

3100

STRICT LIABILITY VERSUS NEGLIGENCE

Hans-Bernd Schäfer and Andreas Schönenberger

Universität Hamburg - Fachbereich Rechtswissenschaft

© Copyright 1999 Hans-Bernd Schäfer and Andreas Schönenberger

Abstract

The purpose of this chapter is to compare negligence rules and strict liability rules and to examine the allocative effects resulting from the application of different liability regimes. It first discusses unilateral accidents, while the more complicated bilateral cases follow afterwards. Each section starts with a discussion of the rule of no liability before moving on to various forms of negligence and ending with various strict liability rules. At the end of each section, there is a discussion on how results change when relaxing specific assumptions. The various aspects are summarised focusing on the question of whether the outcome under a specific liability regime is efficient or not. We also discuss a few more specific topics of interest, for example, the allocative effects of various liability rules when agents enter into a contractual relationship, cases of 'joint liability', the impact of uncertain legal standards, and the interaction between liability law and insurance.

JEL classification: K0

Keywords: Negligence, Strict Liability

1. Introduction

The purpose of this chapter is to compare negligence rules and strict liability rules. They are the major rules of liability used in tort law to deal with situations where one person (the injurer) causes harm to another person (the victim). In England, France and Germany, for instance, the usual forms of liability are the comparative negligence rule and strict liability with the defence of relative negligence, and in the US it is the comparative negligence rule, the negligence rule with the defence of contributory negligence, and strict liability with the same defence. The details of these rules will be discussed below. Zweigert and Kötz (1996, secs. 40-43) provide a rigorous description of tort law in England, France and Germany. For the US, a good reference is Keeton, Dobbs, et al. (1984, chs 5, 11, 13).

Historically, it is interesting to observe the changes in the relative importance of different liability rules. Before the nineteenth century, for instance, strict liability was predominant in most common law jurisdictions. In

the early and mid-nineteenth century, however, this changed with negligence and fault becoming the prevailing standard of tort liability, as Schwartz (1981) notes. Since the twentieth century, rules of strict liability have enjoyed a renaissance and have been applied more and more to determine who should bear the costs of an accident and to what extent. A good example of this phenomenon is the shift back to strict liability in products liability cases.

Moreover, tort law is much under debate because of the increasing number of cases where compensation for losses might substantially exceed the actual damage. In the US, for instance, damages awarded may exceed the losses sustained in the presence of 'punitive' damages where parties acted with ill will, that is the harm was intentional, whereas in Germany higher awards are provided to give victims 'satisfaction' and to compensate them for nonpecuniary losses. The scope of harm and the size of judgements have become exceedingly expansive, and manufacturers pay extremely high premiums for products liability insurance to protect themselves against these awards. Many of them have withdrawn from the market entirely. This and various other results on the issue are presented by Priest (1991). Many economists and lawyers conclude that the tort system is in need of reform. Again, we need to understand the basic principles of how different liability regimes work to be able to evaluate the alternatives to reform.

Tort law is one of those areas in the law where (micro)economic models can be successfully applied. Tort is about damages and has important economic implications. The economic approach to tort is therefore mainly concerned with examining the allocative effects, that is welfare effects, resulting from the application of different liability regimes. Landes and Posner (1987, p. 6) suggest that liability rules can be interpreted as a legal attempt to establish incentives for parties to achieve social efficiency objectives. One of the path-breaking studies in the development of the economic approach to tort is Calabresi (1970). The aim of tort law, he proposes, apart from the requirement for justice, is to minimise the social costs of a tort defined as the sum of total accident costs, administration costs, costs of properly allocating accident losses by means of insurance, and accident prevention costs of both the injurer and the victim. Again, the comparison between strict liability and negligence helps to determine which tort system is most suitable to improve welfare by, first, encouraging individuals to engage in safer activities by providing an incentive to do so, and second, encouraging individuals to make a given activity safer.

Throughout, we will be considering models of accidents involving two individuals, the injurer and the victim. Both of them are engaged in some activity, and both of them exercise a certain level of care. The decisions the parties have to make are twofold. They have to decide how much care they want to exercise and how much they want to engage in an activity. It is plausible to assume that accident prevention costs increase with the amount of care taken,

and that expected damages decrease with the level of care, but increase with the amount of activity the parties engage in.

In the remainder of this chapter, we will discuss first, in Section 2, unilateral accidents because they describe those situations where one party, that is the victim, has no influence on the probability and the size of damages. Also, it is easier to understand the more complicated discussion of the bilateral case which follows in Section 3. Each section starts with a discussion of the rule of no liability before moving on to various forms of negligence and ending with various strict liability rules. At the end of each section, there is also a discussion on how results change when relaxing certain assumptions. In Section 4, the various aspects of the comparison between liability rules are summarised focusing on the question of whether the outcome under a specific liability regime is efficient or not. Section 5 concentrates on a few more specific topics of interest. First, we discuss the allocative effects of various liability rules when agents enter into a contractual relationship, which also implies a brief discussion on the distinction between tort law and contract law. Second, we analyse cases of 'joint liability', that is situations where more than one tortfeasor contributes to the occurrence of an accident.

2. Unilateral Accidents

The discussion here is mainly based on Schäfer and Ott (1995) and Shavell (1987).

In the case of unilateral accidents which we focus on in this section, it is assumed that the victim cannot influence the amount of expected damages. Also, to keep things simple, we further assume that the level of activity is constant. (This assumption will be relaxed below.) Therefore, if we denote accident prevention costs by c , the level of care by x , and if d measures the total amount of expected damages, then, abstracting from administration costs and assuming risk neutrality, the social objective function takes the form of:

$$\min c(x) + d(x) \quad (1)$$

Setting the first derivative with respect to x equal to zero we obtain the following solution:

$$c'(x) = -d'(x) \quad (2)$$

which simply states that the marginal cost to the injurer of taking an additional unit of care (left-hand side of equation (2)) should equal the marginal benefit to the victim represented by a reduction in the total amount of expected damages (therefore the negative sign on the right-hand side of equation (2)). It should now be clear why microeconomic models can be applied so easily in

law and economics as equation (1) is an extremely simple example of a standard optimisation problem recurring very frequently in any area of economic analysis.

We now consider the behaviour of the injurer under various liability rules providing important insights as to the efficiency of these rules.

3. Rule of No Liability

If the injurer cannot be held liable for the harm she causes, and if she therefore does not have to bear the costs of an accident, she will choose the lowest possible level of precaution in order to minimise her costs. Since we assume that the total amount of damages is a decreasing function of the precaution level the accident costs will be extremely high. As a result, the outcome of this liability rule is clearly not socially optimal.

4. Negligence

Under the negligence rule, the injurer will be held liable only if she exercised precaution below a level usually determined by the law and/or by the court. This level is called reasonable care or due care. Posner (1972) proposed an economic efficiency criterion which could be used to identify the efficient precaution level to establish it as the legal standard. It should be borne in mind that one of the most important objectives of tort law is to give the injurer an incentive to apply the efficient level of care fulfilling the optimality condition (2). Interestingly enough, the first person to describe this legal standard of care was not an economist, but a judge. Learned Hand (1947) suggested that an injurer is liable if her burden B of adequate precautions is less than the probability P that the accident occurs, multiplied by the size L of the injury. Note that Judge Hand's statement of the rule is unclear as to whether it refers to total or marginal levels of benefits and costs of caretaking, but we assume that he had marginal values in mind. Stated in algebraic terms, an injurer is negligent if the condition

$$B < PL \quad (3)$$

holds; and equality denotes optimality.

If the injurer exercised due care she will not be held liable for the costs of the accident. Let us now suppose that the court or the law would set the level of due care equal to the socially optimal level of care. Would the negligence rule result in the socially optimal level of care being taken? The answer is yes, as can be seen very easily by noting that a self-interested person will choose her level of precaution to minimise her private costs. Would she therefore want to choose a precaution level above the level of due care? No, because any care

taken in excess of the standard set by the court would be more costly without reducing the costs of compensation since due care is enough to be non-labile. Would she, on the other hand, want to choose a precaution level below due care? No, because now she is running the risk of bearing the total amount of the expected damages.

