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The Economics of Tort Law: A Précis

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The Economics of Tort Law: A Précis

ABSTRACT: Economic analysis has long been employed for the study of tort liability. This paper revisits the main contributions to the subject emphasizing the inherent impossibility for tort liability to set perfectly efficient first-best incentives to take precaution for all parties to an accident and the need to choose among second best outcomes. The paper provides a pathfinder through the literature in various areas of tort law and economics.

The relatively simple structure of a tort problem provides one of the most fertile areas for the application of economic analysis to law. The positive economic theory of tort law maintains that the common law of torts is best explained as if judges are trying to promote efficient resource allocation, i.e., maximize efficiency. The Coase (1960) theorem shows that if parties are allowed to negotiate and transaction costs are sufficiently low, legal entitlements will be reallocated efficiently. In the case of tort accidents, transaction costs are high. This is easily understood because the parties potentially involved in an accident are not easily identifiable ex ante, and the cost of acquiring the relevant information for bargaining can be high. This renders contractual arrangements à la Coase impracticable. In most tort situations the legal system thus needs to provide rules to give potential injurers and potential victims appropriate incentives to act as if they had to bear the total social cost of their activities. This is an important goal of tort law. Tort law is therefore justified when bargaining is not possible because high transaction costs are present, and banning an activity is undesirable given the social value of the risk-creating activity (Calabresi and Melamed, 1972).

In order to create optimal incentives, liability rules need to induce parties to minimize the total social cost of accidents. The relevant variables for this tort problem are the cost of accidents, the cost of accident avoidance (precaution), and the administrative costs of the justice system. Every legal system chooses from various liability rules (e.g., negligence, strict liability, etc.) and safety standards to minimize the overall cost of accidents.

1. The goals of tort law

A first intuitive end of tort law is to compensate the victims for losses due to accidents. This is indeed an important task of tort adjudication but is not the central issue concerning the design of tort rules. It has been shown that tort law is a very expensive means of compensating harms, because it involves high administrative cost due to the functioning of the judicial system. Insurance, to the contrary, is a much cheaper and quicker system (Shavell, 1987, at 263): if the only goal were to compensate victims, first-party insurance would be preferable over tort liability. Moreover, the cost of insurance can be paid by the potential injurers, shared among potential victims or financed by taxpayers, in order to redistribute the costs (McEwin, 2000).

On the contrary, economic analysis suggests that the primary reason for utilizing the tort system is to allow risk-creating activities to be carried out only if the social value of the activity justifies the risk created. This balancing of costs and benefits is currently endorsed by North American tort doctrine and is clearly summarized by the *Restatement (Second) of Torts* § 291: "Where an act is one which a reasonable man would recognize as involving a risk of harm to another, the risk is unreasonable and the act negligent if the risk is of such magnitude as to outweigh what the law regards as the utility of the act or of the

particular manner in which it was done" (The *Restatement (Second) of Torts* §§ 292 and 293, indicate the criteria for verifying utility of conduct and magnitude of risk.)

More specifically, economic analysis suggests that tort law should be designed in such a way as to provide potential injurers and victims with appropriate incentives to avoid the accident by internalizing the externalities created by their activities. In the absence of tort liability, potential tortfeasors would bear the private cost of their precaution without internalizing any of the benefits thereof. The benefits (of precaution) are external with respect to the decision (on how much precaution). This would lead to suboptimal levels of care and excessive accident rates. Through tort liability, a potential tortfeasor internalizes the benefits of his precaution, that is, the reduction in expected liability. Tort rules should thus be designed to induce parties to internalize the external costs of their activities and to adopt optimal levels of precaution.

In addition, tort law gives parties incentives to acquire information about the accident. With respect to risk, the tort law system should enhance an optimal allocation of the risk between victim and injurer, but this goal can be reached via insurance. With respect to transaction costs, the goal of the tort law system is to minimize the administrative cost associated with the functioning of the system itself (mainly the costs of courts and lawyers and the indirect costs borne by litigants). Calabresi (1970) presented the first formulation of the ends of liability in those terms, while Brown (1973) formalized an economic model of accidents. We will focus on incentives toward optimal precaution and discuss the other aspects aside.

