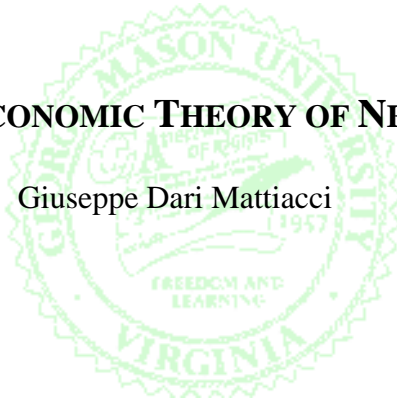# George Mason University

SCHOOL of LAW

TOWARD A POSITIVE ECONOMIC THEORY OF NEGATIVE LIABILITY

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TOWARD A POSITIVE ECONOMIC THEORY OF NEGATIVE LIABILITY

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ABSTRACT

Liability systems internalize negative externalities by providing general tort liability rules. According to such rules, those who cause harm to others should pay compensation. In theory, in the presence of positive externalities, negative liability should apply: those who produce benefits should be paid a compensatory award by the gainers. Nevertheless, current legal systems do not display such general negative liability rules. Rather, they tackle the problem of internalizing positive externalities by implementing a set of different and often indirect solutions. This article suggests an explanation for this puzzle, and furnishes indications for future comparative law research.

1 Introduction

Negative liability is the liability of a person who has received a gain (the gainer) towards the person that contributed to produce it (the benefactor).[1] We call it negative because it may be regarded as the mirror image of positive (tort) liability, which is the liability of a person that contributed to cause a loss (the injurer) towards the person who has suffered it (the victim).[2] In essence, negative liability imposes a duty to compensate one's benefactors. *Negotiorum gestio* and rescue provide two examples of such a duty in various legal systems.[3]

From an economic perspective, positive (tort) liability is primarily a mechanism to internalize negative externalities.[4] The crux of the argument is that, if individuals are held responsible for the losses they impose on others, they will bear the external costs of their activities and act in a socially desirable way. Conversely, negative (gain) liability internalizes positive externalities since, if individuals are rewarded for the gains they produce for others, they will receive the external benefits of their activities and act in a socially desirable way.

In order to achieve an efficient allocation of resources, it may be desirable to assure the internalization of both positive and negative externalities in all those cases in which transaction costs constitute an obstacle to voluntary contractual arrangements. Nevertheless, in most legal systems, we find evidence of a general implementation of tort liability,[5] while negative liability

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[1] This notion is also adopted in Parisi (2002).

[2] Wittman (1984) alternatively refers to this rule as reverse liability or as restitution for benefit. I prefer to use the notion of negative liability as to stress the nature of the rule (a liability rule in the traditional sense) and to distinguish it from the quasi-contractual approach adopted by Calabresi and Melamed (1972), which is traditionally referred to as reverse liability and consists of a compensatory payment by the victim to a polluter (injurer) equal to the polluter's cost of precaution in exchange for the promise not to pollute. In Wittman (1984) reverse liability refers instead to a general situation in which the gainer compensates the benefactor, which does not necessarily overlap with the specific case discussed in Calabresi and Melamed (1972). Issues concerning the question of whether compensation should be based on costs or benefits are discussed in Wittman (1985), with reference to information asymmetries, and Polinsky and Shavell (1994), with reference to legal errors. The term restitution suggests that the gainer returns the benefactor something that initially belonged to him. Instead, in the general case that we will discuss, negative liability generates the duty to compensate for a gain that is jointly produced by the gainer's and the benefactor's activities and did not previously exist (just like the harm resulting from accidents).

[3] *Negotiorum gestio* is a rule inherited by most civil law systems through their Roman matrices. It entitles those who take action in an emergency situation in order to avoid damage to someone else's property to recover from the owner. See Stoljar (1984) for a comparative perspective and Dawson (1961). Rescuers are likewise entitled to recover in some legal systems in many circumstances (especially under the law of admiralty and if the rescuer is a professional provider), see Hasen (1998) with a recent survey of the literature. American law generally denies both liability for nonrescue and rewards to rescuers. See Landes and Posner (1978) and Levmore (1986) rising, from different perspectives, the question of whether rescue should be incentivized and how to do so.

[4] Calabresi (1970) interpreted the goals of tort liability in a threefold economic manner. Firstly, by internalizing accidental losses, liability rules generate incentives to take precaution and hence to reduce the total cost of accidents, defined as the expected loss plus the precaution costs. Secondly, liability rules affect the allocation of the risk of accidents, and hence may contribute to the reduction of risk-bearing costs. Thirdly, liability rules are costly to administer, and hence the design of liability rules affects the administrative costs of using the legal system. In this study, we are concerned with the first order of costs and analyze both positive (tort) liability and negative (gain) liability as mechanisms to generate incentives.

[5] Tort liability was one of the preferred areas of investigation for early law and economics analysts. See Calabresi (1970), Shavell (1987) and Landes and Posner (1987). The economic analysis of law received parallel attention in the

is almost completely absent or relegated to special provisions.[6] The doctrines of unjust enrichment[7] and quasi contract,[8] which may be seen as forms of negative liability, only partially cover issues of positive externalities[9] and are also concerned with the removal of illegal gains – in order to provide an additional or alternative sanction to tort or criminal liability[10] –, the undoing of mistaken payments,[11] the restitution of benefit in family relationships, the distribution of payments amongst multiple debtors, the payment of another's debt and similar cases.

Surprisingly where perfect symmetry in the externality problem exists, we observe an asymmetrical implementation of liability rules.[12] This puzzle provided the inspiration for my analysis.[13]

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field of criminal law, in which the input was given by Becker (1968). Also in this case, the concern is the deterrence of harmful behavior.

[6] See Dawson (1951) at 111-112 remarking, "The most obvious comment about the American law of restitution is that it lacks any kind of system". Levmore (1985) provides an analytic framework for the interpretation of a wide taxonomy of restitution cases. He notices, "the law of nonbargained benefits is most easily described with a general rule and a long list of exceptions that seem on the verge of consuming the rule" (*idem* at 65); nevertheless, "although restitution is hardly the neatest of fields, it is also not the chaotic mass that it first appears to be" (*idem* at 68). My approach is different, as I do not attempt to provide an interpretational framework for existing hypotheses of restitution, but rather to discuss the general relevance of restitution as an internalization device.

[7] See Levmore (1988) also providing a recent survey of the literature. See also Palmer (1978 and 1984). Wonnell (1996 and 2000) has argued for a disunited view of the unjust enrichment principle, as a set of different legal rules without a unitary underlying logic. Bouckaert and De Geest (1995 and 1998) have counter-argued against this thesis.

[8] See Bouckaert and De Geest (1995 and 1998) for an economic analysis of quasi contracts, in which the authors argue in favor of the identification of a unitary economic principle behind the different practical applications of the law of restitution: they remark that quasi contracts are the equivalent of liability rules in the terminology of Calabresi and Melamed (1972). My approach is different as I ask why a unitary (economic) principle is scattered across the legal landscape in the case of positive externalities, while it is embedded in a rather uniform set of rules (the law of torts) in the case of negative externalities.

[9] Consider, besides rescue and *negotiorum gestio*, for which see footnote 3, also the provision of services in apartment buildings (De Geest 1992) and class actions (Bouckaert and De Geest, 1998, at 202, who note that high transaction costs that justify the implementation of some form of negative liability can be due not only to the number or location of potential parties but also to bilateral monopoly problems).

[10] Many legal systems account for a 'tracing rule' or 'accounting for profits' rule which states that one who wrongfully appropriates another's resources and subsequently invests in them is liable for both the value of the resources and the gain that he has extracted from them. Levmore (1998) at 644 notices that restitution is at times in competition with or subsidiary to tort liability as a measure of the damage award and that 'liability based on unjust enrichment will often generate recoveries that are close to indistinguishable from recoveries based on damage or reliance principles'. The reason for the tracing rule has been said to reside in the need to remove the incentive to gamble on someone else's resources. In other cases, unjust enrichment simply works as a measure of the damage award alternatively to the harm to the victim, when the wrongdoer enrichment is easier to value, as in the cases of lost chances. See also Bowles, Faure and Garoupa (2000) on the removal of illegal gains.

[11] Almost every legal system encompasses a residual remedy to undue wrong payments, when normal contractual and tort liability fails to provide a remedy. It has been remarked that the absence of such a rule would induce parties to engage in over-precaution. See Huber (1988) for an economic analysis of the law of restitution with special focus to mistaken transfers.

[12] Wittman (1998) notes that restitution (i.e. negative liability) cases are rare if compared to tort liability cases, even though the rewarding of external benefits is necessary for the production of optimal incentives. In contrast to my analysis, he focuses mainly on the long run effects in explaining why rewards are less likely to be observed than punishments.