5. Relaxing Assumptions

Note that in the previous section we made a few simplifying assumptions. First, we assumed that the court would set the level of due care equal to the socially optimal level. Second, it was assumed that the legal sanction imposed equals the harm actually caused and, third, the level of activity was supposed to be constant. We will now examine how the results change if we relax these assumptions one by one, that is, we will discuss the effects of relaxing only one assumption at a time. Some of these issues are clearly presented by Cooter and Ulen (1997, chs 8 and 9).

Let us first examine the question of how the results of the previous section change when the court sets a level of due care that is not equal to the socially optimal level. Suppose, for instance, that the court does not require any precaution at all. Under these circumstances, it is obviously cheapest for the injurer not to exercise any care, because she will escape liability even without taking any care at all. Taking greater care would have no advantage, but would involve additional costs. Put more generally, the potential injurer will satisfy the legal standard even if it is pegged below the socially efficient level. The same applies to a legal standard above the socially efficient level, with one important exception, though. If the amount of precaution costs at the legal standard exceeds the total amount of precaution and expected damage costs at the socially optimal care level, then the potential injurer will ignore the legal standard and set her caretaking level at the lower socially optimal care level. This result changes if the injurer is not held liable for the entire accident losses, but only for the amount of damage in addition to the damage that would have been caused if the injurer had exercised the level of care set by the courts (partial liability). See, for instance, § 249 BGB under German law. For the US, see Kahan (1989). The first authors to describe this case are Schäfer and Ott (1986). Here, it is optimal for the injurer to exercise socially optimal care even if the legal standard is pegged above the socially efficient level. This is because by exercising the efficient level of care instead of the higher legal standard, precaution costs decrease by more than the imposed legal sanction increases. In general, however, we can say that in order to obtain an efficient outcome the court needs to set the due level of care equal to the socially optimal level of care.

Note also that it is very difficult for courts, legislatures and authorities to identify the efficient level of care in order to establish it as the legal standard. Due or reasonable care is usually identified by comparing what a reasonable person would have done under the circumstances with the actual precautionary activity of the injurer. An illustration of the reasonable person standard is provided by Posner (1992, p. 167). However, this standard is very vague and 'flexible'. Therefore, an alternative to decide whether an injurer was negligent or not without a specific standard of care would be, first, to ask what an injurer could have done (alternatively or in addition) to prevent the damage or to reduce the probability that it occurs. Then, the costs of the alternative or of the additional precaution activity are determined. If either the difference between the actual precaution costs and the costs of the alternative precaution activity or the costs of the additional precaution activity are less than the reduction in the total amount of expected damages as a result of the alternative or additional activity, the injurer will be liable.

Another assumption we made in the previous section is that the legal sanction imposed equals the harm actually caused. What will happen if we relax this assumption? Endres (1991, pp. 51-87) provides a rigorous and rather formal analysis of this question which is beyond the scope of this article. From a rather intuitive and less formal perspective we can say that, under the negligence rule, an equality between harm and sanction is not essential as long as the sanction is sufficiently large so that the private costs of the injurer are minimised by conforming to the legal standard. However, once the legal sanction falls below a certain level, the injurer will minimise her costs by taking less precaution than the legal standard.

Finally, we relax the assumption of a constant level of activity to study the effects of an increase in the injurer's level of activity that will result in a proportional increase in the total amount of expected accident damages, given a specific level of care. This is essential when it comes to assessing the social utility of an activity. Finsinger and Pauly (1990) point out that the total net utility of a risky activity ought to be positive.

The first aspect can be dealt with quite easily by slightly modifying the optimisation problem as represented in equation (1). The social objective function now has to take into account that various levels of activity influence the utility u of the actor, that is the injurer. It is plausible to assume that utility is an increasing function of activity. Those who are familiar with optimisation problems should also note that for a unique solution to exist it is necessary to assume further that the utility function is well-behaved. From the total amount of utility we need, of course, to subtract the total costs of care which are assumed to be equal to the level of activity multiplied by the level of care, x . Eventually, we need to subtract the total amount of expected damages d . Thus we obtain as the social objective function

$$\max u(a) - ax - ad(x) \quad (4)$$

To solve this maximisation problem we first have to determine the optimal level of care x^* by minimising the total costs of taking care represented by the second and third terms in equation (4). Substituting into (4) and differentiating with respect to the level of activity we obtain

$$u'(a) = x^* + d(x^*) \quad (5)$$

which is the equivalent of equation (2) in the case of a constant level of activity. The interpretation is straightforward. The injurer should raise her activity as long as the marginal increase in utility she derives from raising activity exceeds the increment to total costs caused by doing so.

We can now move on to discussing whether the negligence rule can guarantee that an activity is socially useful. A simple example might illustrate this point. Assume that the utility of an activity is 100. The costs of the optimal level of precaution are 80, and the amount of total damages is 30. Since the victim has to bear the costs of the accident when the injurer exercises due care and, therefore, is not liable, the injurer has a benefit of 20 by engaging in her activity. However, the net utility of the activity is clearly negative meaning that the injurer should not engage in the activity in the first place. Since injurers will escape liability by taking due care they have no reason to consider the effect that their activities have on accident damages. As a result, the rule of negligence can create incentives to exercise an optimal level of precaution, but it is not able to make sure that the social utility of an activity is positive.

Yet, there are exceptions where it can be easy for courts to observe the (lack of) social utility of an activity. In these cases, courts can set legal standards for both the optimal level of care and the optimal level of activity. However, because of information costs it is generally difficult for courts to set both standards of caretaking and/or activity levels. Shavell (1987), and Landes and Posner (1987) focus on this issue.

6. Strict Liability

We will now turn the discussion to the major alternative of the rule of negligence: the rule of strict liability. Again, we start off by assuming that the legal sanction equals the actual damage and that the activity level is constant. Under strict liability, the courts do not have to set any level of due care because the injurer has to bear the costs of the accident regardless of the extent of her precaution. In this case, the expected amount of costs to the injurer of taking care x is

$$c(x) + d(x) \tag{6}$$

that is, the injurer faces the *total* amount of costs caused by the accident. Since it is the self-interested injurer's objective to minimise her *private* costs and since, under strict liability, the total *social* costs just *equal* her private costs, the injurer will have an interest to minimise total accident costs. In other words, the social objective function (1) and the private objective function resulting from minimising equation (6) are obviously identical. Therefore, under the rule of strict liability in the case of unilateral accidents, the injurer will choose the socially optimal level of care.

As a result, both the rule of strict liability and the rule of negligence achieve the socially optimal level of care. There are, however, also quite a few differences. For instance, the division of costs under each rule is different. Under strict liability, the injurer has to bear the total amount of expected damages, whereas under the negligence rule, the victim has to bear the accident costs if the injurer exercised due care. Further differences appear when relaxing the assumptions we made.

7. Relaxing Assumptions

As mentioned in the previous section, the courts do not have to set a level of due care. Under strict liability, all the courts need to do is to determine the size of the damage, whereas, under the negligence rule, the courts also need to determine the level of due care as a legal standard for the socially optimal level, and they have to determine the level of care actually taken in order to see whether the injurer was negligent or not. Proving negligence, however, can be difficult and costly.

Shavell (1987, p. 264) argues that under strict liability the number of claims is likely to be higher than under negligence because the victim has an incentive to make a claim whenever her damages exceed the costs of making the claim. Under negligence, on the other hand, the injurer can escape liability by demonstrating that she has not violated the legal standard of care. Since under the rule of strict liability it is not necessary to establish that the injurer was negligent, the probability of trial should be less, because it is easier to predict who is likely to win the case. Consequently, voluntary payments made in the shadow of the law should be much more probable. There is not only more potential for disagreement leading to trial under the negligence rule, it is also plausible to assume that the average administrative cost per claim is higher under negligence because the issue of negligence must be adjudicated, as was mentioned above. As a result, one can expect the average costs of resolving claims to be higher under negligence because of both a higher probability of

trial and higher costs per trial.