2. A taxonomy of liability rules.

There are several ways in which legal systems can apportion liability between parties. Historically, a broad variety of liability rules has been developed by legal systems. Most early legal systems adopted liability rules that did not depend on the fault of the tortfeasor. This feature of early legal systems has been explained as instrumental to promoting appeasement between the parties and to avoiding cumbersome and controversial ascertainment of the subjective elements of a tort (Parisi, 1992 and 2001). Gradually, legal systems began to recognize fault as a viable basis for liability and in modern legal regimes strict liability is seen as an exception to the norm. Liability for accidents should arise only in the case of tortfeasor fault (including both negligent and intentional wrongdoing).

We shall proceed with the presentation of some of the most common liability rules, starting from strict liability to simple negligence and more complex legal regimes. In our analysis we shall utilize the conventional terminology by which the injurer is defined as the individual who does not suffer harm in an accident and the victim as the individual who suffers such harm. In this survey, we shall focus on two-party accidents.

There are two fundamental possibilities in a two-party accident. The first occurs when both parties have to take precaution in order to avoid the accident (*bilateral precaution*). The second is given by situations in which either party can take precaution and successfully avoid an accident (*alternative precaution*). In the second case, there is a waste of precaution cost if both parties take precaution, since one party's precaution would have been already enough. A particular and common case of alternative precaution is unilateral precaution. As in alternative precaution, one party's precaution is enough to prevent the

accident, but only one party has the actual possibility of avoiding the accident. We shall consider all such possibilities when referring to the effect of alternative legal rules on the parties' behavior.

2.1 Strict Rules: No Liability and Strict Liability

Strict liability can be thought of as the mirror-image of no liability. A party who occasions harm to another will compensate the victim regardless of who is at fault. This rule is the converse of no liability. No liability can in fact be thought of as strict liability on the part of the victim, in that the victim always bears the loss regardless of the parties' fault. No liability and strict liability can thus be considered the limit points in the range of possible liability rules. The choice between strict liability and no liability has obvious distributive effects, in that strict liability results in the victim always being compensated, while no liability makes the victim bear all accident costs.

The different allocation of accident costs has clear incentive effects. In a strict liability system, the injurer has to bear both the cost of precaution and the expected accident cost and, hence, he will minimize the sum of those costs. This will lead to the efficient level of precaution. On the contrary, a no-liability rule does not achieve an efficient result because the injurer would bear the cost of precaution without internalizing the benefit of such precaution. Absent liability, the injurer would adopt no precaution at all, which is an inefficient result. On the other hand, if we look at the victim's incentives to take precaution, we see that the opposite is true. Strict liability creates no incentives for victim precaution, while no liability would shift the entire residual liability on the victim, inducing optimal victim care. It follows that strict liability and no liability can give incentives to take efficient precaution only to one party,

respectively either the injurer or the victim. Strict liability will fail to produce an efficient outcome when the avoider is the victim, and no liability will fail when the avoider is the injurer.

With respect to alternative precaution, the result is slightly different. In the case of unilateral precaution, if the tort law system fails to target the avoider, he will take no precaution at all, while in the case of alternative precaution, either party can take precaution; therefore, imposing liability on the party who is not the least cost avoider will result in suboptimal precaution levels and excessive precaution costs. Strict liability and no liability can thus yield efficient results only in the case of unilateral or alternative precaution, provided that liability is allocated on the least cost avoider.

In the case of bilateral precaution, both strict liability and no liability fail to generate optimal incentives, because neither rule can simultaneously threaten both parties with liability in a Nash equilibrium. In bilateral-precaution situations a different rule is therefore needed to induce both parties to adopt the necessary precautions.

2.2 Negligence rules in General

Fault can be seen as a way of creating optimal incentives on both tortfeasors and victims and also of achieving efficiency in the case of bilateral precaution. Negligence rules draw a line between liability and no liability by identifying a level of due care and verifying if the relevant party adopted that level of due care. American case law in a sense anticipated the economic definition of negligence, adopting the simple and formal logic of cost-benefit analysis to adjudicate tort cases. Already in 1947, Judge Learned Hand, in the celebrated decision of *United States v. Carroll Towing Co.* (159 F.2d 169 (2d

Cir. 1947)), clarified the tradeoffs between the costs and benefits of risk and prevention activities using a mathematical formula. This rule became a milestone in the law of torts, and it is now known as the Hand formula of negligence. The formula defines negligence as a function of three variables: a) the probability of a harmful event occurring (magnitude of risk); b) the seriousness of the damage that may result from this event (gravity of harm); and c) the cost of preventing the occurrence of the harmful event (burden of prevention). In the original formula, (P) indicates the magnitude of risk; (L) indicates the gravity of the loss; and (B) indicates the burden of prevention (i.e., the cost of adequate precautions). According to the Hand formula, conduct is negligent if the cost of adequate precautions is less than the cost of the injury multiplied by the probability of its occurrence, i.e., if (B) < (PL).

