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Limiting Limited Liability

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Abstract

Limited liability may result in inefficient accident prevention, because a relevant portion of the expected harm is externalized on victims. This paper shows that under some restrictive conditions further limiting liability by means of a liability cap can improve caretaking.

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1. Introduction

Limited liability is often blamed for making it too easy for firms to take risks that, if materialized, are externalized on unaware victims. The most troubling aspect concerns liability in torts, when accident victims are not part of any contract with the damaging firm, and hence cannot negotiate an appropriate level of precaution. Environmental accidents provide many examples of these types of eventualities.

Limited liability usually results in insufficient caretaking (Summers 1983; Shavell 1986). However, Beard (1990) shows that limited liability may result in *excessive* caretaking, which in turn causes some otherwise solvent firms (Dari-Mattiacci and De Geest, forthcoming) to be bankrupt in the case of an accident. This paradoxical result is explained by noting that a potentially insolvent firm receives a precaution subsidy when it makes *monetary* precautionary expenditures.

In fact, when precaution costs amount to a monetary investment (e.g. a firm improves funding for its safety division), precautionary expenditures reduce the amount of the assets that are available for damage compensation. After making precautionary expenditures, the firm is left with a smaller amount of assets, and thus is exposed to a reduced potential liability. Because more precautions result in less liability, precautionary expenditures may be said to be partially subsidized by the consequent reduction in expected liability, possibly yielding to higher levels of precautions than would be socially optimal. With non-monetary precautions, this scenario would not arise, as the firm's *ex post* liability would be independent of its *ex ante* precaution decisions.

Commentators often advocate piercing the veil of corporate liability,[1] shifting the liability burden to vicarious or third parties[2] or imposing stringent financial requirements[3] as a possible solution to the problems caused by limited liability. Without opposing this view, this paper suggests that the reverse policy could also be socially desirable, showing that further limiting a firm's limited liability, by capping the maximum damage award,[4] may improve precaution incentives and, consequently, social welfare. Section 2. contains the basic model of potentially insolvent firms with monetary precaution costs. Section 3. shows that liability caps may improve social welfare. Section 4. discusses the optimal setting of the liability cap. Section 5. provides a conclusion.

2. Model: firm's assets and precaution

Building on Shavell (1986), we analyze the precaution decision of a risk-neutral limited liability firm with (exogenously determined)[5] assets a, which operates under strict liability.[6] The firm's

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[1] Hansmann and Kraakman (1991); Leebron (1991). See also Beard (1990, p. 633).
[2] Sykes (1981); Kornhauser (1982); Dari-Mattiacci and Parisi (2003); Arlen and MacLeod (2005).
[3] Shavell (2005).
[4] Boyd and Ingberman (1994) are the first to advocate non-compensatory damages as a solution to the dilution of incentives caused by insolvency. However, they employ a model in which precaution expenditures do not reduce the tortfeasor's liability, and hence discuss a different set of problems.
[5] Boyd and Ingberman (1999) study insolvency when assets are endogenous to the model.
[6] The negligence rule is also advocated as a solution to the problem (Summers 1983; Shavell 1986), although it solves the problem only if the standard of care is perfectly anticipated *ex ante* (Craswell and Calfee 1986).

precaution lowers the probability of a single harmful accident involving victims who are strangers[7] to the firm and cannot take any form of precaution in order to protect themselves from harm (e.g. a chemical plant explosion). All functions are continuously differentiable to any desired order. Let:

x	=	the precaution cost, $x \geq 0$;
$p(x)$	=	probability of an accident, $0 < p(x) < 1$, $p' < 0$, $p'' > 0$;
h	=	magnitude of the harm, $h > 0$;
c	=	the liability cap, $c \leq h$;
a	=	the assets, $a > 0$.

The social objective is to minimize the standard (social) cost function:

$$S(x) = p(x)h + x \tag{1}$$

Let x^* denote the (unique) level of precaution that minimizes (1) and let it be positive; x^* represents the first-best level of precaution in the absence of limited liability. The firm has limited assets and, following Beard (1990), its precautionary expenditures are monetary, and hence every dollar spent in precaution reduces the net assets available for liability by the same amount. Unlike this literature, we also assume that there is a limit (the liability cap) on the amount of damages that victims will be legally entitled to recover from the firm in the case of an accident. Because of the liability cap, the firm pays damages equal to $c \leq h$, that is, the damage award may be less than the harm.