Another advantage of the rule of strict liability is that it is the injurer who has to bear the cost of searching for the optimal level of care, as Finsinger and von Randow (1991, p. 89) suggest. In many cases, he is better at deciding what precautions to exercise and to what extent he should do so because he is likely to be familiar with the activity that can cause an accident.

Another assumption we made is that the legal sanction equals the damage actually caused. In the previous section we saw that equality is not essential as long as the sanction is sufficiently large for the injurer to conform to the legal standard. Under strict liability, this result changes quite drastically. Whenever damages are not perfectly compensatory, that is, compensation is below the level that would make the victim indifferent between no accident and an accident with compensation, the potential injurer does not have an efficient incentive to exercise the socially optimal level of care.

The easiest way to see this is by recalling optimality condition (2) which states that the marginal cost to the injurer of taking an additional unit of care should equal the marginal benefit to the victim represented by a reduction in the total amount of *expected* damages. Let us assume that the costs of taking care is a linear and increasing function of the level of care, that is any increase in the level of care leads to a proportional increase in accident prevention costs. We also assume that the functional relationship between the level of care and the reduction in accident damages is such that the exercise of precaution reduces expected damages, but at a decreasing rate. Expressed in more mathematical terms, the first derivative of this function is positive and the second derivative is negative. We now assume that the potential injurer knows and expects that the legal sanction generally does not equal the total amount of the accident damages, but that it equals a fraction of them only, because the tortfeasor remains anonymous, damages are higher than her personal wealth, victims are fully insured by first party or social insurance, or the damage is dispersed, which leaves the victim little incentive to litigate. This leads to a proportional downward shift of the damage reduction function. The crucial impact of the proportional shift is that, holding the level of care constant, the marginal reduction in damage and thus the marginal benefit of taking an additional unit of care is less than in the case of perfect compensation. Since, on the other hand, the cost function of taking care is assumed to be linear, the marginal cost of taking care remains constant. As a result, the optimality condition is not met any longer under the circumstances given. In order for the cost minimising condition to be satisfied again, the potential injurer will reduce her level of care which leads to an increase in the marginal reduction in damage by taking care. As a result, the potential injurer does not exercise the socially optimal level of care when damages are not perfectly compensatory.

Suppose that the tort-liability system works imperfectly in the sense that only a fraction of all victims actually brings suit and recovers. Let us call the ratio of compensated victims to the total number of victims the enforcement error. The efficiency loss due to enforcement errors can be offset by augmenting compensatory damages with punitive damages. In order to restore efficient incentives for the potential injurer to exercise optimal care we need a punitive multiple (multiplicative factor by which compensatory damages are adjusted to offset the enforcement error) that equals the inverse of the enforcement error. If, for instance, only half of the total number of victims actually bring suit then the courts should double compensatory damages when calculating total damages. Thus, compensatory damages and punitive damages add up to total damages. References for issues related to punitive damages and their allocative effects are Cooter (1982) and Kolstad, Ulen and Johnson (1990).

Finally, we relax the assumption of a constant level of activity. Recall that under negligence the net utility of an activity could be negative because the injurer had no reason to consider the effect that her activity had on others as she can escape liability by taking due care. Under strict liability, however, the injurer has to bear the total social costs of an accident, that is the sum of the total precaution costs *and* the total accident damages, regardless of the level of precaution she takes. She cannot escape liability, and the effects of activity on risk and accident costs are fully internalised. Therefore, the injurer will engage in an activity if and only if the net utility of that activity is positive.

Put more generally, given the possibility of escaping liability, the injurer will not be motivated to consider the effect on the total amount of harm of the level at which she engages in her activity. She will consider her private benefits only. Any increase in activity, however, will raise the total amount of expected accident damages given the level of care. Thus, the injurer will choose too high a level of activity (see for example Polinsky, 1980). Under strict liability, the injurer internalises the total amount of social costs and reduces the level of activity to the socially optimal level. This conclusion was first clearly stated by Shavell (1980).

8. Bilateral Accidents

We now extend the analysis made above to cases where both parties in an accident may contribute to the accident costs. Again, this section is based mainly on Schäfer and Ott (1995), Shavell (1987), but also on Adams (1985), and Cooter and Ulen (1997). One of the first economists to study these issues was Brown (1973) who introduced the use of the assumption that the probability that an accident will not occur is a function of the caretaking of both the tortfeasor and the victim. In fact, it is rare that an accident is due to one

party (that is the injurer) only. It is much more common that the victim can also exercise some precaution to prevent an accident. What makes bilateral accidents quite a complicated issue to look at is the interdependence of the parties' behaviour. We will see that in many cases the choice of one party in terms of levels of activity and care essentially depends on the other party's choice.

Since we now also have to take into account the victim's ability to reduce the probability or size of an accident, we need to modify the social objective function given above. If we denote the level of care taken by the injurer by x , as before, and if y measures the level of care taken by the victim, the social objective function now becomes

$$\min c(x) + c(y) + d(x,y) \quad (7)$$

where $d(x,y)$ denotes the total amount of expected damages which, of course, depends on the level of care exercised by both parties. Let x^* and y^* denote the socially optimal values of x and y .

There are now two conditions determining the optimal levels of care. First,

$$c'(x) = -dx(x,y^*) \quad (8)$$

with dx being the partial derivative of d with respect to x and with y assumed to be optimal. What it says is that the marginal cost to the injurer of taking an additional unit of care should equal the marginal benefit of the reduction in the expected cost of the accident, provided that the victim chooses the socially optimal level of care. Second,

$$c'(y) = -dy(x^*,y) \quad (9)$$

which says that the marginal cost to the victim of increasing her level of care should equal the marginal benefit of the expected reduction in accident costs, provided that the injurer chooses the socially optimal level of care.

The fact that the socially optimal solution requires that both parties exercise optimal care will be crucial in the analysis that follows.

9. The 'Cheapest Cost Avoider'

Before discussing and comparing the various liability rules in the case of bilateral accidents we want to examine cases which exhibit properties of both unilateral and bilateral accidents. This version can emerge when either the injurer or the victim (or a third person) are able to prevent the accident. Note the distinction: unlike in the case of unilateral accidents, it is now not only the injurer, but also the victim who can prevent the accident. And unlike in the case of bilateral accidents where typically *both* parties need to exercise care to achieve the socially optimal and efficient outcome, it is now *either* the injurer

or the victim who has to take care to achieve the socially optimal result.

As Calabresi (1970) argues, in these cases, the person should be held liable who could have prevented the accident with the least cost of taking care (cheapest cost avoider). The idea is quite simple: We know that as long as property rights are well-defined and there are no transaction costs, trade between agents would result in an efficient allocation of resources when there is an externality, a conclusion commonly known as the Coase Theorem (see Coase, 1960). Furthermore, note that what is known as causation in tort law can be reinterpreted as an externality in economics. An externality can be defined as a cost that the action of a person imposes on others without their consent. The prevention of an accident would therefore be undertaken by the party who could do so with the least cost (cheapest cost avoider). However, this solution will not be achieved because of prohibitive ex ante costs of bargaining about who should be held liable for possible accident damages. In this case, the courts should place the burden of covering the costs of the accident on the individual who can avoid the accident at the lowest cost no matter whether it is the injurer, the victim, or a third party.

10. Rule of No Liability

As before, if the injurer cannot be held liable for the harm she causes, she will choose the lowest possible level of care, that is zero, to minimise her cost. This may also lead the victim to exercise excessive care. As we have seen in the previous section, this is clearly not optimal because accident costs will be excessively high.

11. Negligence

Recall that the rule of negligence imposes the obligation to satisfy a legal standard of care usually defined as due care. The injurer is therefore liable unless he can prove that he has exercised due care. We now continue our analysis by introducing, discussing, and comparing several forms of the negligence rule (see for example Wittmann, 1986; Haddock and Curran, 1985). Let us begin with the simplest form of negligence.

Simple Negligence

The properties of this rule are basically the same as in the unilateral case, that is, the injurer is liable if and only if her level of precaution is below the legal standard regardless of the precaution level exercised by the victim. Assume now that the level of due care chosen by the courts equals the socially optimal level.