Although the Hand formula does not directly consider the social value of risk-creating behavior, it produces the proper incentives for the evaluation of such behavior. By imposing a balance between risk and prevention, the result in *Carroll Towing* encourages individuals to weigh the cost of prevention against the utility of the behaviour. When deciding whether to engage in an activity, the reasonable person will consider whether the utility derived from the activity justifies the risk of liability and/or the cost of prevention (this is, indeed, the question of the *Restatement (Second) of Torts* § 291, comment a, which asks whether "the game is worth the candle"). According to this logic, individuals will respond to liability rules by undertaking the socially optimal level of precaution. A vast region of law and economics literature has explored the wisdom of this tort doctrine, often with the use of formal economic models, bringing to light the importance of using marginal (rather than total) values in the assessment of liability. Along similar lines, after establishing a positive economic model of tort law, Landes and Posner (1982) conclude that the Hand

formula of negligence, as applied, coincides with the economic model of due care.

Introducing fault means setting a due level of precaution, defined by the legislator or by the judge. The due level of precaution should be set to be equal to the efficient level of precaution. Under any negligence rule the judge has to perform such a test by confronting the level of precaution actually taken by the parties with the due level of precaution. This increases the administrative cost of adjudication compared to strict liability rules and generates some complexities.

Among such complexities is the fact that, while some forms of precaution are easily observable ex post, some others are very difficult, or even impossible to assess and to compare with the legal standard of precaution. In the presence of non-observable precautions, it is clear that individuals would rationally limit their investment to observable precaution to avoid negligence and refrain from investing in non-observable precautions, since they could not draw much benefit from such investment.

In the law and economics literature the case of non-observable precautions is generally treated under the discussion of care levels versus activity levels. The most common example of activity level is the repetition of a dangerous action, as driving. Although courts may occasionally take into account the frequency of an activity in their assessment of negligence, often no threshold of "optimal frequency" can be easily utilized by legal rules as a liability allocation mechanism, given the difficulty of pinpointing a critical value to separate efficient from excessive activity. Since courts cannot be asked to balance unascertainable costs and benefits and cannot be asked to evaluate non-observable precaution levels, it is clear that the types of precautions that are evaluated for the finding of negligence are generally confined to care levels, not

activity levels. Therefore, the introduction of the criterion of negligence introduces a dichotomy between care-type and activity-type precaution investments (Shavell, 1980a). No such distinction between care and activity level is relevant in regimes of strict liability and no liability.

2.2 Negligence rules under which the Victim is the Residual Bearer

Hereafter we shall analyze those rules that are generally referred to as negligence rules. It will soon be clear that we can think of them as being constructed by adding a negligence defense to a rule of no liability.

Simple Negligence. Within negligence regimes, the most straightforward rule is simple negligence. Under simple negligence an injurer is liable for damages only if he is found negligent. The victim bears the so-called residual liability, in the sense that he has to bear the consequences of the accident if the injurer cannot be blamed for negligence. In this sense, simple negligence is analogous to a no-liability rule, because it leaves residual liability on the victim.

With unilateral-precaution accidents, when the victim is the avoider, the injurer cannot be declared negligent since it is not possible for him to take effective precautions. Therefore, the victim bears the cost of the accident and he will have incentives to take the optimal level of precautions (care and activity level) as under no liability. If the avoider is the injurer, he will have to pay only when he does not take at least the due level of care. If the injurer is negligent, he has to bear the cost of care and the expected accident cost (pay damages to the victim). On the contrary, if he takes due care he avoids liability and bears only the cost of care. If due care is set at the efficient level, the injurer will have incentives to take due care. We can conclude that in unilateral- precaution cases

simple negligence produces the right incentive to take optimal care when either the injurer or the victim is the avoider.