As a result, if an accident occurs, the firm will pay the (possibly capped) damage award c if his remaining assets $a - x$ (that is, the amount of assets left after making precautionary expenditures x) are larger than (or equal to) c; the firm will pay $a - x$ if its remaining assets are less than c. Thus, the firm's liability costs are as follows:

$$L(x) = p(x)\min\{c, a - x\} + x \tag{2}$$

If $c = h$, we have the case analyzed by Beard (1990), in which it can be proved that the level of precaution taken by the firm may be higher than x^* (e.g.: when $a = h + x^*$). Some firms, which would be solvent had they taken the socially optimal level of precaution (in the example, $a - x^* = h$), may be induced to take a higher level of precaution, which is the only cause of their bankruptcy and lowers social welfare.

3. Analysis: liability cap and precaution

We will now show that by lowering c it is possible to improve social welfare. From (2), the firm's liability minimization problem can be written as follows:

$$\min\left\{\min_x\left[p(x)c + x\right], \min_x\left[p(x)(a - x) + x\right]\right\} \tag{3}$$

The problem is convex in x. In order to determine the pattern of the firm's precaution as a function of c, note that the first part in (3) depicts the firm's minimization problem when the firm is solvent, that is when $c \geq a - x$. In this case, the firm is able to pay the (truncated) damage award. For convenience, let x_c be the level of precaution that minimizes the firm's liability in this case. The second part in (3) depicts the liability costs of an insolvent firm, when $c < a - x$.

[7] That is, the victims cannot negotiate the level of precaution with the firm.

Let x_{a-x} denote the level of the firm's precaution that minimizes the firm's liability in this case. Note that x_{a-x} is constant in c and, by the Implicit Function Theorem, increasing in a. On the contrary, x_c is increasing in c but constant in a. Therefore, comparing (1) and (3), we have $x_c \leq x^*$, as long as $c \leq h$. The infra-marginal decision between solvency (taking x_c) and insolvency (taking x_{a-x}) depends upon which of these two possibilities yields the lowest total cost for the firm:[8]

$$p(x_c)c + x_c <> p(x_{a-x})(a - x_{a-x}) + x_{a-x} \tag{4}$$

Using (4) we can determine the level of the firm's assets at which the firm will switch from x_{a-x} to x_c:

$$a_c = \frac{p(x_c)c + x_c - (1 - p(x_{a-x}))x_{a-x}}{p(x_{a-x})}$$

By the Envelop Theorem, $p(x_c)c + x_c$ is an increasing function of c; thus, a_c also increases in c. Therefore, by lowering c below h the firm can be induced to take x_c instead of x_{a-x}. This improves social welfare as long as:

$$p(x_c)h + x_c < p(x_{a-x})h + x_{a-x}$$

Figure 1 shows the pattern of the firm's precaution with and without a liability cap.