[13] The application of negative liability rules may be limited by the need to prevent voluntary bypassing of market transactions, when transaction costs are low. The Restatement of the Law of Restitution (1973) excludes the 'officious intermeddler' from recovery when he knowingly conferred an unsolicited benefit to another. See Long (1984) proposing to consider similar cases under the heading of hypothetical contracts. Bouckaert and De Geest (1998) at 200, remarks that this situation corresponds to a voluntary bypassing of market transactions when

We will neither question the desirability of internalizing external benefits as opposed to external costs, which depends on their relative empirical relevance, nor the adherence of existing liability systems to our ethical inclinations to punish certain behaviors and reward others.[14] We will instead focus on the functioning of liability as an internalization device. The analysis will develop centered around a fundamental theoretical issue: is it possible to apply to negative liability the theoretical results found in economic literature in relation to positive (tort) liability? The answer as will be later supported is negative.

The kernel of my argument is based on a peculiar advantage that punishments have over rewards. If in equilibrium we expect compliance,[15] punishments will not be applied, while rewards will always be paid. For this reason, a punishment that has not been consumed while incentivizing the first party may be reused for a second party and so forth. A reward is instead always consumed any time it is applied. Put differently, only punishments enjoy a multiplicative property.

Consider this simple example: an enforcer intends to induce two parties to behave in a way that costs them both a sum of 30. The enforcer's power is limited and he may apply sanctions equal to 70 in total. If the sanction is a punishment, he may succeed by setting a very simple rule: if only one party complies, the other will be punished; if both parties comply, no one will be punished; if neither of them complies the punishment will be shared. Examining figure 1, which depicts three different examples of sharing, it is easy to see that compliance is a dominant strategy for at least one party under sharing (a), (b) and (c). This result may be applied to any sharing arrangement. Once one party complies, he escapes the sanction, which is now entirely available to incentivize the other party, whose optimal reaction is comply as well. Thus, comply/comply is always the only Nash equilibrium for any sharing of the punishment.

FIGURE 1   *and*   **FIGURE 2**

If the sanction consists of a reward of 70, the enforcer will not find it easy to succeed. Consider a rule similar to the former: if only one party complies, he will be rewarded; if both parties comply, the reward will be shared; if neither of them complies no one will be rewarded. Figure 2 considers three sharing possibilities analogous to those considered for punishments (the

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[14] transaction costs are not high enough to prevent contractual arrangement. Many civil law systems are more indulgent with intermeddlers however they still limit the recovery in the case of *negotiorum gestio* to necessary costs only. This paper is concerned with those situations in which transaction costs are high enough to prevent parties from bargaining.

[14] For an account of the various explanations of reward versus punishment see Wittman (1984) at 60-61.

[15] This is clearly not the case if there is uncertainty over the standard of negligence that courts apply. See Diamond (1974a) and Craswel and Calfee (1986) analyzing the equilibrium level of the injurer's precaution under uncertain due care standards. My analysis assumes certainty, as in Brown (1973), Landes and Posner (1980), Shavell (1980 and 1987).

numbers change because this time the compliance cost of 30 must be subtracted from the reward).[16] It is evident that comply/comply is an equilibrium only under sharing (b). In general, comply/comply is an equilibrium only if the share in the reward exceeds the compliance cost for each party.[17] Likewise, it is true that do not comply/do not comply is also an equilibrium in this case.

Moving from punishments to rewards, the enforcement mechanism is weakened as compliance is in equilibrium only if sharing is appropriate and this may not be the only equilibrium. This article exploits these simple findings and analyzes traditional positive (tort) liability – which is based on a punishment equal to the expected loss – as opposed to negative liability – which is based on a reward equal to the expected gain. We will study the implications of these findings for the equilibrium levels of care and activity that parties take and show that the economic theory of positive liability cannot be straightforwardly applied to its negative twin. In particular, I will argue that the use of negligence in torts decouples the incentives without decoupling liability,[18] as it may multiply the only sanction available under tort law (the accident loss) and apply it repeatedly and entirely to several non-cooperative parties. The same is not possible under negative liability.

This article is organized as follows. Section 2 will analyze my findings, relate them to current economic literature and provide some terminological clarifications (The reader may find it useful to return to this section after reading the rest of the article). Section 3 will review the main results attained in tort law and economics and relate them to the topic of this study. Section 4 will analyze negative liability and prove my thesis in a more general model. Towards the end of sections 3 and 4, I will provide an informal interpretation of the results. Section 5 will conclude with some considerations on the comparative law and economics of negative liability.

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[16] When one party complies and the other does not comply, the former spends 30 in compliance and receives the full reward of 70, hence his net payoff is 40; the latter spends nothing and receives nothing. If both comply, both spend 30, while receiving only a fraction of the reward that depends upon the sharing rule in force. In the examples, the sharing for party 1 and 2, respectively, are as follows: a) 70, 0; b) 35, 35; and c) 10, 60. Thus, the payoffs are respectively: a) 40, -30; b) 5, 5; and c) -20, 30.

[17] Since the payoff is zero if a party does not comply, compliance must yield a positive payoff for both parties. Thus, the share of the reward that each party receives must be at least equal to 31. Since this must be true simultaneously for both parties the feasibility range for each share is 31 to 39. Recall that the sharing of the punishment in the previous example was unconstrained.

[18] Under decoupled liability what the injurer pays does not necessarily correspond to what the victim receives. This way the problem of making both of them fully internalize marginal costs and marginal benefits of their actions can be solved by making the injurer pay a fine equal to the accident loss and leaving the victim uncompensated. Polinsky and Che (1991) study the incentives to take precaution together with the incentives to sue under decoupled liability. In this paper, I develop my point in relation to two parties; however, the same arguments are valid in a larger setting, as for example in the case of accident with multiple tortfeasors, as in Landes and Posner (1980). See also section 5 infra.

2   Negative liability: a mirage of the cathedral in a Coasean desert

2.1   Duality in externality: 'the problem of social cost' vs. 'the problem of social gain' in a Coasean setting

Coase, in his analysis of the problem of how efficiently to allocate resources in society, is concerned with "those actions of business firms which have harmful effects on others".[19] One of his main findings is that, in the absence of impediments to bargain, parties will reach the efficient reduction of such harmful effects contractually. Thus, the initial allocation of entitlements matters only if bargaining is prevented. If one of two neighbors produces smoke that displeases the other, the optimal amount of smoke emission may be efficiently set in either of two ways: either through parties bargaining (irrespective of the initial legal allocation of the right to produce smoke or to be free from it) or, if bargaining is not possible, through some legal allocation of rights.

Although Coase focused on examples of negative externalities, adhering the confines of contemporary economic debate,[20] his findings clearly apply to any externality; thus, also to positive ones. Compelling Coasean logic urges us to state that parties that are able to bargain will also optimally enhance the production of such positive effects. If one of two neighbors produces vital clean air in an otherwise polluted area by growing a number of trees in his garden, the optimal amount of clean air will be efficiently set in a similar way as the optimal amount of smoke through bargaining or by the allocation of legal rights.[21]

The Coase theorem applies to external costs as well as to external benefits. Coase focused his prose and his examples on the former, showing his contention. By doing so, he probably nourished (or inherited) a one-sided interest for legal economists in the problem of social cost, whilst concealing the symmetrical 'problem of social gain', which did not reach his article's title.

Despite this tendency, on a theoretical level, the internalization of positive externalities is as important as the internalization of negative externalities. While non-internalized external costs result in excessive harmful activities, non-internalized external benefits result in too low

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[19] Coase (1960) at 1.

[20] See Coase (1960) at 28-44. Mishan (1971) at 1 remarks that the interest in the externality problem increased during the postwar period, nourished by the urgency of problems created by environmental spillovers.

[21] See Levmore (1985) at 67 noting, "Restitution occupies the crucial ground between its much-studied neighbors, tort and contract. Restitution deals with nonbargained benefits; tort law with nonbargained harms; contract law with bargained benefits and harms. Whereas the law of torts regularly 'creates' bargains by assigning liability where the parties would have exacted payment if able to bargain, the law of contracts (and restitution) does not obviously intervene and create bargains among strangers who might be expected to wish for such agreements. The law of benefits is apparently not the counterpart of the law of harms. Located at the intersection of tort and contract law, restitution offers an opportunity to inspect this asymmetry between the law's treatment of harms and its treatment of benefits".

levels of beneficial activity. In opposite ways, both yield a social loss.[22] If bargaining is feasible, both types of externalities will be internalized through contract. If bargaining is not feasible, two symmetrical problems arise: one of reducing social cost and one of enhancing social gain. This article recognizes such duality in the externality problem (and in the Coasean logic) and searches for a similar duality in liability rules.