However, with respect to activity level, only the victim, as a residual bearer, has incentives to take the optimal level of precaution. In equilibrium, in fact, the injurer will adopt due care and avoid liability, so that any investment in non-observable precautions would yield him no private benefit. Simple negligence thus gives efficient incentives with respect to activity level only to the victim, since he bears the full cost of the accident in equilibrium.

The same logic also allows us to show that also in the case of alternative precaution both parties face incentives to adopt optimal care levels. However, we know that in such situations efficiency requires only the least-cost avoider to take care. If the other party or both parties adopt precautions there is an inefficient result. One way to avoid obtaining such an inefficient outcome is to formulate the negligence criterion in light of such requirement, so that negligence could be found only when the injurer is the least-cost avoider.

The introduction of the requirement of negligence improves the performance of the rule in bilateral-precaution situations. The negligence criterion makes both parties take the optimal level of care in all situations (unilateral, alternative and bilateral precaution), but gives incentives to choose an optimal activity level only to the residual bearer, the victim.

Contributory and comparative negligence. Under contributory negligence, the injurer is liable to compensate his victim only if he was negligent and the victim was careful. In all remaining cases the victim remains the residual bearer and receives no compensation for his loss. Therefore, the victim does not have the right to compensation when both were negligent, when both were careful, and obviously when the injurer was careful and the victim negligent. Similar results are reached with a rule of comparative negligence. In a regime of

comparative negligence, however, victim negligence does not constitute a complete bar to recovery but leads to a reduction of liability in proportion to the parties' respective levels of negligence.

In both regimes, the injurer can escape liability by taking the due level of care. This creates the appropriate incentive for the injurer to comply with the legal standard of care. Given that the injurer can reasonably expect to bear the entire residual loss, he would also face incentives to behave carefully, since he would internalize the full benefit of his precaution investment. Contributory and comparative negligence thus create efficient care incentives for both parties, but only the victim, as a residual bearer, would have incentive to undertake an optimal activity level. The injurer is able to avoid liability with the adoption of due care and therefore would have no incentive to invest in non-observable precautions.

Contributory and comparative negligence thus produce the same set of incentives generated by a rule of simple negligence, but they have possible distributive effects, because they would either foreclose or reduce compensation when the victim is found negligent.

2.3 Strict Liability with Negligence Defenses: the Injurer as the Residual Bearer

A negligence rule can also be applied in conjunction with strict liability. In these cases, the residual bearer is the injurer. Under strict liability with the defense of contributory negligence, there is a test on the victim's fault. If the victim is at fault, he is barred from obtaining compensation. When there is no fault on the part of the victim, the injurer is strictly liable, regardless of his fault. A regime of strict liability with a defense of dual contributory negligence

encompasses a double test on fault; the negligence criterion is applied to both the victim and the injurer. In this case the victim bears the accident loss only if he was negligent and the injurer careful: in all the remaining cases he is entitled to compensation. The injurer has to pay damages if both were negligent, if only the victim was careful and if both were careful. This rule generates the same incentive effects as strict liability with a defense of contributory negligence.

Under both variants of this rule of strict liability with negligence defenses, the victim has incentives to take the due level of care to avoid losing his right to compensation in case of an accident. If the victim is careful, the injurer bears the expected accident cost and will take the level of precaution (care and activity level) that minimizes the total cost of accidents, a level that would correspond to the socially optimal level of precaution.

Under these regimes, it is sufficient for the victim to take due care in order to be compensated for the accident loss, so that he does not have any incentive to take (additional) unobservable precaution. On the contrary, since the injurer is the residual bearer, he will have incentives to invest in both observable and unobservable precautions.

2.4 Comparative Causation and Loss Sharing Rules

Under the liability regimes examined above, if neither party is at fault the loss is either entirely borne by the victim (negligence rules under which the victim is the residual bearer) or is shifted entirely on the tortfeasor (strict liability with negligence defenses). These rules lack explicit ways for apportioning the loss between a faultless victim and a faultless tortfeasor. Historically, comparative causation emerges in the midst of legal systems based on negligence, in response to the conviction that, absent fault, there is no

obvious reason to let the loss fall on the innocent victim, just like there is no reason to shift it on the tortfeasor. The criterion of comparative causation allows the spreading of an accident loss among a faultless tortfeasor and an innocent victim on the basis of the relative causal contribution of the parties to the loss. The principle of comparative causation only operates as a residual basis for liability in the presence of faultless parties, avoiding the all-or-nothing allocation of liability generated by traditional rules.