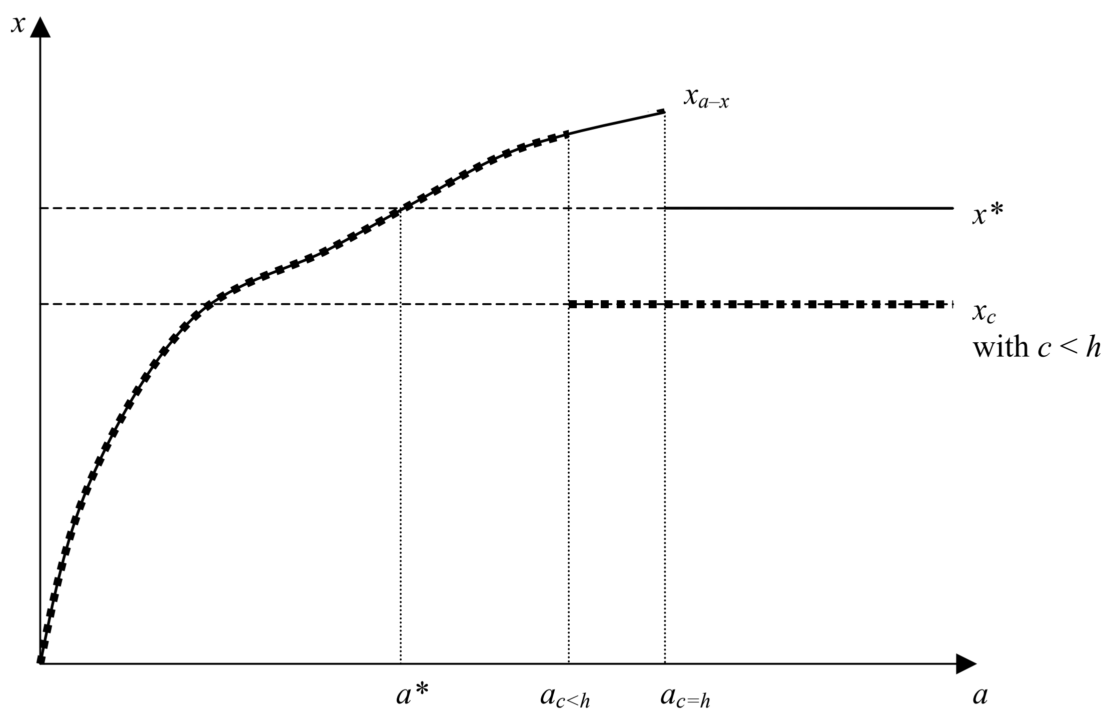

FIGURE 1: *Liability cap and firm's precaution*

[8] For this solution algorithm, see Dari-Mattiacci and De Geest (forthcoming).

4. Policy implications: the optimal setting of the liability cap

In a world with only one firm, the optimal $c \leq h$ depends upon the firm's assets a. In general, c should be set as high as possible, since the social cost decreases in c, but not too high, since we want the firm to prefer x_c to x_{a-x}. Such a level of c satisfies a strict equality in (4) and is an increasing function of a. Figure 2 depicts the impact of such a liability cap on the social cost. Let $c\hat{}=c\hat{}(a)$ denote this level of c. In addition, let $a\hat{}$ be such that $S(x_c(c\hat{}(a\hat{}))) = S(x_{a-x}(a\hat{}))$.

To the right of x^*,[9] $S(x_{a-x}(a))$ increases as a increases, since $x_{a-x} > x^*$ moves further away from x^*. On the contrary, $S(x_c(c\hat{}(a)))$ decreases as a increases, since $x_c < x^*$ moves closer to x^*. It follows that for $a \geq a\hat{}$ the social cost is lower when the firm takes x_c than when it takes x_{a-x}. On the contrary, for $a < a\hat{}$ the social cost is lower when the firm takes x_{a-x} than when it takes x_c. At the other end of the spectrum, when $a \geq a_{c=h}$, the firm takes x^* if no liability cap is applied, while it takes x_{a-x} when $a < a_{c=h}$ and no liability cap is applied. Therefore, in the range $a\hat{} < a < a_{c=h}$ the optimal liability cap is $c\hat{}(a) < h$, since the firm's precaution can be improved by making it take x_c instead of x_{a-x}. Outside this range $c = h$ is optimal, either because the firm already has incentives to take x^* (upper end) or because x_{a-x} results in lower social costs than any feasible x_c (lower end).