2.2   Duality in liability: Calabresi and Melamed's fourth rule and Wittman's framework

Calabresi and Melamed,[23] whose article also deals with instances in which the legal system is concerned with the internalization of external costs, adopt a similar one-sided view of the externality problem. They consider three main solutions to it as well as a further fourth rather illuminating one.

While discussing the available solutions to a pollution problem[24] they suggest two possible allocations of legal entitlement (to pollute or to be free from pollution) and two possible ways of protecting legal title (through a property rule or through a liability rule). They observe that, although in theory there are four feasible possibilities, only three of them can be found in use (and they provide some reasons for that).[25] The first three possibilities are 1) an entitlement to be free from pollution protected by a property rule, 2) an entitlement to be free from pollution protected by a liability rule and 3) an entitlement to pollute protected by a property rule. These rules are consistent with our common experience, while the fourth alternative is not: 4) an entitlement to pollute protected by a liability rule.

Calabresi and Melamed interpret the last alternative as a rule giving the victim the right to buy a reduction in pollution by refunding the polluter's cost of such a reduction. I will argue that this interpretation of the fourth rule, also referred to as reverse liability,[26] is a special quasi-contractual form of the negative liability rule being discussed in this article. It is worth noting that, although this article presents negative liability as a way to internalize positive externalities, the present discussion will enable us to see that negative liability may also internalize negative externalities, a point which will be elaborated upon in the next subsection. Employed for negative externalities, negative liability is a rule that gives the polluter the right to claim compensation from the victim for any reduction in pollution.

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[22] The concept of externality originated from Marshall's (1920) notion of external economies as "those [economies] dependent on the general development of the industry" (see *idem* at 221). In exemplifying the concept, he refers to improvements that derive from the general progress of the industrial environment (*idem* at 365). In Marshall, the concept develops its positive connotation. In the subsequent analysis by Pigou (1932), the conceptualization evolves towards a duality. The notion of externality both refers to incidentally rendered services "of such a sort that payment cannot be extracted from the benefited parties" and disservices concerning which compensation cannot be "enforced on behalf of the injured parties" (*idem* at 183). Such duality is recognized in Coase (1960) at 34.

[23] Calabresi and Melamed (1972). See Kaplow and Shavell (1996) restating the problem.

[24] Calabresi and Melamed (1972) at 1115-1124.

[25] Calabresi and Melamed (1972) at 1116-1117.

Common (positive) tort liability – rule 2) – protects the victim from pollution by entitling him to claim compensation from the polluter, i.e. tort liability sets a price that the injurer must pay to pollute. Conversely, negative liability is a rule that gives the polluter the right to pollute and protects such a right by entitling the polluter to claim compensation from the victim for any reduction in pollution. Under negative liability the polluter is a benefactor who may claim compensation to the same level as he reduces pollution. The right to claim compensation produces efficient incentives for optimal pollution reduction, as it makes the polluter internalize the benefit of his precaution efforts. In other words, negative liability sets a price that the victim must pay in exchange of pollution reduction.

Both positive and negative liability are activated by the party protected by the legal entitlement, who may act as plaintiff in a legal suit: the victim in the former case, the polluter in the latter. In both cases, the legal system intervenes only after the choice on whether to pollute and to what extent to do so has already been made. At this point the legal system sets the magnitude of the compensation.

So far we have shown that negative liability protects the polluter's right to pollute, while inducing optimal pollution, in a symmetrical way as positive tort liability protects the victim's right to be free from pollution. The level of pollution is the same in both cases. The practical feasibility of such rules has not been an issue up to this point, as we are concerned with the designing of the theoretical framework for our analysis. We will now introduce the reverse liability rule described by Calabresi and Melamed and show how it corresponds to a quasi contract.[27] Then we will examine the feasibility of three other similar rules.

Under Calabresi and Melamed's reverse liability rule, the polluter's right to pollute is protected by obliging the victim to pay for a reduction in pollution. The price is set equal to the cost of precaution. This rule is different from a property rule only because the polluter is obliged to accept the offer of the victim. In this sense, it may be defined as a liability rule, as the transaction is not channeled through a contract but through a quasi contract, a form of forced transaction in which the victim has the right to buy a reduction in pollution.

Likewise, we can imagine three other similar options: one according to which the polluter has the right to pollute and the right to sell the victim a reduction in pollution; another according to which the victim has the right to be free from pollution and the injurer has the right to buy from the victim a permit to pollute; a third rule stating that the victim has the right to be free from pollution and the right to sell the injurer a permit to pollute.[28]

The difference between the positive and negative liability rules and the four quasi-

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[26] See Kaplow and Shavell (1996) at 723, footnote 29.
[27] See Bouckaert and De Geest (1995 and 1998) and *supra* footnote 8.
[28] The rules in which one party has a right to sell might require a legal determination of the optimal amount of

contractual rules resides in the fact that the former are activated after the decision on how much to pollute has been taken, while the latter envisage a compulsory (for one party) contract to be signed at the moment of deciding the level of pollution and to be subsequently enforced. Calabresi and Melamed's fourth rule is only one of the four theoretically possible quasi-contractual rules. It is my contention that they should be regarded as special cases of positive and negative liability and that negative liability does in fact better fit the missing fourth alternative identified by Calabresi and Melamed than explanations given in their own analysis. An analogy can be made between the four quasi-contractual cases and put or call options for the legal entitlement attributed to the victim or the injurer.

Wittman (1984) considers an analogous, though not perfectly symmetrical, setting. Paraphrasing Wittman,[29] there are four available rules: I) the injurer pays the victim damages equal to the harm, II) the victim pays the injurer compensation equal to the gain (no harm), III) the injurer sells the victim the right to be free of harm (or the victim buys it), IV) the victim sells the injurer the right to do harm (or the injurer buys it). Case I) corresponds to Calabresi and Melamed's rule 2), positive tort liability. Rule II) is a negative liability rule. Rules III) and IV) may be seen either as traditional liability rules in which the measure of compensation is related to the cost of precaution rather than to the harm/gain or as quasi-contractual arrangements. In the latter case, Calabresi and Melamed's forth rule matches rule IV). Wittman (1984) focuses his analysis on the sign of the sanction (rule I versus II and II versus IV), while leaving the problem of determining the optimal magnitude of the compensation to a separate study.[30] He examined whether or not the sign of liability should be the opposite of the sign of the externality in a world with positive administrative costs. He gives a positive answer. I will proceed irrespective of this problem and, as will be emphasized in the next subsection, focus on the structural asymmetry between the two forms of liability, an issue not addressed in Wittman (1984).

2.3 *The lightness of the antithesis between liability rules and externalities to internalize*

In the previous two subsections we have noted dualities in the externality problem and in the liability approach. In this subsection, we will examine whether or not they are interdependent and conclude that they are not necessarily so.

As positive (tort) liability is generally recognized as a system for the internalization of negative externalities, it should be possible to also apply it symmetrically to a system for the internalization of positive externalities. We have seen that positive externalities are disregarded

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pollution.

[29] See Wittman (1984) at 59.

[30] See Wittman (1984) at 59, footnote 5, and Wittman (1985).

in the Coasean approach, and that negative liability remains likewise a hidden side of the 'cathedral'[31] in Calabresi and Melamed's framework. Despite the appeal of the pureness of the antithesis between a problem and its solution exercises, I shall argue that the link is only suggestive. Although this article discusses negative liability in a framework in which the parties' interaction produces positive externalities, my results would be valid even if the externality were negative.

To see why this is the case, consider that in theory negative externalities may be tackled either by means of traditional tort liability or by means of negative liability, as Calabresi and Melamed recognize while advocating the admissibility of their fourth rule.[32] In theory, an injurer may be induced to take optimal care either by entitling the victim to compensation for harm, or by entitling the injurer to compensation from the victim for harm reduction.[33] Likewise, positive externalities may be internalized by positive as well as negative liability. In fact, a benefactor may be induced to take optimal care either by entitling him to compensation from the gainer for the gain produced, or by entitling the gainer to compensation from the benefactor for the gain foregone. For example, rescuers may be incentivized to rescue by entitling them to claim compensation from people they save and by making them liable for failure to rescue.

This point is made even stronger by the fact that, from an economic perspective, an avoided loss is in fact a gain, just like a foregone gain is a loss.[34] Thus, the distinction between positive and negative externalities may ultimately fade away and does not furnish the necessary theoretical support for the applicability of either form of liability. In fact, this article is neither concerned with the problem of whether or not positive externalities deserve the same attention as their negative counterparts, nor with the relation between the liability rule and the externality to internalize. On the contrary, I am advocating a theory of negative liability. Grounding my

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[31] On this metaphor, see Calabresi and Melamed (1972) at 1090, note 2.