In terms of levels of care, a rule of comparative causation under negligence may induce both victims and tortfeasors to adopt socially optimal levels. Comparative causation differs from traditional regimes in this respect, since both parties face positive shares of the accident loss in equilibrium. This results in the spreading of expected accident loss and activity level incentives between the parties, rather than the concentration of such losses and incentives on one or the other party. As a result, under comparative causation the activity level chosen by one party improves at the expense of the other. Thus, neither version of comparative causation dominates traditional negligence and strict liability rules on both activity level margins.

The loss-sharing and resulting dilution of activity level incentives may or may not increase total net benefits. Loss spreading in equilibrium may promote optimal risk allocation among risk-averse agents when insurance is not readily available. Loss spreading may similarly minimize distortion of incentives deriving from truncated liability when tortfeasors face large potential losses. However, comparative causation is also likely to exacerbate administrative costs, given the need to ascertain relative causation and the need to adjudicate cases even in situations where neither party is at fault. This may explain the limited spread of this rule in contemporary legal systems.

3. Conclusion: The Difficult Design of Tort Law

All liability rules based on negligence struggle with a common dilemma. An increase in care level or a reduction in activity level for one party makes an accident less likely to occur. However, each party's precautions also make the accident less likely for the other party. There is no feasible and cost-effective mechanism in tort law to induce victims and tortfeasors to internalize the benefits and costs of their behavior in all dimensions.

Tort rules can only direct efficient incentives with respect to activity level towards the residual bearer, thus failing to enhance the other party's efficient behavior. This is Shavell's theorem on activity level (Shavell, 1980a) according to which no negligence rule exists which can give both parties efficient incentives with respect to activity level. This follows from the fact that the distinction between care (precaution the judge can observe ex post) and activity level (precaution the judge cannot observe ex post) is due to the introduction of the negligence criterion. The party who can escape liability by simply taking the due level of care will not invest in other unobservable precautions, while the other, the residual bearer, will.

This point can be generalized by observing that a point of discontinuity in the liability curves faced by the parties must be created to entice both parties to choose optimal care and activity levels. With respect to care, this is generally done by identifying a socially optimal care level and by utilizing that level to mark the boundaries between diligence and negligence. Landes and Posner (1987, at 70-71) and Gilles (1992) suggest that courts take into account activity levels in their assessment of negligence whenever it is feasible to do so. However, no threshold of "optimal activity level" is generally invoked by legal rules as a liability allocation mechanism. The reason for this omission is due to

the difficulty of pinpointing a critical value to separate efficient from inefficient activity levels. Absent this critical threshold, no discontinuity in the parties' expected liability can be created.

Optimal activity levels are difficult to specifiy because the value of such activities can only be ascertained from private information of the parties. Unlike optimal levels of care, which largely depend on the objective cost of precaution and the expected gravity of harm, optimal activity levels rely on values that are harder to ascertain by a third party decision maker since they include the subjective value of the individual that carries out the risk-creating (or risk-bearing) activity. In the absence of such a threshold it is difficult to induce both parties to internalize the full social cost of their activity levels in equilibrium.

This leads us to point out a general characteristic of tort law. Since it is not possible for both parties to bear the accident loss in equilibrium, traditional legal rules concentrate activity level incentives on one or the other party. Negligence rules under which the victim is the residual bearer (simple negligence, contributory and comparative negligence) give efficient incentives with respect to activity level only to the victim, the residual bearer in those cases, while the strict-liability-based negligence rules (under which the injurer is the residual bearer: strict liability and strict liability with negligence defenses) give efficient incentives with respect to activity level only to the injurer, the residual bearer in those remaining cases.

In theory, a rule of decoupled liability could give both parties efficient incentives with respect to care and to activity level. Decoupling liability (Polinsky and Che, 1991) means making both the injurer and the victim the residual bearers by denying the victim any compensation (as under no liability) and having the injurer pay a fine equal to compensatory damages (as under

strict liability), regardless of their level of precaution. However, other functions of tort law (e.g., compensatory, etc.) would be compromised by such a decoupling mechanism.