Injurers will therefore have an incentive to exercise due care in order to escape liability. Hence, the victim faces the costs

$$c(y) + d(x^*, y) \quad (10)$$

and will choose the level of care that minimises this expression. Setting the first derivative with respect to y equal to zero we obtain equation (9), one of the two optimality conditions in the bilateral case.

If the injurer expects that the self-interested victim will exercise due care, the same arguments as in the unilateral case apply. The injurer faces the costs

$$c(x) + d(x, y^*) \quad (11)$$

and will choose the level of care that minimises this expression. Again, setting the first derivative with respect to x equal to zero we obtain equation (8), the other optimality condition in the bilateral case.

Therefore, we can conclude that the simple negligence rule leads to socially optimal levels of care. The outcome is a Nash equilibrium which can be expected to emerge straightaway because a rationally self-interested person will assume that another equally self-interested person has decided to exercise efficient precaution and, that being so, it is reasonable for that person also to exercise efficient precaution. Generally, a pair of strategies is said to be a Nash equilibrium if player A's choice is optimal given B's choice, and player B's choice is optimal given A's choice. It is standard in the literature to assume the existence of a Nash equilibrium. However, there might be problems of existence, even in the case of well-behaved functions (see, for example, Endres and Querner, 1995). It is also standard to discuss bilateral accidents in the context of a Nash framework (for a reference that points to alternative approaches (see Endres, 1992). Finally, note that under the rule of simple negligence there is no need to establish a legal standard of care for the victim. This conclusion changes under the following rules.

Negligence with the Defence of Contributory Negligence

Under this rule, the injurer will be held liable if she does not take due care, *and* if, in contrast to this, the victim does take due care. The injurer will not be held liable if she *either* takes due care *or* if the victim does not take care. In other words, in comparison to simple negligence, the injurer now has, apart from the exercising of due care, an additional possibility to escape liability by showing that the victim failed to take due care.

To see whether this rule leads to a socially optimal outcome, we can use the same line of argument as before. If the injurer assumes that the victim takes due care to avoid liability, she will also have an incentive to do so for the same reason. This, in turn, leads the victim to take due care because she now has to bear the total amount of damages. She can minimise these costs by taking due

care. Since the injurer is aware of this, it is reasonable for her to take due care herself and so on. Again, we have a stable and unique equilibrium, and a socially optimal result will be achieved.

Comparative Negligence Rule

The difference between this rule and the two previous ones is that, when both parties are negligent, the accident costs are divided between them in proportion to the extent of their negligence. One way of doing this is to calculate the ratio of the differences between the due level of care and the actual level of care.

If the courts choose optimal levels of due care, then both the injurer and the victim will exercise due care. The rationale is precisely the same as before. Again, we can conclude that the outcome under this rule is socially optimal.

When comparing the various versions of the negligence rule we come to the conclusion that none of these versions is more or less efficient than the others (efficiency equivalence theorem, see Orr, 1991; Rubinfeld, 1987). They all lead to socially optimal outcomes, provided that the courts set the legal standard of precaution at the efficient level, because self-interested agents have an incentive to choose the legal standard of care. The reason for this is, in essence, that whenever one party exercises due care, then it is entirely upon the other party to decide whether it alone will be held liable by failing to take due care. However, as White (1989) argues, there is empirical evidence that, in contrast to the equivalence theorem, contributory negligence provides better incentives to avoid accidents.

An analysis of how these results change when relaxing and modifying some of the underlying assumptions will be given later. First we will examine various forms of strict liability.

12. Strict Liability

As in the previous section, there are several forms of the strict liability rule to consider. We begin with the simplest form of strict liability.

Simple Strict Liability

In this case, the injurer has to bear the total amount of accident costs regardless of the extent of her precaution. Conversely, the victim will be compensated for all costs imposed on her which implies that the marginal benefit to the victim of taking an additional unit of care is zero for any level of care. Thus, it is optimal for the victim to choose a zero level of care because at zero level the marginal cost of taking care equals zero, and her private optimality condition is satisfied. Of course, optimality condition (9) is not met and the outcome is not socially optimal because the marginal benefit of increasing the level of care

exceeds the marginal cost to the victim.

Strict Division of Losses

Under this liability rule, the injurer has to pay a fraction f of the accident costs. Hence, the injurer faces the costs

$$c(x) + f \cdot d(x,y) \quad (12)$$

and the victim faces the costs

$$c(y) + (1 - f) \cdot d(x,y) \quad (13)$$

It is crucial to note that the size of the fraction is assumed to be independent of their levels of care. Thus, the first order conditions are

$$c'(x) = -f \cdot dx(x,y) \quad (14)$$

and

$$c'(y) = -(1 - f) \cdot dy(x,y) \quad (15)$$

Comparing these optimality conditions with conditions (8) and (9) it is clear that, at any level of care, the marginal benefit of taking care is less under strict division. Since parties save only a fraction of the true reduction in accident losses by taking care, they have too little incentive to exercise a socially optimal level of care.

Strict Liability with the Defence of Contributory Negligence

Under this rule, the injurer is liable for the accident losses unless the victim's level of care was less than her due level of care. It is straightforward to show that under this rule the outcome is socially optimal, provided that the courts choose the level of care for victims equal to the socially optimal level of care. The rationale is the same as under the various versions of the negligence rule. Since injurers will be liable for accident damages if victims take due care and therefore will not bear the accident costs, injurers will exercise due care to minimise accident costs. On the other hand, victims will exercise due care because they do not want to be found contributorily negligent. Again, we obtain a socially optimal Nash equilibrium as a result.

Strict Liability with the Defence of Relative Negligence

This rule is basically the same as the previous one with the following difference: if the victim is found negligent because she failed to take due care, she will have to bear only a fraction of her losses. If the fraction depends on the victim's actual level of care relative to due care, if it is sufficiently large, and if the courts choose the legal level of care equal to the socially optimal level of care, then the outcome is socially efficient. The rationale is the same as before.

13. Relaxing Assumptions

Recall the first simplifying assumption that the court sets the level of due care equal to the socially optimal level. In the section on unilateral accidents, we conclude that under strict liability the courts need only determine the size of the damage, whereas under negligence the courts must in addition calculate the socially optimal level of due care, and they have to determine the level of care actually taken in order to see whether the injurer was negligent or not.

In bilateral accidents, however, this result holds true only for the rule of simple strict liability which, as we saw in the previous section, does not achieve socially efficient results. Those forms of strict liability that lead to socially optimal outcomes have the same requirements with respect to their ease of application as the various rules of negligence. The only difference affecting the ease of application of the two rules is that under strict liability the courts do not need to determine the actual level of care of the injurer.

The second assumption concerns the equality between the legal sanction and the damage actually caused. In the case of unilateral accidents we see that, whenever damages are not perfectly compensatory, the potential injurer does not have an efficient incentive to exercise the socially optimal level of care. In the case of bilateral accidents, this result holds true only for, first, the potential injurer, and second, under the rule of simple strict liability.

For instance, it is important to note that, under simple strict liability, undercompensation would tend to create an incentive for the victim to exercise precaution by creating some residual liability. This is also how insurance companies deal with the problem of moral hazard. Since, however, the incentive problem of the potential injurer remains unsolved, undercompensation cannot lead to socially optimal results.

Also, we should note that, under the rules of strict liability with the defence of contributory or relative negligence, equality between the legal sanction and the harm does not matter as long as the sanction is sufficiently large so that the private costs of the parties are minimised by conforming to the legal standard. These are, of course, the same results as under the rules of negligence.

Finally, the third assumption eventually refers to the constant level of activity. Recall that in the case of unilateral accidents the rule of strict liability and the rule of negligence produced different results. Under negligence, the injurer had no reason to consider the effect that her activity has on others and would therefore choose too high a level of activity. Under strict liability, on the other hand, the injurer internalises the total amount of social costs and therefore reduces the activity level to the socially optimal level. The crucial condition in order for any liability rule to lead to a socially efficient level of activity is that the parties engaging in some activity must bear the total amount of accident losses. Otherwise only a fraction of the activity's costs are

internalised, and the level of activity will be too high. As a matter of fact, though, it is impossible for *both* parties to bear the accident losses.