[32] See Calabresi and Melamed (1972) at 1116-1117 and section 2.2 supra.

[33] For an example see the discussion of a pollution problem given in section 2.2 supra.

[34] It is interesting to note that Coase (1960) at 35 emphasizes the reversibility of the externality problem, which he makes a central tenet of his analysis. While discussing the smoking chimney example made by Pigou (1932) at 184, Coase remarks that regarding the production of smoke as a negative externality, as he does, and regarding the reduction of smoke as a positive externality, as Pigou does, are both correct approaches to the externality problem. One of Coase's points is that the externality problem is reciprocal in nature and mainly consists of reconciling conflicting interests. Reciprocity and reversibility seem to support each other. See also Wittman (1984) at 58 noting that the economist symmetrical perspective on the antinomy harm/benefit renders it difficult to make a clear distinction between the two. See *idem* at 71-72 constructing a criterion to distinguish positive externalities from negative ones based on administrative costs and long-run incentives. Externalities are positive if the cheaper internalization device is a subsidy, and, likewise, they are negative if it is a tax. In the absence of administrative costs the two are indistinguishable in Wittman's framework (see *idem* at 58-59). My analysis is different in two respects: first, I do not ask the question of what should be the sign of the liability or the question of whether or not the sign of the liability should depend on the sign of the externality; second, I do not base my argument on the presence of administrative costs. The asymmetry between positive and negative liability is based on a game-theoretical difference between the two. In this respect, my analysis does not depend on whether or not we are able to distinguish between positive and negative externalities. Yet, administrative costs enter my analysis from a different perspective: the distinction between care and activity level is indeed a matter of administrative costs, but their effect is symmetrical under both positive and negative liability. See Shavell (1980) at 22-23 on this point.

analysis on the findings of forty years of research in the field of positive (tort) liability, I address the question of why positive liability is more common than negative liability as a general internalization device for externalities, irrespective of their sign. A general overview of most legal systems yields that in reality positive (tort) liability deals with most instances in which negative externalities are to be internalized and with a number of situations in which positive externalities result from the parties' interaction (as for example liability for failure to rescue). Negative liability only seems to be applied as a special solution for some cases of positive externalities.

Although it is certainly one of the possible views of the cathedral envisaged by Calabresi and Melamed,[35] negative liability's general applicability will be severely questioned in this article. We will give an explanation for the virtual inexistence of the fourth rule, which differs from the explanation given by their original proponents, based mainly on practical difficulties in its implementation.[36] It is worth repeating that the fact that the formal analysis is built on a positive externality framework does not impinge upon the general applicability of the results and their applicability to the internalization of negative externalities. Our view of the problem of allocating legal entitlements will ultimately reveal a mirage of a cathedral situated in an unexplored region of the Coasean world.

2.4   A digression over terminology

As a matter of terminology, we shall refer to the parties involved in the production of positive externalities as the gainer – the party that receives the gain in the first place – and the benefactor – the party that does not receive the gain in the first place. For the sake of generality, we will analyze situations in which both parties contribute to the production of the positive externality.[37]

The gain falls on the gainer, just like the accident loss falls on the victim. Negative liability and positive (tort) liability define criteria to reallocate the gain or the loss to the other party (the benefactor or the injurer, respectively) in order to produce ex ante incentives to take precaution. In tort liability, the terms precaution, care, and activity level are used to refer to the parties' actions that influence the expected accident loss. Precaution is any action that can reduce the expected accident loss; often parties can take more than one precautionary measure, thus precaution refers in general to the set of all precautionary measures that each party can take. Care and activity level refer to two subsets of precautionary measures: care encompasses those precautionary measures that are included in the negligence criterion, while activity level those

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[35] See Calabresi and Melamed (1972) at 1089-1090, footnote 2.

[36] See Calabresi and Melamed (1972) at 1117-1124. See also Kaplow and Shavell (1996) at 725 (footnote 37), 742 (footnotes 89 and 92), 743 (footnote 93), 757 (footnote 142), and 777 (comment c).

[37] No assumption will be made on whether their efforts are complements or substitutes in the production of positive external effects.

that are omitted from it.[38]

We shall use the same terminology whilst referring to negative liability. In negative liability, precaution is the set of actions that each party can take in order to increase the expected gain of the interaction. Care and activity level are defined as above.

The expected accident loss is the product of the magnitude of the harm and the probability of the accident. Likewise, the expected gain results from the product of the magnitude of the gain and the probability that a gain will result from the parties' interaction.

Under traditional negligence rules in tort liability, the equilibrium situation consists of both parties being non-negligent. The party that pays the residual loss in the case of both being non-negligent is referred to as the residual bearer. Notoriously, under simple negligence, contributory negligence and comparative negligence as well as under no liability, the residual bearer is the victim. Under strict liability, with or without more or less refined negligence defenses, the residual bearer is the injurer.[39] In negative liability the residual bearer could be redefined as the residual claimant i.e. the party that enjoys the gain when both parties are non-negligent. Nevertheless, we shall refrain from going beyond simple description and we add that, since traditional negligence rules may fail to induce both parties to be non-negligent in negative liability, the use of the term residual claimant is subject to careful screening, as the party that in fact receives the gain in equilibrium may be different from the party that would have received the gain had both parties been non-negligent. The reason for this outcome will be later clarified in the model.

3   *Divide et impera*: rethinking the functioning of negligence in positive (tort) liability

The literature on the economic analysis of tort law has proven that, while strict rules (no liability and strict liability) only provide either party (the victim and the injurer, respectively) with incentives to take precaution, the negligence inquiry leads to both parties to take the optimal level of care.[40] However, parties must also decide their levels of activity. In this respect, no negligence rule is able to provide both parties with optimal incentives. However, it is still possible to design the liability rule in such a way that optimal activity level is best approached. We will review these results and emphasize some important aspects that will play a central role in the analysis of negative liability.

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[38] See Shavell (1980) at 22-23.

[39] See Cooter and Ulen (2000) for a clear illustration.

[40] The model used in this paper is based on Brown (1973), as concerns the general setting, Landes and Posner (1980), for proof that *any* negligence rule yields both parties' optimal care, and Shavell (1980), in relation to the introduction of the parties' levels of activity into the analysis. For a recent systematic formal treatment see also Miceli (1997).

3.1   The model

Let us consider the behavior of two risk-neutral, rational, and wealth maximizing parties. The victim (the party that suffers a loss as a consequence of the accident) and the injurer (the other party) are strangers to each other. Let subscripts denote derivatives. Let:

x	$=$	injurer's cost of care, $x \geq 0$;
y	$=$	victim's cost of care, $y \geq 0$;
$l(x,y)$	$=$	expected accident loss, $l(x,y) \geq 0$; $l_x < 0$, $l_y < 0$ and l is a strictly convex function of x and y where l is positive;
s	$=$	injurer's level of activity, $s \geq 0$;
t	$=$	victim's level of activity, $t \geq 0$;
$u(s)$	$=$	injurer's gross utility of engaging in his activity, $u(s) \geq 0$, $u_s > 0$, $u_{ss} < 0$, for $s < \hat{s}$, $u_s(\hat{s}) = 0$;
$v(t)$	$=$	victim's gross utility of engaging in his activity, $v(t) \geq 0$, $v_t > 0$, $v_{tt} < 0$, for $t < \hat{t}$, $v_t(\hat{t}) = 0$;
σ	$=$	injurer's share when both parties are non-negligent, $\sigma = [0,1]$;
θ	$=$	injurer's share when both parties are negligent, $\theta = [0,1]$.

All functions are assumed to be continuous and continuously differentiable to any desired order. Let us define the social objective as the maximization of the sum of the parties' utility less the expected accident loss and the parties' cost of care. Following the literature,[41] each party's activity level multiplies the number of instances in which an accident occurs and within which that party must take care. Thus, the social welfare maximization problem may be written as follows:

$$(1) \qquad \max_{x,y,s,t} \left[u(s) + v(t) - stl(x,y) - sx - ty \right].$$

As usual, we assume strict concavity and that all variables are positive at the optimum.[42] The first order conditions for the optimal levels of care for the injurer and the victim, respectively are:

$$(2) \qquad \begin{aligned} -tl_x &= 1 \\ -sl_y &= 1 \end{aligned}.$$

Let us define the optimal care levels as those levels of x and y that, satisfying the conditions in

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[41] See Shavell (1980) on this form of social welfare function for accidents. Note, however, that my findings do not depend on this.
[42] See also Shavell (1987) at 44. The same shall also be assumed in the rest of this paper for all variables except for σ^*.