4. A Guided Tour throughout the Literature

In this section we shall provide a pathfinder through the existing law and economics literature on torts. The listings are by necessity limited to some of the more representative contributions.

Textbooks on tort law and economics. Shavell (1987) and Landes and Posner (1987) were the first systematic treatments of the topic. Although outdated, they remain the fundamental reference for tort law and economics. Miceli (1997) [Chapters 2 and 3] provides a more recent, simple and rigorous formal treatment of the theory. Cooter and Ulen (2004) [Chapters 8 and 9] add a discussion of contemporary issues.

The origin of the economic approach to tort law. Coase (1960) yielded an intellectual revolution in the way scholars considered the problem of externalities (accidents) in two ways. First, it put forward the reciprocal nature of accidents as both victims and injurers are to be considered as joint inputs to the externality. Hence, simply making the injurer pay may not be the optimal solution. Second, it raised the question of why we need tort law if market exchange can do the job. Calabresi (1961 and 1970) may be considered the intellectual response to the first problem. It analyzed different liability rules against the goals of providing incentives to reduce the total accident costs (precaution costs plus expected harm), the risk-bearing cost and the administrative costs of the system. Calabresi and Melamed (1972) provided an

answer to the second problem, by arguing that tort law is needed in situations in which transaction costs prevent parties from bargaining (but the discussion on this point is open to date). Brown (1973) formalized this framework in the now standard economic model of torts.

Incentives to take precaution: The fundamental results. Under the simple assumptions of the Brown model, two main results have been derived with respect to incentives: first, Landes and Posner (1980) showed that any liability rule that features a negligence defense leads to both the injurer(s) and the victim taking optimal care; second, Shavell (1980a) proved that no such rule can induce both parties to take the optimal level of activity (defined as including all precautionary measures not explicitly included in the negligence inquiry). Gilles (1992) analyzed the actual ability of American courts to include issues concerning the frequency or repetition of certain dangerous actions in the determination of negligence.

Incentives to acquire information about risk. Liability rules also serve another important goal besides those indicated by Calabresi (1970): they induce the residual bearer to acquire information in order to reduce the loss he bears. These incentives are distinct from the incentives to take optimal precaution. Posner (1973) raised the issue, Shavell (1992) analyzed it in a formal model.

Risk allocation and insurance. Concerning the allocation of risk, the liability system is said to be comparatively more expensive than insurance, which is in general desirable even if it partially dilutes the incentives towards optimal precaution, as proven in Shavell (2000).

Administrative costs. To date, the economic analysis offers no satisfactory

theory concerning the administrative cost of different liability rules. However, a particularly common rule, comparative negligence, seems to be more expensive than other likewise efficient (in the standard model) rules. This puzzling waste of administrative costs has called for scholarly attention.

Comparative negligence. The literature has moved in the direction of relaxing some of the standard assumptions. Comparative negligence seems to improve incentives when judges make random errors in comparing the due level of care to the level of care actually taken by the parties (evidentiary uncertainty, Cooter and Ulen, 1986) when the standard of care is uniform for all parties but the individual costs of care differ (Rubinfeld, 1987), and when judges err regarding the level of care cost actually borne by parties (Haddock and Curran, 1985). Bar-Gill and Ben-Shahar (2003) criticize part of this approach. The literature is vast and the academic discourse remains open.

Comparative causation. While the apportionment of losses among negligent actors (comparative negligence) is a reality that is difficult to explain, apportioning damages among non-negligent is a profitable solution that has hardly found its way in actual legal systems, as argued in Parisi and Fon (*forthcoming*).

Errors, uncertainty and accuracy. The incentive effects of liability rules crucially depend on their correct implementation. Errors or uncertainty in the determination of the damage award, the causal link, or the issue of negligence might distort incentives. See Calfee and Craswell (1984), Craswell and Calfee (1986), Diamond (1974). However, when this does not happen, a certain degree of inaccuracy might help save administrative costs. See Kaplow and Shavell (1994 and 1996).