Therefore, results change quite drastically in the case of bilateral accidents as compared to unilateral accidents. As Shavell (1987, p. 29) puts it, the reason, in essence, is that for injurers to choose the correct level of activity they must bear accident losses, but for victims to choose the correct level of activity they, too, must bear accident losses. Yet, of course, injurers and victims cannot both bear accident losses under a liability regime, but the problem can be nicely solved by using Pigou taxes, which has led Baumol and Oates (1988) to prefer a system of Pigou taxes to liability as a matter of principle.

As a result, in bilateral accidents no liability rule leads to socially optimal levels of activity. This implies that the net utility of an activity can be negative, as the following example illustrates. In bilateral accidents, an activity is socially useful if the utility to the injurer less the precaution costs to both the injurer and the victim less the costs of the accident is positive. Assume now that the utility is 100, optimal precaution cost to the injurer is 40, optimal precaution cost to the victim is 30, and the expected accident cost is 50. Obviously, the activity is not socially useful because its net utility is negative. Note, however, that under both the rule of negligence and the rule of strict liability the injurer will engage in the activity. Under negligence, his private utility is $100 - 40 = 60$, and under strict liability, his private utility is $100 - 40 - 50 = 10$. This is because, as noted above, the injurer does not take into consideration the precaution cost of the victim.

A theoretical possibility to achieve a socially optimal outcome would be to establish the legal obligation for the injurer to bear her own precaution cost, the accident cost, and also the precaution cost of the victim (see for example, Rose-Ackerman, 1989).

14. Comparing Strict Liability and Negligence

Let us now summarise some of the main results of the previous sections. In the case of unilateral accidents, both the rule of strict liability and the rule of negligence achieve a socially optimal outcome, provided that courts set the level of due care equal to the socially optimal level of care, that the legal sanction equals the harm, and that the level of activity is constant. Relaxing these assumptions provides further insights favouring the rule of strict liability. Under strict liability, all the courts need to do is to determine the size of the damage, whereas, under the negligence rule, the courts also need to determine the level of due care as a legal standard for the socially optimal level, and they have to determine the level of care actually taken in order to see whether the injurer was negligent or not. These information requirements are difficult and costly to acquire. Moreover, the average costs of resolving claims tend to be

higher under negligence.

A major drawback of the rule of strict liability in unilateral accidents, though, emerges when we relax the second assumption. Whenever damages are not perfectly compensatory, that is, compensation is below the level that would make the victim indifferent between the case of no accident and that of an accident with compensation, the potential injurer does not have an efficient incentive to exercise the socially optimal level of care.

Another important advantage of the rule of strict liability emerges when allowing for variable levels of activity. Under negligence, the injurer has no reason to consider the effect that her activity has on others because she can escape liability by taking due care. Thus, the injurer will choose too high a level of activity. Under strict liability, the injurer internalises the total amount of social costs and reduces the level of activity to the socially optimal level.

So far the results suggest that the rule of strict liability achieves socially optimal results provided that damages are set at the perfectly compensatory level. What happens, though, when an accident is bilateral requiring both parties to take precaution against accidents? Now the efficiency of the rule of strict liability becomes problematic because, even though strict liability may at first create the right incentives for potential injurers, it will create an incentive problem for potential victims and will in return lead injurers to exercise suboptimal care. This can be seen by noting that strict liability is the mirror image of no liability. One rule fails to create incentives for precaution by the victim, the other rule fails to create incentives for precaution by the injurer.

Therefore, our analysis suggests that in the case of bilateral accidents we should apply either one of the negligence rules or the rules of strict liability with the defence of contributory or relative negligence. All of them lead to socially optimal outcomes, provided that the courts set the legal standard of precaution at the efficient level, because self-interested agents have an incentive to choose the legal standard of care.

This conclusion is reinforced when allowing for inequality between the legal sanction and the damage actually caused. Under any of the negligence rules and under the rules of strict liability with the defence of contributory or relative negligence, equality between legal sanction and harm does not matter as long as the sanction is sufficiently large so that the private costs of the parties are minimised by conforming to the legal standard.

When allowing for various levels of activity, finally, we concluded that no liability rule at all leads to socially optimal levels of activity. This conclusion again confirms that in the case of bilateral accidents the negligence rules or the rules of strict liability with the defence of contributory or relative negligence are equivalent.

15. Liability and Contracts

In the previous sections of this article, we concentrated on situations where parties do not enter into contractual relationships because of high transaction costs such as the costs of bargaining. The notion of transaction costs, however, is crucial for the analysis of liability and deterrence. Recall the basic insight of the Coase Theorem which says that when parties can bargain with each other in order to settle their disagreements, their behaviour will be efficient regardless of the underlying rule of law. This implies that, whenever transaction costs are low, people enter into contractual relationships and the rules of contract law apply. Conversely, whenever transaction costs are high, people do not enter into contractual relationships and the rules of tort apply. There are a few areas, however, where tort law and contract law seem to merge, such as 'products liability' and 'implicit contracts'.

We now examine the allocative effects of various forms of liability rules in those cases where parties have entered into contractual relationships. We assume profit-maximising behaviour of firms and perfect competition. That is, the price of a product equals total unit costs including liability costs. It is also assumed that rational consumers buy a product only if the utility of the product exceeds its *perceived* price, that is, the price actually charged plus *expected* accident costs not covered by liability payments.

If the customers' knowledge of risk is perfect, firms will take optimal care under any liability rule, even under the rule of no liability. This is because customers would immediately notice whether firms took less than optimal care or not. Thus, the perceived price of the product including expected losses would be higher than the product price of firms exercising optimal care. The potential loss of customers forces firms to exercise optimal care regardless of the underlying rule of liability. Also, the level of consumption is optimal because the price of the product as compared by customers with their utility includes expected accident losses.

These results change, however, once we assume that customers have imperfect knowledge of the risk associated with a product. If customers cannot determine product risks, they will not reward firms for making products safer. Therefore, firms do not have any incentive to take optimal care unless there is some rule of liability. Moreover, under the rule of no liability and under the negligence rule, the level of consumption will not be optimal. Only under strict liability does the misperception of risks not matter, because customers are fully compensated for their losses anyway, and market prices reflect the true risk of accident losses. In all other cases, market prices, and thus consumption, are either too high or too low.

16. Multiple Tortfeasors

We now turn to the case of multiple tortfeasors. Landes and Posner (1980) were the first authors to study the incentives to take care in the case of multiple tortfeasors, yet restricting their attention to negligence. For a more general discussion see Kornhauser (1989).

We will consider situations where there is more than one injurer affecting the probability of accident losses. Furthermore, we need to distinguish between cases where injurers act independently with the victim's harm being indivisible, and cases where injurers act together (in concert) to cause the victim's harm.

Under strict liability, injurers who act independently will not always act optimally in equilibrium. Assuming that each injurer is liable for a fixed fraction of losses only, any increase in the injurer's exercise of care diminishes her liability by only a fraction of the reduction in expected losses which induces the injurer to take a level of care clearly below the optimal level of care. When injurers act together, however, their minimisation problem obviously turns into a situation exactly equivalent to the one where there is only a single injurer. Thus, under strict liability and if injurers act in concert, injurers take optimal care. Note that this result is not obtained if injurers pay a fraction identical to their probability of causation.

Under the rule of negligence, we obtain different results. Injurers will now act optimally (they will take due care) in equilibrium both in cases where they act independently and in cases where they act together, provided that the due level of care is optimally determined, of course. Again, the analysis is straightforward and is precisely analogous to the previous analysis of situations of bilateral accidents. If one injurer alone fails to take due care, she will be held liable for the total amount of accident losses. A rationally self-interested injurer will now assume that another equally self-interested injurer has decided to exercise efficient precaution and, that being so, it is reasonable for that injurer also to exercise efficient precaution. Note that this outcome is unique and stable, and that it also holds true if injurers act in concert.