(2), guarantee equality between the marginal benefits (the marginal reduction in the expected loss) and the marginal costs of care for both parties. By regarding t and s as parameters, we may write the optimal levels of care as functions of the levels of activity, $x^*=x(s,t)$ and $y^*=y(s,t)$. If the levels of activity change, the optimal responses in terms of care also change. That is, the concept of optimal care is conditional on the levels of activity taken by the parties.

The first order conditions with respect to the activity levels are:

$$(3) \quad \begin{aligned} u_s &= tl(x,y) + x \\ v_t &= sl(x,y) + y \end{aligned}.$$

Let us define the optimal levels of activity as those levels of s and t that, satisfying the conditions in (3), guarantee the equality of the marginal benefits and the marginal costs of the activities of both parties. No negligence rule can induce both parties to take the optimal levels of activity,[43] as it is not possible to make both of them bear the entire expected loss, as required by Exp. (3).[44] Assuming that parties are induced to take optimal care, they will take the levels of activity that maximize their gross utility less the *portion* of the expected loss they bear in equilibrium less the cost of care:

$$(4) \quad \begin{aligned} s &= \arg\max\left\{u(s) - s[\sigma t l(x^*, y^*) + x^*]\right\} \\ t &= \arg\max\left\{v(t) - t[(1-\sigma)sl(x^*, y^*) + y^*]\right\} \end{aligned}.$$

Since x^* and y^* are functions of s and t, the chosen levels of activity will depend only on the share of the damages that a party bears when they are both non-negligent and on the activity of the other party: $s=s(\sigma,t)$ and $t=t(\sigma,s)$. As a result, even if the first best levels of activity cannot be achieved, a second best may be defined as consisting of those levels of activity that, given optimal care, maximize the social welfare function of Exp. (1) subject to the restrictions on s and t given in Exp. (4). Let s^* and t^* denote such solutions.[45] Likewise, σ^*, such that $s^*=s(\sigma^*,t^*)$ and $t^*=t(\sigma^*,s^*)$, will be the optimal sharing of the accident loss between non-negligent parties. The second-best socially optimal levels of care will therefore be $x^*=x(s^*,t^*)$ and $y^*=y(s^*,t^*)$.[46]

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[43] See Shavell (1980).

[44] Decoupling liability is an option not considered in this paper. See also footnote 18.

[45] We assume that s^* and t^* are unique and positive.

[46] Shavell (1987) at 42-43 remarks that social welfare may be increased by raising due care above the socially optimal level. The reason is that, as due care increases, the costs borne by the parties given the same levels of activities also rise. Thus, the parties will be induced to curb their activity levels, which may be socially desirable as the parties' activity levels are in general excessive. Shavell proves his contention in a unilateral precaution context (when only the injurer may adjust his level of activity). The same applies to the bilateral precaution framework discussed in this article. This solution is subject to an upper limit: the due level of care may be increased as long as it does not undermine the parties' incentive to comply with due care. For this reason, taking into account the possibility of higher than optimal due care would not change the substance of my results.

3.2   The virtues of the negligence rule in positive (tort) liability

Let us now verify whether the implementation of any rule based on negligence provides both parties with incentives to take the optimal levels of care and activity. We will therefore analyze both simple, contributory and comparative negligence and all strict liability rules with similar defenses. For this purpose, let us consider the most general setting in which if a party is negligent and the other is not, the negligent party bears the entire accident loss, while if both parties are negligent or both are non-negligent the accident loss is shared according to some shares θ or σ, respectively. It is easy to verify that this framework comprises all negligence rules mentioned.[47] The game theoretical interaction between the victim and the injurer can be described as in figure 3.

FIGURE 3

We will prove the following proposition. NE stands for Nash Equilibrium.

Proposition 1. Under positive (tort) liability, if due levels of precaution for the injurer and the victim are set at the optimal levels, x^* and y^* is the only NE of the game for any θ, the sharing of the accident loss when both parties are negligent, and any σ^*, the optimal sharing when both are non-negligent.

In order to prove proposition 1, let us show that the following three statements are true for any value of σ^* and θ:

1. (x^*, y^*) is a NE, which implies that $(x^*, y<y^*)$, $(x<x^*, y^*)$, $(x^*, y>y^*)$, $(x>x^*, y^*)$ are not NEs;
2. $(x<x^*, y<y^*)$ is not a NE;
3. $(x>x^*, y>y^*)$ is not a NE.

Concerning the first point, if the victim takes y^*, the injurer's utility is $u(s^*)-s^*[\sigma^* t^* l(x^*,y^*)-x^*]$, if he also takes x^*.[48] If he takes $x<x^*$, he will be found negligent and bear $u(s)-s[t^* l(x,y^*)-x]$. Comparing the latter with condition (2), we learn that it is maximized by x^*.[49] Hence, taking less

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[47] The share σ determines whether the rule is a traditional negligence rule, where the victim is the residual bearer, ($\sigma=0$) or one based on strict liability, where the injurer is the residual bearer ($\sigma=1$), or something in between ($0<\sigma<1$), in which each party bears a portion of the accident loss in equilibrium. Likewise, the share θ determines whether the defense of negligence allows for a comparative sharing when both parties are negligent ($0<\theta<1$) or charges the entire loss on either of injurer, as under simple negligence and strict liability with defense of dual contributory negligence ($\theta=1$), or on the victim, as under contributory negligence and strict liability with defense of contributory negligence ($\theta=0$).

[48] The optimal levels of activity follow from the fact that parties are taking optimal care and the share σ^* is optimal.

[49] Note that this conclusion holds for $s \neq 0$ and that we have ruled out the case of $s=0$.

than x^* is not advantageous. If the injurer takes $x>x^*$, his total cost increases, in fact $u(s)-s[\sigma^* t^* l(x,y^*)+x]$ is clearly maximized by $x<x^*$. The same can be symmetrically verified for the victim; thus, neither party has an incentive to deviate unilaterally from the optimal levels of care. Hence, we have proved 1.

Concerning the second point, for $(x<x^*, y<y^*)$ to be a NE, both parties must simultaneously find it more convenient to be negligent and bear a portion of the accident loss than to be non-negligent and bear no accident loss (as the other party is negligent and bears it all). Let the superscript ^{nn} denote the utility maximizing level of activity of a party that is unilaterally non-negligent. Hence, the following conditions should be simultaneously satisfied for $x<x^*$ and $y<y^*$:

(5)
$$\begin{cases} u(s)-\theta stl(x,y)-sx > u(s^{nn})-s^{nn}x^* \\ v(t)-(1-\theta)stl(x,y)-ty > v(t^{nn})-t^{nn}y^* \end{cases}.$$

Summing them up we obtain $u(s)+v(t)-stl(x,y)-sx-ty>u(s^{nn})+v(t^{nn})-s^{nn}x^*-t^{nn}y^*$. The right hand-side is maximized by s^{nn} and t^{nn}. Thus, if we set $s\neq s^{nn}$ and $t\neq t^{nn}$ and subtract a positive quantity, the value of the right-hand side must decrease. Therefore, the inequality may be rewritten as $u(s)+v(t)-stl(x,y)-sx-ty>u(s^*)+v(t^*)-s^*t^*l(x^*,y^*)-s^*x^*-t^*y^*$, which cannot be true for $x<x^*$ and $y<y^*$, as, by hypothesis, s^*, t^*, x^* and y^* maximize the left-hand side.[50] Thus, we have proved 2.

Likewise, for both parties to have an incentive to take more than optimal precaution the following must hold true for $x>x^*$ and $y>y^*$:

(6)
$$\begin{cases} u(s)-\sigma^* stl(x,y)-sx > u(s^*)-\sigma^* s^* t^* l(x^*,y^*)-s^*x^* \\ v(t)-(1-\sigma^*)stl(x,y)-ty > v(t^*)-(1-\sigma^*)s^* t^* l(x^*,y^*)-t^*y^* \end{cases}.$$

Summing them up, we obtain $u(s)+v(t)-stl(x,y)-sx-ty>u(s^*)+v(t^*)-s^*t^*l(x^*,y^*)-s^*x^*-t^*y^*$, which by hypothesis cannot be true for $x>x^*$ and $y>y^*$.[51] Thus, we have proved 3. $\square$

3.3 Interpretation of the results for positive (tort) liability

The results of the previous subsection may be summarized in figure 4, which we will use to provide an interpretation of the logic behind the functioning of the negligence rule.