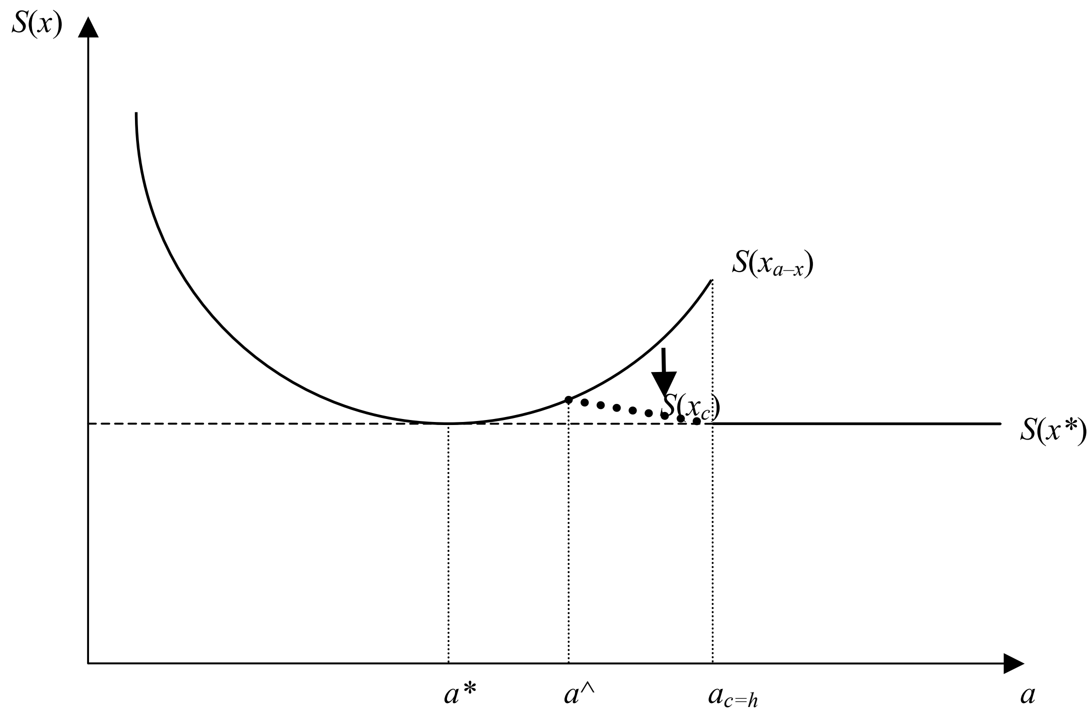

FIGURE 2: *Social cost and liability cap*

[9] To the left of x^* a liability cap would only worsen caretaking.

Let us now consider a world in which many firms exist with different assets, where the liability cap affects *all* firms at the same time. Given a distribution of firm types between $\underline{a}$ and $\bar{a}$, with density $f(a) \geq 0$ over the relevant region and cumulative distribution $F(a)$, with $F(\underline{a}) = 0$ and $F(\bar{a}) = 1$, we have the following restatement of the social cost in (1) as a function of c:

$$\min_c \left[\int_{\underline{a}}^{a_c(c)} S(x_{a-x}(a))dF(a) + \int_{a_c(c)}^{\bar{a}} S(x_c(c))dF(a) \right]$$

where firms with assets below a_c take x_{a-x}, while firms with assets above a_c take x_c. A change in c affects the level of precaution taken by the latter group of firms and, at the same time, also affects the composition of both groups, since a_c varies with c. Assuming convexity, the optimal setting of the liability cap solves the following FCO:

$$\frac{dS(x_c(c))}{dc}[1 - F(a_c(c))] = [S(x_c(c)) - S(x_{a-x}(a_c(c)))]f(a_c(c))\frac{da_c}{dc} \tag{5}$$

Expression (5) is readily interpreted. The LHS can be seen as the marginal benefit of raising the liability cap, thereby increasing the levels of precautions taken by all firms to the right of a_c. Recall that by raising c we bring x_c closer to x^*, thereby reducing the social cost. The RHS depicts instead the marginal benefit of lowering the liability cap: the marginal firm (with assets equal to a_c) is induced to take $x_c < x^*$ instead of $x_{a-x} > x_c$, in so doing, possibly reducing the social cost. The optimal liability cap balances these opposite effects and depends upon the distribution of the firm types.

5. Conclusions

A potentially insolvent firm may be induced to take *more* precaution than is socially optimal. This is due to an implicit precaution subsidy generated by monetary precautionary expenditures, which reduce the amount of the firm's assets exposed to liability. This increment in precaution increases the total social cost of accidents. We have shown that capping the firm's liability can reduce both the firm's precaution and the social cost of accidents.

Liability caps are limits on the firm's liability exposure set by law. Contrary to the firm's assets, liability caps are independent from the firm's precautionary expenditures. An increase in the firm's precaution reduces the firm's assets but does not affect the liability cap. For this reason, liability caps are not vulnerable to the perverse incentives created by monetary precautionary expenditures and can effectively counter excessive precaution, thereby giving the opportunity to improve social welfare.

In a world in which many firms exist with different assets, liability caps come at some costs, as they also lower the level of precaution of some solvent firms. Optimal liability cap policies balance these costs against the benefits we have emphasized above in this paper.

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