17. Risk Aversion, Liability Law and Insurance

So far we have constrained our analysis to the case of risk-neutral parties. We will now extend the analysis by allowing for risk-averse individuals, and we will discuss the interaction between risk aversion, liability law and insurance.

Risk aversion depends on the concavity of the utility function of wealth, that is the rate at which utility losses grow with losses of wealth. The concavity of the utility function implies that a \$1,000 loss will cause greater harm to a person with assets of \$10,000 than to a person with assets of \$100,000. The

shifting of risks from the more to the less risk-averse will raise social welfare given that social welfare is the sum of the individuals' expected utilities. Social welfare will also increase if risks are shared among risk-averse parties thereby reducing the potential extent of the losses that each party might suffer.

One way of shifting and sharing risks is by insurance. Insurance can be described as a private system of liability law in which contracts determine the allocation of risks. In the theory of insurance, a distinction has to be made between the cases in which the insured persons can influence risks and the cases in which they cannot. In the situations where the probability of damage cannot be affected by the actions taken by the insured persons, an insurance policy that offers complete coverage is socially optimal. If the insured, however, can influence risks, complete reimbursement creates the problem of moral hazard: the individual has no incentive to take care at all.

We now turn to the discussion of the interaction between risk aversion, liability law and insurance. Under the assumption that injurers are subject to liability, but that there is no insurance, the comparison of liability rules shows that the rule of negligence is preferable when victims are less risk-averse than injurers, and the rule of strict liability is preferable when the reverse holds true. The rationale behind these results is that under the negligence rule injurers will not bear risk when taking due care, whereas victims will bear their losses. Thus, social welfare will be lower if victims are more risk-averse than injurers. The outcome is quite different under the rule of strict liability. Injurers will bear risk regardless of the level of care they take. If injurers are more risk-averse than victims social welfare will decrease.

Under the assumption that insurance is available, both the rule of negligence and the rule of strict liability yield socially optimal outcomes because individuals, if risk-averse, can obtain liability insurance. The more efficient rule is the one that costs less. Assuming, for instance, that consumers can insure more cheaply than manufacturers strict product liability should be limited.

18. Liability and Uncertain Legal Standards

In the real world, legal standards are frequently uncertain. Factors leading to uncertainty are, amongst others, courts' errors in determining due levels of care, courts' errors in assessing a party's true level of care, and parties' inability to control their momentary level of care. Craswell and Calfee (1984) focus on this issue. These sources of uncertainty change the deterrent impact of legal rules by creating two opposing effects. The first effect can give even risk-neutral parties an incentive to overcomply, that is injurers take more precaution than is prescribed by the legal standard of care. Overcompliance enables potential injurers to increase the chance that they will not be held

responsible for the social costs of their behaviour, thus giving themselves a margin of error to be sure that they avoid liability. However, uncertainty also reduces incentives to comply by creating a positive chance that someone who violates the legal standard will not be held liable.

In order to determine whether the net incentives are to undercomply or to overcomply we need to know the relative strength of these two effects. It is difficult, however, to identify the exact relationship between a defendant's behaviour and the actual probability of her being held liable. In general, uncertainty will tend to lead parties to take more than due care as long as there is a positive probability of underassessment of their levels of care and uncertainty is relatively small. If there is, on the other hand, a high enough chance of overassessment of care and if the uncertainty generated by the legal system is relatively broad, parties are likely to take less than due care. More specifically, under the two seemingly plausible assumptions that uncertainty is distributed normally around the optimal level of compliance and that the distribution of errors is not too dispersed, the result under any liability standard will be too much precaution. Note, however, that overprecaution is less under comparative negligence than it is under any other form of the negligence rule because under comparative negligence losses are shared between the two parties rather than being concentrated on one party.

This possible effect of an uncertain precautionary standard cannot, of course, arise under a system of strict liability.

The picture changes drastically, however, if an uncertain legal standard is combined with a total damage compensation which is higher than the total loss of society. This possibility arises especially in the case of economic losses. Wrongful behaviour can lead to economic losses for some parties and, at the same time, to economic gains for other parties that are such that the total social losses are only a small fraction of the economic losses. Thus, a system of strict liability results in overcompensation and overdeterrence. Under a negligence rule, overcompensation does not distort the incentives if the standard of due care is precisely defined as the tortfeasor can avoid excessive cost by complying with the legal standard. If, however, the standard is not precise, negligence will almost certainly lead to overcompliance because there is an extra pay-off decreasing the probability of being held liable. In some legal orders, this problem is solved by negligence rules which restrict compensation to cases of obvious negligence or to wilful behaviour such as in § 826 of the German Civil Code. This makes the negligence standard more precise and thus avoids overdeterrence.

Acknowledgments

The authors are indebted to two anonymous referees for their helpful

comments. The usual disclaimer applies.

Bibliography on Strict Liability versus Negligence (3100)

- Adams, Michael (1985), *Ökonomische Analyse des Gefährdungs- und Verschuldenshaftung* (Economic Analysis of Strict and Fault Liability), Heidelberg, R.v Decker's/C.F. Müller, 310 p.
- Alpa, Guido (1976), 'Colpa e Responsabilità Oggettiva nella Prospettiva dell'Analisi Economica del Diritto (Negligence and Strict Liability In An Economic Analysis of Law Perspective)', *Politica del Diritto*, 431-448.
- Bakker, B.B. and Sterks, C.G.M. (1988), 'Optimal Legal Standards in Negligence Based Liability Rules', *136 De Economist*, 383-400.
- Brown, John Prather (1973), 'Toward an Economic Theory of Liability', *2 Journal of Legal Studies*, 323-350.
- Burrows, Paul (1982), 'Idealised Negligence, Strict Liability and Deterrence', *2 International Review of Law and Economics*, 165-172.
- Cabrillo, Francisco (1994), 'Industrialización y Derecho de daños en la España del siglo XIX (Industrialization and Tort Law in XIXth Century Spain)', *12 Revista de Historia Económica*, 591-609.
- Cafaggi, Fabrizio (1995), 'La Nozione di Difetto ed il Ruolo dell'Informazione. Per l'Adozione di un Modello Dinamico-Relazionale di Difetto in una Prospettiva di Riforma (The Notion of Defect and the Role of Information. For the Adoption of a Dynamic-Relational Model of Defect in a Perspective of Reform)', *13 Rivista Critica del Diritto Privato*, 447 ff.
- Cafaggi, Fabrizio (1996), *Profili della Colpa Relazionale* (Outlines of Relational Fault), Padova, CEDAM.
- Calabresi, Guido (1965), 'The Decision for Accidents: An Approach to Non-Fault Allocation for Costs', *78 Harvard Law Review*, 713-745.
- Calabresi, Guido (1970), *The Costs of Accidents: A Legal and Economic Analysis*, New Haven, Yale University Press, 340 p.
- Calabresi, Guido and Hirschoff, Jon T. (1972), 'Toward a Test for Strict Liability in Tort', *81 Yale Law Journal*, 1054-1085. Reprinted in Rabin, Robert L. (ed.) (1983), *Perspectives on Tort Law*, Boston, Little Brown, 192-212.
- Centner, Terence J. (1989), 'Groundwater Quality Regulation: Implications for Agricultural Operations', *15 Hamline Law Review*, 589-605.
- Centner, Terence J. (1990), 'Blameless Contamination: New State Legislation Regulating Liability for Agricultural Chemicals in Groundwater', *45 Journal of Soil and Water Conservation*, 216-220.
- Centner, Terence J. and Wetzstein, Michael E. (1992), 'Agricultural Pesticide Contamination of Groundwater: Developing a "Right-to-Spray Law" for Blameless Contamination', *14 Journal of Agricultural Taxation and Law*, 38-52.
- Chapman, Bruce (1990), 'Punitive Damages as Aggravated Damages: The Case of Contract', *16 Canadian Business Law Journal*, 269-280.
- Chelius, James R. (1976), 'Liability for Industrial Accidents: A Comparison of Negligence and Strict Liability Systems', *5 Journal of Legal Studies*, 293-309.
- Cooter, Robert D. (1982), 'Economic Analysis of Punitive Damages', *56 Southern California Law*