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[50] It is worth noticing that s^*, t^*, x^* and y^* are the levels of activity and care that maximize the social welfare function subject to $s=s(\sigma,t)$ and $t=t(\sigma,s)$. Likewise, the left-hand side of the inequality is subject to the similar, though not identical, conditions $s=s(\theta,t)$ and $t=t(\theta,s)$, as each negligent party maximizes his gross utility less the *portion* of the accident loss he bears less his care cost, as in Exp. (6). Even if the sharing is θ when the parties are both negligent (the case that we are analyzing) and σ when the parties are both non-negligent (the case to which the optimal levels of activity and care refer), given the identity of the problem and the identical domain of σ and θ, the optimal θ ought to be equal to the optimal σ and any other level of θ will yield a lower value for the left-hand side of the inequality. Thus, the conclusion reached in the text is correct.

[51] In this case the conditions $s=s(\sigma,t)$ and $t=t(\sigma,s)$ are exactly the same as in the social welfare maximization problem.

FIGURE 4

Figure 4 simplifies figure 3 and shows which party bears the accident loss in each case. We have shown that in the standard model the sharing of the accident loss when both parties are negligent is irrelevant and that the sharing when both are non-negligent is only relevant for the activity level, as optimal care is compatible with any sharing that is optimal for the activity level. This result is particularly relevant as it implies that the share σ, may be freely set according to the need to induce optimal activity level and that any such share attains the parties' compliance with the due care standard. It is easy to show that, in a model in which all the parties' precautionary measures are included in the negligence standard (hence, there is no concern with the activity level), the share σ, becomes completely irrelevant.

The shares θ and σ are not the reason why the parties take the optimal due care levels. It is evident that the crucial feature of the negligence rule resides in the diagonal (quadrants I and III). The negligence rule decouples the incentives provided by tort liability by charging the entire accident loss on the party that deviates from optimal precaution. A strategy that could be described as *divide et impera* (divide and conquer),[52] borrowed from the common famous definition of successful warfare, which also denotes a specific algorithmic approach to complex problems in computer science.

Quadrant II provides with an indication of the residual bearer. Under strict liability with some defense of negligence, the entire loss is borne by the injurer (σ=1). On the contrary, under simple, contributory, and comparative negligence (σ=0), the entire residual burden falls on the victim. In this model, σ determines who bears the accident loss in equilibrium and creates incentives to further reduce it by means of adjusting the activity level. In between these two extreme cases, the whole range of σ values is possible.[53]

Quadrant IV shares the loss between negligent parties. Under simple negligence, θ equals 1 (and σ=0). The same occurs under strict liability with defense of dual contributory negligence (where σ=1 instead). On the contrary, under contributory negligence and strict liability with defense of contributory negligence θ equals 0 (while σ equals 0 or 1, respectively). Intermediate values of θ are typical in comparative negligence or strict liability with defense of comparative

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[52] Miceli (1997) at 19 refers to what we call the '*divide et impera*' strategy as a 'dual' method: the accident loss is attributed to one party, while the other is given the possibility to avoid liability by taking optimal care. However, it is clear that under comparative negligence none of the parties is actually burdened with full liability, as the accident loss will be shared. On the contrary, both parties are threatened with full liability on the diagonal of figure 4, when either of them is negligent.

[53] Parisi and Fon (2001) suggest the possibility of sharing the residual burden between the parties instead of allocating the whole burden to either of them entirely, as in the analysis by Shavell (1980).

negligence (again σ equals 0 or 1, respectively). Other possibilities are provided by any possible combination of intermediate values of σ and any value of θ, even though it is difficult to label them clearly. The important point is that, unless some of the assumptions of the basic model are relaxed, the sharing of the accident loss among negligent parties (θ) neither affects the level of care nor the level of activity that the parties take.[54]

I conclude this section by remarking that the diagonal allocation of the accident loss when either party is unilaterally at fault provides the ultimate leverage for the decoupling of incentives by means of the negligence criterion in tort law.

4   The functioning of negligence in negative liability: the *sharing* strategy

In this section, we will study parties' interactions that produce accidental gains instead of losses. Let:

$g(x,y)$ =   expected gain for the gainer; $g_x > 0$, $g_y > 0$; g is a strictly concave function of x and y, where g is positive;

Consequently, we will substitute the term 'victim' with 'gainer' (the party on which the gain initially falls) and 'injurer' with 'benefactor' (the other party, to which liability rules may reallocate the gain). Similarly to Exp. (1), let us define the social objective as the maximization of the parties' gross utilities plus the expected gain less the parties' care costs.

$$(7) \qquad \max_{x,y,s,t}\left[u(s) + v(t) + stg(x,y) - sx - ty\right].$$

The first order conditions for the optimal levels of care of the benefactor and the gainer, respectively, are:

$$(8) \qquad \begin{array}{l} tg_x = 1 \\ sg_y = 1 \end{array}.$$

As before, the optimal care levels that solve Exp. (8) guarantee the equality between marginal benefits and marginal costs of care for both parties and are functions of t and s.

The first order conditions with respect to the activity levels are:

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[54] Diamond (1974a and 1974b) first analyzed the effect of sharing the accident loss between negligent parties on the equilibrium level of precaution, an aspect that had not been included in the original formulation by Brown (1973). Landes and Posner (1980) further analyzed the topic and generalized the results. In the latter formulation, any sharing between negligent parties induces optimal care. Moreover, since it induces optimal care, it is also irrelevant for the activity level, as parties will act non-negligently. This result is usually referred to as the efficiency-equivalence theorem. See also Cooter and Ulen (2000) for a recent discussion of these results.

(9)
$$u_s + tl(x, y) = x$$
$$v_t + sl(x, y) = y$$.

The optimal levels of activity that solve Exp. (9) guarantee the equality of the marginal benefits and marginal costs of the activities of both parties. No negligence rule can induce both parties to take the optimal levels of activity, as it is not possible to make both of them receive the entire expected gain.[55] Assuming that the parties are induced to take optimal care, they will take the levels of activity that maximize their gross utility plus the *portion* of the expected gain they bear in equilibrium less the cost of care:

(10)
$$s = \arg\max\{u(s) + s[\sigma t g(x^*, y^*) - x^*]\}$$
$$t = \arg\max\{v(t) + t[(1-\sigma)sg(x^*, y^*) - y^*]\}$$.

As in positive liability, even if the first best levels of activity cannot be achieved, a second best may be defined as consisting of those levels of activity s^* and t^* that, given optimal care, maximize the social welfare function of Exp. (7) subject to the restrictions given in Exp. (10). Such second best levels are induced by σ^*, the optimal sharing of the expected gain between non-negligent parties.

4.1   The limits of the negligence rule in negative (gain) liability

Let us now verify whether in negative liability a general negligence rule can be designed that has the same properties as in tort liability, that is, the property to induce both parties to comply with due care. Again, if either party is negligent, let the gain be assigned entirely to the non-negligent party; if both parties are non-negligent or if both are negligent, let the gain be shared according to σ and θ, respectively. Figure 5 depicts the game created by such a rule.

FIGURE 5

We will prove the following proposition:

Proposition 2. Under negative liability, if due levels of precaution for the injurer and the victim are set at the optimal levels, (x^*, y^*) is a NE only if each non-negligent party's share in the gain covers at least his total precaution costs. However, (x^*, y^*) may not be the only NE, as $(x < x^*, y < y^*)$ may also be a NE.

In order to prove proposition 2, let us show that the following three statements are true:
   1. (x^*, y^*) is a NE only if each party's share in the gain covers at least his total precaution

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[55] Here we are applying to gains the logic that Shavell (1980) developed for losses.

costs, which implies that $(x^*, y<y^*)$, $(x<x^*, y^*)$, $(x^*, y>y^*)$, $(x>x^*, y^*)$ are not NEs at the same conditions;

2. $(x<x^*, y<y^*)$ may also be a NE;

3. $(x>x^*, y>y^*)$ is not a NE.

To prove the first point, let us first formalize the condition that each party's share covers his total precaution costs (direct cost of care plus decrease in the utility due to reduced activity level) as follows:

(11) $$\begin{cases} \sigma^* s^* t^* g(x^*, y^*) > s^* x^* + u(\hat{s}) - u(s^*) \\ (1-\sigma^*) s^* t^* g(x^*, y^*) > t^* y^* + v(\hat{t}) - v(t^*) \end{cases}.$$

Let us now show that Exp. (11) provides necessary conditions for (x^*,y^*) to be a NE. With the gainer being non-negligent, if the benefactor is also non-negligent, his payoff is $u(s^*)+s^*[\sigma^* t^* g(x^*,y^*)-x^*]$.[56] If he is negligent his payoff is $u(s)-sx$, which is clearly maximized by $x=0$ and $s=\hat{s}$. Hence, the benefactor will be non-negligent if $u(s^*)+s^*[\sigma^* t^* g(x^*,y^*)-x^*]>u(\hat{s})$, which is precisely the first condition in (11) rewritten in a different form.[57] In addition, the benefactor never takes $x>x^*$, as his utility would decrease, in fact $u(s)+s[\sigma^* t^* l(x,y^*)-x]$ is clearly maximized by $x<x^*$. The same may be likewise verified for the gainer, which proves point 1.

