E. \tag{27}$$

Finally, (26)&(27) $\rightarrow$
$(\bar{c}, \bar{d})$ is a N.E.$\rightarrow (\bar{c}, \bar{d}) \in M$. •

Proof of Lemma 3

Let f be any simple liability rule. Let under f, $[(\exists p \in [0,1))[f(p,1) = (0,1)]$ or $(\exists q \in [0,1))[f(1,q) = (1,0)]]$ hold. There are two possible cases.
Case 1: Suppose, $(\exists p \in [0,1))[f(p,1) = (0,1)]$ holds.
In this case, $f(p,1) = (0,1)$ for some $p < 1$.
Take any $\bar{\alpha} > 1$, $\bar{\alpha}_i > 1$ and $\bar{\alpha}_v > 1$. Let, $t > 0$. Choose a positive number r such that $0 < r < t$. Take any C_I and D_I. Now consider the following specification of C, D, L:
$C = \{0, pc_0, c_0\}$, where $c_0 = r/(1-p)$,
$D = \{0, d_0\}$, where $d_0 > 0$,
$L(0,0) = t + pc_0 + d_0 + \delta$, where $\delta > 0$,
$L(pc_0, 0) = t + d_0 + \delta$, $\ L(c_0, 0) = d_0 + \delta$, $\ L(0, d_0) = t + pc_0$,
$L(pc_0, d_0) = t$, $\ L(c_0, d_0) = 0$.
Clearly, (c_0, d_0) is the unique configuration of efficient care levels and the specification satisfies (A1)- (A3). Let $(c_0, d_0) = (c^*, d^*)$. From the above specification it is immediately clear that given d_0 opted by the injurer, the victim is strictly better off by choosing pc_0 rather than choosing c_0. Therefore, for the above specification of C_I, C, D_I, D, L, $(c^*, d^*) \in M$ and $\bar{\alpha} > 1$ satisfying A1-A3, (c^*, d^*) is not a N.E.

Case 2: $(\exists q \in [0,1))[f(1,q) = (1,0)]$ holds.
Take any $\bar{\alpha} > 1$, $\bar{\alpha}_i > 1$ and $\bar{\alpha}_v > 1$. Let $t > 0$. Clearly, $qt < t$. Let, $r > 0$ be such that $qt < r < t$.
Take any C_I and D_I. Now consider the following specification of C, D, and L:
$C = \{0, c_0\}, c_0 > 0$,
$D = \{0, qd_0, d_0\}$, where $d_0 = r/(1-q)$,
$L(0,0) = t + qd_0 + c_0 + \delta$, where $\delta > 0$
$L(c_0, 0) = t + qd_0$, L(0, qd$_0$) $= t + c_0 + \delta$, $L(0, d_0) = c_0 + \delta$,

$L(c_0, qd_0) = t$, $\mathrm{L}(c_0, d_0) = 0$.
Clearly, (c_0, d_0) is the unique configuration of efficient care levels. Let $(c_0, d_0) = (c^*, d^*)$. Again, (c^*, d^*) is not a N.E.
$\bullet$

Proof of Proposition 4

Let $c_I = \bar{c}_I$, $d_I = \bar{d}_I$ and f satisfy NIL. Take any arbitrary C_I, C, D_I, D, L, $(c^*, d^*) \in M$, and $\bar{\alpha} > 1$, satisfying A1-A3. From Proposition 1 clearly, (c^*, d^*) is a N.E. Now, to prove that $f \in F$, it will suffice to show that $(\forall(\bar{c}, \bar{d}) \in C \times D)[(\bar{c}, \bar{d})$ is a N.E. $\rightarrow (\bar{c}, \bar{d}) \in M]$.
Let, $(\bar{c}, \bar{d}) \in C \times D$ be a N.E.
From Remark 2 when $\bar{d} \geq d^*$, or $\bar{d} < d^* \& \ \bar{c} \geq c^*$, we have
$[(\bar{c}, \bar{d})$ is a N.E. $\rightarrow (\bar{c}, \bar{d}) \in M]$.
Now, consider the case $\bar{d} < d^* \& \bar{c} < c^*$.
Since $c_I = \bar{c}_I \& \ d_I = \bar{d}_I$, i.e., both the parties buy information, we have $\alpha_i = \alpha_v = \bar{\alpha}$. Adding (8) and (9) we have, $(\bar{c}, \bar{d})$ is a N.E. $\rightarrow$
$\bar{c} + \bar{d} + L(\bar{c}, \bar{d}) \leq c^* + d^* + L(c^*, \bar{d}) - y[p(c^*), q(\bar{d})]\bar{\alpha}L(c^*, \bar{d})$. Or,
$\bar{c} + \bar{d} + L(\bar{c}, \bar{d}) \leq c^* + d^* + L(c^*, \bar{d}) - \bar{\alpha}L(c^*, \bar{d})$, as $y[p(c^*), q(\bar{d} < d^*)] = 1$ by condition NIL. Or,
$\bar{c} + \bar{d} + L(\bar{c}, \bar{d}) < c^* + d^*$, as $\bar{\alpha} > 1$ and $L(c^*, \bar{d}) > 0$. Which is a contradiction. Thus,
$\bar{d} < d^* \& \ \bar{c} < c^* \rightarrow (\bar{c}, \bar{d})$ is not a N.E.
Therefore, under f
$(\forall(\bar{c}, \bar{d}) \in C \times D)[(\bar{c}, \bar{d})$ is a N.E. $\rightarrow (\bar{c}, \bar{d}) \in M]$. $\bullet$