- Review*, 79-101.
- Cooter, Robert D. and Ulen, Thomas S. (1997), *Law and Economics* (2nd edn), Reading, MA, Addison-Wesley, 481 p.
- Cooter, Robert D., Kornhauser, Lewis A. and Lane, D. (1979), 'Liability Rules and Accidents: Some Results Regarding Limited Information and Public Bads', *Bell Journal of Economics*, 366 ff.
- Craswell, Richard and Calfee, John E. (1984), 'Some Effects of Uncertainty on Compliance with Legal Standards', **70** *Virginia Law Review*, 965-1003.
- Craswell, Richard and Calfee, John E. (1986), 'Deterrence and Uncertain Legal Standards', **2** *Journal of Law, Economics, and Organization*, 279-303.
- Endres, Alfred (1991), *Ökonomische Grundlagen des Haftungsrechts* (Economic Fundamentals of Liability Law), Heidelberg, Physica.
- Endres, Alfred (1992), 'Strategic Behavior under Tort Law', **12** *International Review of Law and Economics*, 377-380.
- Endres, Alfred and Querner (1995), 'On the Existence of Care Equilibria under Tort Law', **147** *Journal of Institutional and Theoretical Economics*.
- Epstein, Richard A. (1973), 'A Theory of Strict Liability', **2** *Journal of Legal Studies*, 151-204.
- Epstein, Richard A. (1974), 'Defenses and Subsequent Pleas in a System of Strict Liability', **3** *Journal of Legal Studies*, 165-215.
- Faure, Michael G. and Skogh, Göran (1992), 'Compensation for Damages Caused by Nuclear Accidents: A Convention as Insurance', **17** *Geneva Papers on Risk and Insurance*, 499-513.
- Faure, Michael G. and Van den Bergh, Roger (1987), 'Efficiënties van het Foutcriterium in het Belgisch Aansprakelijkheidsrecht (Efficiencies of the Fault Criterion in Belgian Liability Law)', **51** *Rechtskundig Weekblad*, 11-19.
- Faure, Michael G. and Van den Bergh, Roger (1987), 'Negligence, Strict Liability and Regulation of Safety under Belgian Law: An Introductory Economic Analysis', **12** *Geneva Papers on Risk and Insurance*, 95-114.
- Finsinger, Jörg and Pauly, Mark V. (1990): 'The Double Liability Rule', **15** *Geneva Papers on Risk and Insurance*, 159-170.
- Finsinger, Jörg and von Randow, Philip (1991): 'Neue Aktivitäten und Haftungsregeln, zugleich ein Beitrag zur ökonomischen Analyse des Nachbarrechts (New Activities and Liability Rules)', in Ott, Claus and Schäfer, Hans-Bernd (ed), *Ökonomische Probleme des Zivilrechts*, Berlin, Springer, 347 p.
- Frech, H. Edward III (1994), 'State-dependent Utility and the Tort System as Insurance: Strict Liability versus Negligence', **14** *International Review of Law and Economics*, 261-272.
- Gallo, Paolo (1993), 'Appunti in Tema di Colpevolezza, Colpa Soggettiva ed Efficienza Economica (in occasione di alcune recenti pubblicazioni) (Notes about Liability, Subjective Fault and Economic Efficiency on the Occasion of Some Recent Publications)', *Quadrimestre*, 712-732.
- Gilles, Stephen G. (1992), 'Rule Based Negligence and the Regulation of Activity Levels', **21** *Journal of Legal Studies*, 319-363.
- Goldberg, Victor P. (1994), 'Litigation Costs under Strict Liability and Negligence', **16** *Research in Law and Economics*, 1-15.
- Grady, Mark F. (1983), 'A New Positive Theory of Negligence', **92** *Yale Law Journal*, 799-829.

- Grady, Mark F. (1988), 'Why Are People Negligent?: Technology, Nondurable Precautions, and the Medical Malpractice Explosion', **82** *Northwestern University Law Review*, 293 ff.
- Grady, Mark F. (1992), 'Better Medicine Causes More Lawsuits, and New Administrative Courts will not solve the Problem: Review of Medical Malpractice on Trial by Paul C. Weiler', **86** *Northwestern University Law Review*, 1068 ff.
- Grady, Mark F. (1994), 'Res Ipsa Loquitur and Compliance Error', **142** *University of Pennsylvania Law Review*, 887 ff. Reprinted in Rabin, Robert L. (1995), *Perspectives on Tort Law*.
- Haddock, David D. and Curran, Christopher (1985), 'An Economic Theory of Comparative Negligence', **14** *Journal of Legal Studies*, 49-72.
- Hand, Learned (1947), *United States v. Carroll Towing Co.*, 159 F.2d 169 (2nd Cir. 1947).
- Hasen, Richard L. (1990), 'Comment, Efficiency Under Informational Asymmetry: The Effect of Framing on Legal Rules', **38** *UCLA Law Review*, 391 ff.
- Hylton, Keith N. (1990a), 'The Influence of Litigation Costs on Deterrence under Strict Liability and under Negligence', **10** *International Review of Law and Economics*, 161-171.
- Hylton, Keith N. (1990b), 'Costly Litigation and Legal Error under Negligence', **6** *Journal of Law, Economics, and Organization*, 433-452.
- Hylton, Keith N. (1993), 'Litigation Cost Allocation Rules and Compliance with the Negligence Standard', **22** *Journal of Legal Studies*, 457-476.
- Johnston, Jason Scott (1987), 'Bayesian Fact-Binding and Efficiency: Toward an Economic Theory of Liability Under Uncertainty', **61** *Southern California Law Review*, 137 ff.
- Kahan, Marcel (1989), 'Causation and Incentives to Take Care under the Negligence Rule', **18** *Journal of Legal Studies*, 427-447.
- Kobayashi, Bruce H. (1996), 'Strict Liability, Gun Control, and Sin Taxes', in Shughart, William F. II (ed.), *Taxing Choice: The Political Economy of Fiscal Discrimination*, New Brunswick, NJ, Transaction Publishers.
- Kolstad, Charles D., Ulen, Thomas S. and Johnson, Gary V. (1990), 'Ex Post Liability for Harm vs. Ex Ante Safety Regulation: Substitutes or Complements', **80** *American Economic Review*.
- Kornhauser, Lewis A. (1989), 'Sharing Damages among Multiple Tortfeasors', **98** *Yale Law Journal*.
- Landes, William M. and Posner, Richard A. (1980): 'Multiple Tortfeasors: An Economic Analysis', **9** *Journal of Legal Studies*, 517-555.
- Landes, William M. and Posner, Richard A. (1987), *The Economic Structure of Tort Law*, Cambridge, MA, Harvard University Press, 330 p.
- Lando, Henrik (1996), *Hvornår bær Objektivt Ansvar Gælde? Det Retsøkonomiske bud på et sæt af Kriterier for Objektivt Ansvar* (When Should Strict Liability Apply? The Law-and-Economics Answer), Working Paper, Institute of Finance.
- Lee, Gary L. (1981), 'Strict Liability versus Negligence: An Economic Analysis of the Law of Libel', *Brigham Young University Law Review*, 398-406.
- Levmore, Saul (1986), 'Rethinking Comparative Law: Variety and Uniformity in Ancient and Modern Tort Law', **31** *Tulane Law Review*, 235-287.
- Low, Stuart and Smith, Janet Kiholm (1992), 'The Relationship of Alternative Negligence Defense Rules to Litigation Behavior and Tort Claim Disposition', **17** *Law and Social Inquiry*, 63-87.