Insolvent and disappearing injurers. If the injurer's assets are not sufficient to cover the victim's compensation or if there is a chance that the injurer will not be identified or sued, incentives to take precaution might be diluted. Summers (1983) identified this problem; Shavell (1986) analyzed it in connection with insurance; Dari Mattiacci and De Geest (*forthcoming*) show that the level of precaution that the injurer takes depends on the precaution technology available.

Vicarious liability and mandatory insurance. In response to the two problems mentioned above, liability may be shifted from the insolvent or disappearing injurer to his principal in order to give the latter incentive to exercise a delegated control function on the former. Sykes (1981) and Kornhauser (1982) provided the first analysis. Mandatory insurance may serve the same purpose. Dari Mattiacci and Parisi (2003) analyze different such systems of delegated control in a unitary framework.

Punitive damages. If injurers can escape liability, their incentives may be diluted. Their incentives may be corrected by increasing the damages they pay when they are actually apprehended. Punitive damages are hence seen as a corrective mechanism for disappearing injurers. See Cooter (1982) and Polinsky and Shavell (1998).

Pure economic loss. Some losses consist of the victim's forgone profits. In this case, the market mechanism might cause a third party (e.g. a competitor of the victim) to increase his profits as a consequence of the accident. It has been said that such losses do not correspond to a socially relevant loss, hence the victim does not deserve compensation. The issue is approached differently in different legal systems and is often discussed. The issue originated from Bishop (1982) and Rizzo (1982). Bussani, Parisi and Palmer (2001) provide a

comparative analysis.

Non-pecuniary loss and compensation for pain and suffering. The economic model of torts is based on the assumption that the victim's loss (as well as the parties' precaution costs) may be easily expressed in monetary terms and that monetary compensation can restore the victim to the pre-accident situation. Both assumptions are often not satisfied, raising the two related problems of whether and how much compensation to award, also in connection with the injurer's incentives. See Arlen (2000) section B, for a survey of both the empirical literature and of economic arguments in favor and against compensation of such loss.

Product liability. Accidents that occur in connection with products are of a different type from ordinary torts. In fact, the victim (the consumer) and the injurer (the producer) are parties to a contractual relationship. The Coase theorem applies and, if its conditions are satisfied, the liability rule is irrelevant to the outcome, as parties will bargain around it. However, producers will in general enjoy an informational advantage compared to consumers and, hence, the liability rule might make a substantial difference. Strict liability is in general preferred as it puts the informational burden on the producer (see also section incentive to acquire information). See Spence (1977).

Joint and several liability. When more than one injurer is responsible for the loss suffered by the victim, a problem arises of how to apportion damages among them. In the standard model, the apportionment rule does not affect the outcome (Landes and Posner, 1980). However, in connection with insolvency and the possibility of settling out of court, the problem becomes relevant and the rules that govern the apportionment of the loss affect the injurers' incentives. See Kornhauser and Revesz (1990).

Causation. The issue of causation is controversial in economics, as both the victim and the injurer may be seen as joint inputs in the production of the accident loss in a Coasean perspective. The analysis has mainly focused on ascertaining the effects of causation on the functioning of the negligence rule (Grady, 1983, and Kahan, 1990), on the allocation of damages when there is uncertainty over the causal contribution of several injurers (Shavell, 1985), and on the optimal restriction of the scope of liability (Shavell, 1980b).

Tort liability and regulation. Tort liability as a way of producing incentives to optimal precaution may be compared to the regulatory system, which serves the same purpose. Regulation may substitute or complement tort liability when the latter is impaired by problems related to an insolvent or disappearing defendant. Burrows (1999), Kolstad, Ulen and Johnson (1990), Schmitz (2000), Shavell (1984a and 1984b), Wittman (1977).

Litigation. Liability as a system of providing parties with incentives to take precaution relies on the enforcement of the duty to pay damages. The way in which the judicial system functions may affect the incentives produced by tort liability as it affects the victims' ability to collect from injurers and hence the injurers' internalization of the victims' loss. A survey of the ongoing research on the topic may be found in Cooter and Rubinfeld (1989) and Kobayashi and Parker (2000).

History and evolution of tort liability. Economic analysis may be also applied to the study of the genesis and evolution of tort liability in response to changes in society and technology, which in turn affected the nature and the probability of accidents. Posner (1980 and 1981) and Parisi (1992 and 2001).

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