Proof of Proposition 6

Let f denote the rule of comparative negligence. Clearly, f satisfies the condition NIL. Take any arbitrary C_I, C, D_I, D, L, $(c^*, d^*) \in M$, and $\bar{\alpha} > 1$, satisfying A1-A3. Proposition 1 and the fact that f satisfies NIL means that (c^*, d^*) is a N.E. Also, Lemma 2 shows that under f
$(\forall(c, d) \in C \times D)[(c, d)$ is a N.E. $\rightarrow (c, d) \in M]$.
Now, to prove that $f \in F'$ it is sufficient to show that $c_I = 0$ and $d_I = 0$. From the proof of Lemma 2 we note that (c, d) is a N.E. only if $d \geq d^*$. Arguing on the line of the explanation of Remark 1, it is easy to see that under f, (c, d) is a N.E. implies $d = d^*$. With $d = d^*$, an argument analogous to the one in the proof of Proposition 5 shows that not buying information is a strictly dominant strategy for both the parties, i.e., $c_I = 0$ and $d_I = 0$. $\bullet$

References

Barnes, D. W. and Stout, L. A. (1992), The Economic Analysis of Tort Law, St. Paul, West Publishing Company.

Brown, J. P. (1973), 'Toward an Economic Theory of Liability', *Journal of Legal Studies*, 2, 323-350.

Cooter, R. D. and Ulen, T. S. (1997), Law and Economics, second edition, New York, Addison-Wesley.

Craswell, R and Calfee, J.E. (1986), Deterrence and Uncertain Legal Standards, *Journal of Law, Economics, and Organization* 2: 279-303.

Endres, A and Lüdeke, A (1998). Limited Liability and Imperfect Information- On the Existence of Safety Equilibria Under Products Liability Law, *European Journal of Law and Economics*, 5: 153-165.

Jain, S.K and Singh, R. 2001 " Efficient Liability Rules: Complete Characterization", *Journal of Economics Zeitschift Für Nationalokonomie,* Vol. 74 No 1, 1-20 (forthcoming)

Kahan M. (1989), Causation and incentive to take care under the rule of negligence, *Journal of Legal Studies* 18: 427-47.

Kaplow, L. 1994. The value of accuracy in adjudication: an economic analysis. *Journal of Legal Studies* 23: 307-401.

Kaplow, L. 1995. A model of the optimal complexity of legal rules, *Journal of Law, Economics, and Organization* 11: 150-63.

Kaplow, L. 1998. Accuracy in adjudication, in The New Palgrave dictionary of Economics and The Law, Macmillan Reference Limited, 1998.

Kaplow, L. and Shavell, S. 1992. Private versus socially optimal provision of exante legal advice. *Journal of Law, Economics, and Organization* 8: 306-20.

Kaplow, L. and Shavell, S. 1993. Accuracy in Assessment of Damages, Cambridge, Mass; Working Paper No. 4287. National Bureau of Economic Research.

Kaplow, L. and Shavell, S. 1994. Accuracy in the determination of liability, *Journal of Law and Economics* 37: 1-15.

Kaplow, L. and Shavell, S. 1996. Accuracy in the assessment of damages, *Journal of Law and Economics* 39: 191-210.

Miceli, T. J. (1997), Economics of the Law: Torts, Contracts, Property, Litigation, Oxford, Oxford University Press.

Landes, William M. and Posner, Richard A. (1987), The Economic Structure of Tort Law, Cambridge (MA), Harvard University Press.

Miceli, T J. (1990), Optimal prosecution of defendants whoes guilt is uncertain, *Journal of Law, Economics, and Organization* 6: 189-201.

Miceli, T J. (1997), Economics of the Law: Torts, Contracts, Property, Litigation, Oxford, Oxford University Press.

Polinsky A.M. and Shavell S. (1989), Legal errors, litigation, and the incentive to obey the law, *Journal of Law, Economics, and Organization* 5: 99-108.

Posner, R. A. (1992), Economic Analysis of Law, fourth edition, Boston, Little, Brown and Company.

Rasmusen, E (1995), Predictable and unpredictable error in torts awards: the effect of plaintiff self selection and signalling, *International Review of Law and Economics:* 15: 323-45.

Shavell, S. (1987), Economic Analysis of Accident Law, Cambridge (MA), Harvard University Press.

Tullock, G (1994). Courts Errors, *European Journal of Law and Economics*, 1: 9-21.