In order to prove the second point, for $(x<x^*, y<y^*)$ to be a NE, both parties must simultaneously find it more convenient to be negligent and receive only a portion of the expected gain than to be non-negligent and receive it all (as the other party is negligent). To see that this is possible, let us consider the case in which the expected gain is zero whenever either party's care is zero: hence $g(x,0)=0$ and $g(0,y)=0$. Henceforth, it is easy to show that in the subgame in which one party is negligent and the other is non-negligent, the dominant strategy is to set the level of care as low as possible for both parties: zero for the negligent party and the due level for the non-negligent one. Thus, the payoff of the unilaterally non-negligent benefactor and gainer will be equal to: $u(\tilde{s})-\tilde{s} x^*$ and $v(\tilde{t})-\tilde{t} y^*$, respectively, where $\tilde{s}$ satisfies $u_s=x^*$ and $\tilde{t}$ satisfies $v_t=y^*$. For $(x<x^*, y<y^*)$ to be a NE the following conditions must be simultaneously satisfied:

(12) $$\begin{cases} u(s) + \theta stg(x, y) - sx > u(\tilde{s}) - \tilde{s}x^* \\ v(t) + (1-\theta)stg(x, y) - ty > v(\tilde{t}) - \tilde{t}y^* \end{cases}.$$

Exp. (12) holds true if the subgame in which both parties are negligent yields in equilibrium a

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[56] The optimal levels of activity follow from the fact that parties are taking optimal care and that the share σ^* is optimal.

[57] I prefer to use strict inequality to rule out the case in which a party is indifferent in his choice.

sufficiently large expected gain $g(x,y)$ and the share θ is appropriate. Thus, we have proved 2.

The proof for point 3 is similar to the one provided in the previous section for positive liability.

4.2 Interpretation of the results for positive (tort) liability

Figure 6 describes this result and shows that, unlike in tort liability, the sharing of the gain between non-negligent parties is of crucial importance for the equilibrium.

FIGURE 6

Proposition 2 states that an appropriate sharing of the expected gain among non-negligent parties is a necessary condition for the parties to take optimal due care. However, this is not a sufficient condition. The achievement of the optimal level of care requires the share σ^* to take certain values,[58] which might be incompatible with the level of σ^* that is optimal for the activity level. For example if $\sigma^*=0$ is optimal for the activity level, it would be certainly inadequate for the parties to take due care.[59] Moreover, since the second-best levels of activity have been defined on the assumption that parties take optimal care, missing the latter objective also upsets the former, and the only feasible solution will be a third-best.

In tort liability the determination of the sharing of the accident loss among non-negligent parties does not affect the equilibrium level of care, and it can be manipulated in order to produce the appropriate incentives to optimally choose the activity level. On the contrary, in negative liability the sharing of the gain among non-negligent parties is a crucial issue for the determination of the equilibrium level of care and, if the rule is to produce optimal incentives, the setting of the share is severely constrained.

The result is that the determination of the incentives to take care cannot be disjoined from the determination of the incentives to choose the level of activity. In general, the desirability of a certain sharing with respect to care will have to be traded off with the need to control the activity level.[60]

In addition to that, we have noticed that, whilst in tort liability the sharing between negligent parties is irrelevant, in negative liability an accurate determination of such sharing might be needed in order to avoid multiple equilibria.

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[58] Rearranging Exp. (11) we derive the maximum and the minimum values for the share σ^*: $[s^*x^*+u(s^\wedge)-u(s^*)]/s^*t^*g(x^*,y^*)<\sigma^*<1-[t^*y^*+v(t^\wedge)-v(t^*)]/s^*g(x^*,y^*)$.

[59] It is easy to show that if $\sigma^*=0$ the benefactor will always take $x=0$, which is not optimal by the assumptions made.

[60] Shavell (1980) focuses on the effect of all-or-nothing allocations of the residual burden to either party. Parisi and Fon (2001) analyze the effect of sharing the residual burden according to causal contribution. These choices are clearly constrained if the shares have to be set within a bounded range for the purpose of providing parties with

While the production of incentives in tort liability is based on a *divide et impera* strategy, the same task assumes in negative liability a different characterization. Sharing becomes the central, indispensable and, at times, internally conflicting feature.

5   Conclusions

We have shown that, in negative liability, the negligence rule functions differently from positive (tort) liability. We have proved this difference by showing that negative sanctions (like the duty to pay damages) may be multiplied and hence simultaneously used to incentivize more parties. In fact, if in equilibrium parties comply with the rule, the punishment does not need to be applied and may be reused as an incentive for the next party. On the contrary, positive sanctions (like gains) do not share this property. If in equilibrium parties comply, the reward must be paid and thus cannot be reused. This might explain why liability based on sticks (tort liability) is more common than liability based on carrots (negative liability).

We have applied and formally demonstrated this property by studying the behavior of two parties under negligence rules. The same logic may be applied to multiple parties as well. In particular, it might be of use in situations in which there is more than one injurer. Landes and Posner (1980) proved that the negligence rule produces optimal incentives to take care for multiple tortfeasors irrespective of the contribution rule. Consistent with our results, in order for the equilibrium to be efficient the division of how the loss is shared among the injurers is irrelevant. Obviously, this result also applies to the case of multiple victims. As we might expect, the same cannot be true in a multilateral setting involving gains. Just like in the bilateral case, if there is more than one benefactor and/or more than one gainer, the gain must be appropriately apportioned for the incentive device to produce the desired effects.

The analysis shows that, under standard assumptions, negative liability is plagued by two problems: a potential conflict between optimal incentives for care and for activity level and the possibility of multiple equilibria. In reality, these shortcomings might render the functioning of negative liability difficult to control and might justify the dispersed legal approach to the internalization of positive externalities and the scarce application of the various forms of negative liability.

I remarked in the introduction that negative liability is not as widely implemented as tort liability and that it mainly relies on the specific rules of a narrow range of application. It is interesting to note that at times positive (tort) liability is adapted to the internalization of positive externalities in those situations in which the absence of negative liability leaves a gap to be filled.

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incentives to take care.

In some cases, for example, instead of rewarding the production of positive externalities, the legal system punishes the failure to produce them by considering it as a nonfeasance triggering tort (or criminal) liability.[61] In other cases, positive externalities are grouped together with negative ones and only serve to reduce the normal tort liability for the latter, as in the case of pure economic loss.[62] Pure economic loss has been interpreted in economics as comprising instances of accidents that produce a loss for one party and a gain for another. Since the positive externality is not separately internalized, tort law picks up the task of internalizing both the positive and the negative externalities.

In accordance with our analysis, it has been recently remarked that while governments are obliged to compensate for the taking of private entitlements, they cannot directly claim compensation for the enhancement in the value of private entitlements that results from their action.[63] Yet, not only has the absence of jurisprudence in the domain of governmental givings been seen as an unfortunate oversight, it has also been argued that if it were to be implemented in a profitable fashion, there would be no obstacle to its juridical consistency.[64] This observation correlates with our analysis and shows that the absence of a general treatment of privately produced positive externalities in the liability system has long been ignored by law and economics scholars, who have given the systematization furnished by legal doctrines in giving torts more importance than the concept of negative liability.

This article, however, distinguishes between the object of legal intervention and the means by which to realize it. It is maintained that an asymmetrical method (a homogeneous positive (tort) liability discipline versus scattered negative liability rules) might correspond to symmetrical objectives i.e. the internalization of negative versus positive externalities.

The consequence is that, even though the need to internalize positive externalities may be translated into legal doctrines symmetrical to those that support the internalization of negative externalities,[65] the actual realization of these tasks might have to take different legal routes. This

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[61] An example is the positive duty to rescue reinforced by tort liability for nonfeasance or criminal sanctions, implemented in many legal systems.

[62] Bishop (1982) first argued that the instances in which legal systems do not entitle victims to compensation for financial losses correspond (or should correspond) to those in which the victim's loss is counterbalanced by a third party gain, and is therefore to be considered as merely private. Awarding compensation for private losses that do not amount to social losses would induce over-precaution on the part of the injurer, in the view of Bishop. See also Rizzo (1982) for a different view. Arlen (2000), Bussani, Palmer and Parisi (2001) and Dari Mattiacci (2003) have recently analyzed the problem. In particular, Parisi (2001) notices that if the third party gain is higher than the victim's loss, then negative (i.e. gain) liability should apply: the injurer should be able to collect from the gainer.