- Low, Stuart and Smith, Janet Kiholm (1995), 'Decisions to Retain Attorneys and File Lawsuits: An Examination of the Comparative Negligence Rule in Accident Law', **24** *Journal of Legal Studies*, 535-557.
- Newman, Harry A. and Wright, David W. (1990), 'Strict Liability in a Principal-Agent Model', **10** *International Review of Law and Economics*, 219-231.
- Orr, Daniel (1991), 'The Superiority of Comparative Negligence: Another Vote', **20** *Journal of Legal Studies*, 119-129.
- Page, Talbot (1987), 'On Strict Liability: Reply to Hausman and to Schwartz', **97** *Ethics*, 817-820.
- Parisi, Francesco (1993), 'Learned Hand Formula of Negligence', **X** *Digesto Civile*, 436-443.
- Perry, Stephen R. (1988), 'The Impossibility of General Strict Liability', **1** *Canadian Journal of Law and Jurisprudence*, 147-171.
- Polinsky, Mitchell A. (1980), 'Strict Liability vs. Negligence in a Market Setting', **70(2)** *American Economic Review. Papers and Proceedings*, 363-367.
- Posner, Richard A. (1972), 'A Theory of Negligence', **1** *Journal of Legal Studies*, 29-96.
- Posner, Richard A. (1973), 'Strict Liability: A Comment', **2** *Journal of Legal Studies*, 205-221.
- Posner, Richard A. (1979), 'Epstein's Tort Theory: A Critique', **8** *Journal of Legal Studies*, 457-475.
- Posner, Richard A. (1992), *Economic Analysis of Law* (4th edn), Boston, Little Brown.
- Priest, George L. (1991), 'The Modern Expansion of Tort Liability: Its Sources, Its Effects, and Its Reform', **5(3)** *Journal of Economic Perspectives*, 31-50.
- Rabin, Robert L. (1981), 'The Historical Development of the Fault Principle: A Reinterpretation', **15** *Georgia Law Review*, 925 ff. Reprinted in Rabin, Robert L. (ed.) (1983), *Perspectives on Tort Law*, Boston, Little Brown, 44-70.
- Ramseyer, J. Mark and Minoru Nakazato (1989), 'The Rational Litigant: Settlement Amounts and Verdict Rates in Japan', **18** *Journal of Legal Studies*, 263 ff.
- Rizzo, Mario J. (1980), 'Law amid Flux: The Economics of Negligence and Strict Liability in Tort', **9** *Journal of Legal Studies*, 291-318.
- Rose-Ackerman, Susan (1989), 'Dikes, Dams, and Vicious Hogs: Entitlement and Efficiency in Tort Law', **18** *Journal of Legal Studies*, 25-50.
- Rubinfeld, Daniel L. (1987), 'The Efficiency of Comparative Negligence', **16** *Journal of Legal Studies*, 375-394.
- Schäfer, Hans-Bernd and Ott, Claus (1986) *Begründung und Bemessung des Schadensersatzes wegen entgangener Sachnutzung* (Foundation and Rating of the Compensation for Damage Because of Lost Utility of Property), **7** *Zeitschrift für Wirtschaftsrecht*, 613-624.
- Schäfer, Hans-Bernd and Ott, Claus (1995), *Lehrbuch der ökonomischen Analyse des Zivilrechts* (Textbook on Economic Analysis of Civil Law), 2 Auflage, Berlin, Springer.
- Schwartz, Gary T. (1981), 'Tort Law and the Economy in Nineteenth-Century America: A Reinterpretation', **90** *Yale Law Journal*, 1717-1775.
- Schwartz, Gary T. (1989), 'Objective and Subjective Standards of Negligence: Defining the Reasonable Person to Induce Optimal Care and Optimal Populations of Injurers and Victims', **78** *Georgetown Law Journal*, 241-279.
- Schwartz, Gary T. (1992), 'The Beginning and the Possible End of the Rise of Modern American Tort Law', **26** *Georgia Law Review*, 601-702.

- Schwartz, Gary T. (1993), 'Waste, Fraud, and Abuse in Workers' Compensation: the Recent California Experience', *52 Maryland Law Review*, 983-1015.
- Schwartz, Gary T. (1996), 'Weaver v. Ward', *74 Texas Law Review*, 1271-1275.
- Schwartz, Warren F. (1988), 'Objective and Subjective Standards of Negligence: Defining the Reasonable Person to Induce Optimal Care and Optimal Populations of Injurers and Victims', *76 Georgetown Law Journal*, 241 ff.
- Shavell, Steven (1980), 'Strict Liability versus Negligence', *9 Journal of Legal Studies*, 1-25.
- Shavell, Steven (1987), *Economic Analysis of Accident Law*, Cambridge, MA, Harvard University Press, 312 p.
- Simon, Marilyn J., Wolf, Robert G. and Perloff, Jeffrey M. (1985), 'Product Safety, Liability Rules and Retailer Bankruptcy', *51 Southern Economic Journal*, 1130-1141.
- Sloan, Frank A., Reilly, Bridget A. and Schenzler, Christoph M. (1995), 'Effects of Tort Liability and Insurance on Heavy Drinking and Drinking and Driving', *38 Journal of Law and Economics*, 49-77.
- Smith, Steven D. (1984), 'Rhetoric and Rationality in the Law of Negligence', *69 Minnesota Law Review*, 277-323.
- Stout, Lynn A. and Barnes, David D. (1992), *Economic Analysis of Tort Law*, St Paul, MN, West Publishing.
- Trimarchi, Pietro (1961), *Rischio e Responsabilità Oggettiva (Risk and Strict Liability)*, Milano, Giuffrè, 383 p.
- Tullock, Gordon (1981), 'Negligence Again', *1 International Review of Law and Economics*, 51 ff.
- Vandall, Frank J. (1983), 'Applying Strict Liability to Professionals: Economic and Legal Analysis', *59 Indiana Law Journal*, 25-64.
- Vandall, Frank J. (1986), 'Judge Posner's Negligence-Efficiency Theory: A Critique', *35 Emory Law Journal*, 383-418.
- Versteeg, John C. (1974), 'Strict Liability and Judicial Resources', *3 Journal of Legal Studies*, 217-248.
- Von Hippel, Eike (1978), 'Prevention of Accidents and Compensation of Accident Victims', in Skogh, Göran (ed.), *Law and Economics. Report from a Symposium in Lund*, Lund, Juridiska Föreningen, 211-221.
- Von Randow, Philipp and Wehrt, Klaus (1989), 'Comment: New Technologies, Liability Rules and Adaptive Behaviour', in Faure, Michael and Van den Bergh, Roger (eds), *Essays in Law and Economics. Corporations, Accident Prevention and Compensation for Losses*, Antwerpen, Maklu, 107-116.
- Wetzstein, Michael E. and Centner, Terence J. (1992), 'Regulating Agricultural Contamination of Groundwater Through Strict Liability and Negligence Legislation', *22 Journal of Environmental Economics and Management*, 1-11.
- White, Michelle J. (1989), 'An Empirical Test of the Comparative and Contributory Negligence Rules in Accident Law', *20 Rand Journal of Economics*, 308-330.
- Witt, Robert C. and Urrutia, Jorge (1983), 'A Comparative Economic Analysis of Tort Liability and No-Fault Compensation Systems in Automobile Insurance', *50 Journal of Risk and Insurance*, 631-669.
- Wittman, Donald A. (1986), 'The Price of Negligence under Differing Liability Rules', *29 Journal of Law and Economics*, 151-163.
- Zwier, Paul J. (1985), 'The Consequentialist/Nonconsequentialist Ethical Distinction: A Tool for the Formal Appraisal of Traditional Negligence and Economic Tort Analysis', *26 Boston College Law*

Review, 905-944.

Other References

Baumol, William J. and Oates, Wallace E. (1988), *The Theory of Environmental Policy*, Cambridge, Cambridge University Press.

Coase, Ronald H. (1960), 'The Problem of Social Cost', **3** *Journal of Law and Economics*, 1-44.

Keeton, W.P., Dobbs, D. et al. (1984), *Prosser and Keeton on Torts*, St. Paul, West Publishing Company.

Zweigert, Konrad and Kötz, Hein (1996), *Einführung in die Rechtsvergleichung*, Amsterdam, North-Holland.

Cases

United States v. Carroll Towing Co., 159 F.2d 169 (2nd Cir.1947).