[63] Bell and Parchomovsky (2001) indicate a number of examples of givings (e.g. up-zoning, changes in zoning, relaxation of environmental standards, licensing) especially in parts II and III of the paper. The authors argue that charging for givings would reduce interest group politics, enhance the efficiency of government and improve the fairness of the property system

[64] See Bell and Parchomovsky (2001) at 549: "Eclipsed by their celebrated twin, takings, givings occupy a crucial yet barely visible role in the universe of constitutional property law. While takings – government seizures of property – have been subject to an elaborate body of scholarship, givings – government distributions of property – have been overlooked by the legal academy" (footnotes omitted). See further *ibidem* at 550-554.

[65] See Bell and Parchomovsky (2001) on this point.

study has identified a serious asymmetry that distinguishes negative from positive (tort) liability in a way that is not ascribable to the sign of the externalities, but rests on the intrinsic functioning of the liability rule.

In this article I have supported a symmetrical view of the cathedral – positive externalities ought to be as internalized as negative ones – whilst accepting that the scope of negative liability may in fact be limited compared to that of positive (tort) liability. Ultimately, we may conclude that symmetrical aims are bound to live by asymmetrical means.
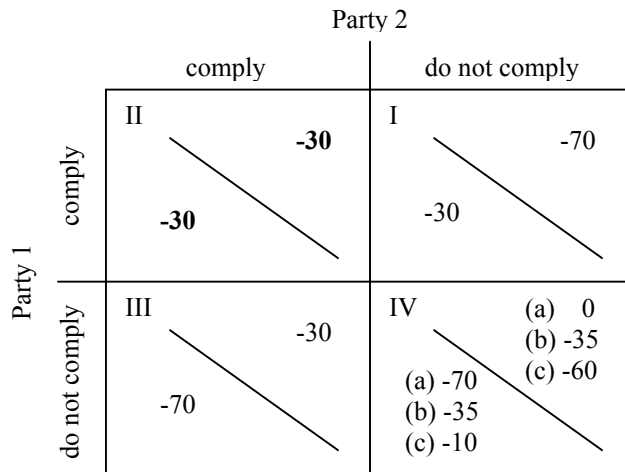
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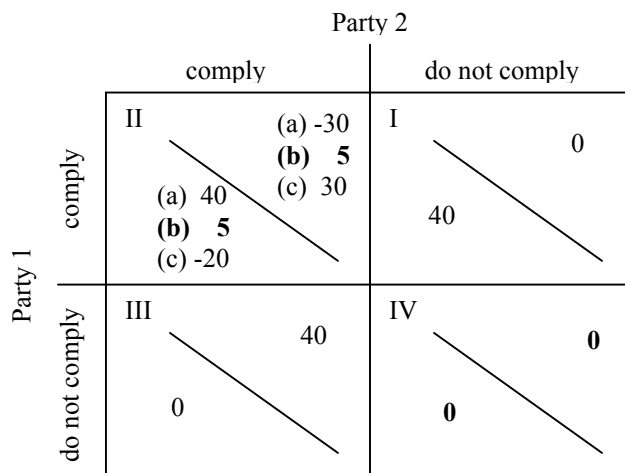
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Figures

Party 2

	comply	do not comply
comply (Party 1)	**II** **-30** (top right) **-30** (bottom left)	**I** -70 (top right) -30 (bottom left)
do not comply (Party 1)	**III** -30 (top right) -70 (bottom left)	**IV** (a) 0, (b) -35, (c) -60 (top right) (a) -70, (b) -35, (c) -10 (bottom left)

Figure 1: Enforcing by punishing

Party 2

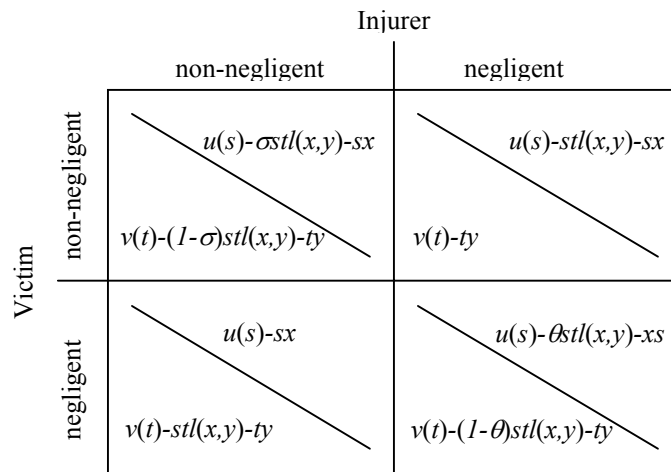|	comply	do not comply
comply (Party 1)	**II** (a) -30, **(b) 5**, (c) 30 (top right) (a) 40, **(b) 5**, (c) -20 (bottom left)	**I** 0 (top right) 40 (bottom left)
do not comply (Party 1)	**III** 40 (top right) 0 (bottom left)	**IV** **0** (top right) **0** (bottom left)

Figure 2: Enforcing by rewarding

Figure 3: The game created by negligence in positive (tort) liability
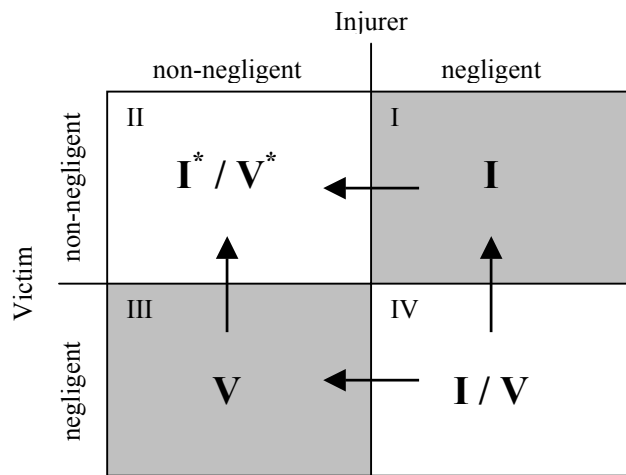
Figure 4: The functioning of negligence in tort liability
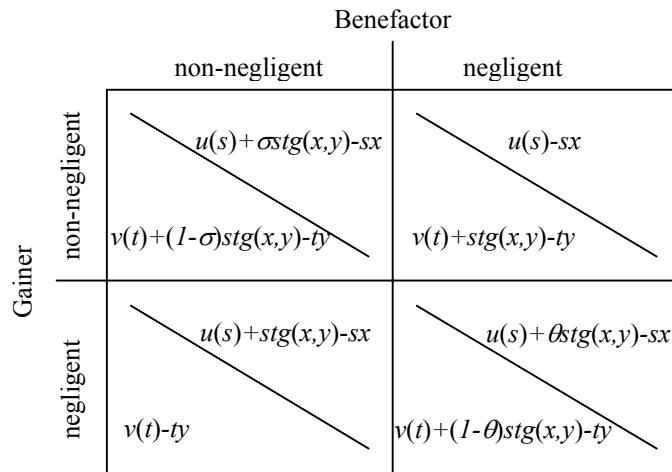
Benefactor

	non-negligent	negligent
non-negligent (Gainer)	$u(s)+\sigma stg(x,y)-sx$ $v(t)+(1-\sigma)stg(x,y)-ty$	$u(s)-sx$ $v(t)+stg(x,y)-ty$
negligent	$u(s)+stg(x,y)-sx$ $v(t)-ty$	$u(s)+\theta stg(x,y)-sx$ $v(t)+(1-\theta)stg(x,y)-ty$

Figure 5: The game created by negligence in negative liability

Benefactor

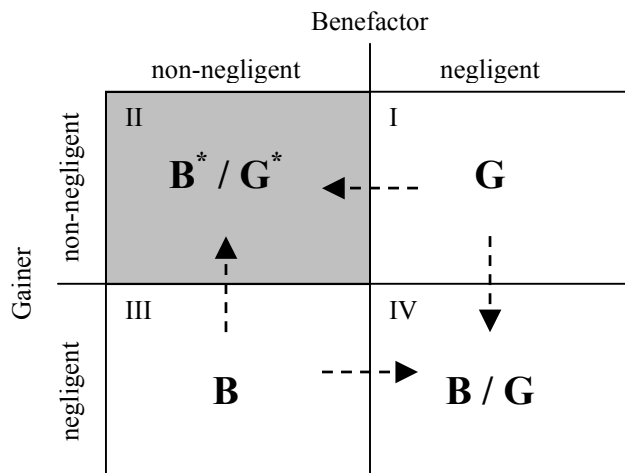|	non-negligent	negligent
non-negligent (Gainer)	II B^* / G^*	I G
negligent	III B	IV B / G

Figure 6: The functioning of negligence in negative liability