Environmental Harm and Financial Responsibility[*]

by Eberhard Feess[**] and Ulrich Hege[***]

Firms will exert too little care due to a limited liability effect if damages are likely to exceed their equity. This is particularly important for environmental and product liability and motivates the current discussion about mandatory insurance and extending liability to creditors. We model the choice of the care level as a moral hazard problem that can be solved through costly monitoring. Conventional strict liability and lender liability both lead to distortions in the capital structure and to inefficiently low care. By contrast, mandatory liability coverage (financial responsibility) that can be satisfied by either an insurance contract or a lender guarantee leads to the first best allocation if managers can self-insure, and to the second best if managers cannot self-insure but choose to be monitored.

1. Introduction

Contribution

It is well-known that strict liability will induce firms to choose inefficiently low care levels if there is a possibility that they go bankrupt. Damages large enough to put the firm into bankruptcy, like environmental and product liability or health risks, will be undervalued because some of the losses of the victims will go unclaimed under conventional strict liability (limited liability effect).[1] Moreover, for firms facing considerable liability risks, levering up the capital structure may become an effective evasion strategy. In an empirical study for the U.S., Wiggins and Ringleb (1990) indeed find that firms attempt to avoid liability by shielding assets through divestiture. Their analysis suggests that the incentive to avoid liability led to a 20 per cent increase in the number of small corporations between 1967 and 1980.

There is an active discussion among economists and practitioners on how to mitigate the insolvency problem. The following four proposals in particular have gained importance. First, *extending liability* to third parties (like lenders) having contractual relationships to the potentially insolvent firm. This is most prominent in the United States where managers, shareholders, holding companies and notably secured creditors are among the groups which have been held liable under the Comprehensive Environmental Response, Compensation and

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** Department of Economics, University of Frankfurt, Schumannstrasse 34a, D-60325 Frankfurt, Germany. E-mail feess@wiwi.uni-frankfurt.de.
*** Tilburg University, Center for Economic Research and Department of Finance, Warandelaan 2, NL-5000 Tilburg, The Netherlands. E-mail hege@kub.nl.
[1] See Summers, 1983, Schwartz, 1985 and Shavell, 1986. Beard, 1990 and Posey, 1993 extend the discussion to care costs that reduce the coverage of the defendant. Kornhauser and Revesz, 1990 discuss the problem of multiple tortfeasors. See Kraakman, 1998 for different inefficiencies caused by limited liability.

Liability Act (CERCLA). Kroszner and Strahan (1998) find empirical evidence that concerns about future tort liabilities refrain creditors from being present on board, so that they can not be considered as third parties. Second, to authorize hazardous plants only if operators show proof that all environmental risks are covered, i.e. to impose *mandatory insurance* or a variant, "*financial responsibility*". Financial responsibility is in principle identical to mandatory insurance, but it *explicitly* permits that the environmental risk is covered by a financial guarantee *other* than a regular insurance contract, for example by the guarantee of a lender. Third, *funds* financed by firms facing similar risks. They are important under CERCLA besides extended liability ("Superfund"), and play an important role within the European Union. Fourth, many insurance policies have conditions which de facto imply *mutual risk-sharing*, thus reducing each firm's liability risk.[2]

If information were perfect, then all these proposals would clearly be fully efficient.[3] In practice, however, there are pervasive problems of asymmetric information between investors and firms, e.g. because investors have difficulties in correctly anticipating environmental risks (adverse selection) or cannot costlessly monitor the care level (moral hazard). Liability for environmental hazards beyond the firm's equity leads then to agency costs and other distortions.

The academic discussion on the insolvency problem, briefly surveyed below, has yielded the insight that there is *no single mechanism which is constrained efficient in all environments*. The debate, therefore, must concentrate on identifying the determinants of the conditional optimality of the proposals at hand. This paper focuses on two key parameters not analysed elsewhere in the discussion, namely possible distortions in the debt structure and the availability of audits or monitoring technologies to supervise the safety measures and the level of care.[4] We compare *strict liability only*, *lender liability* and *financial responsibility* in a setting where the firm's care level is unobservable. We show that the concept of financial responsibility implements a first-best solution if firms can self-insure, and a second-best solution if they cannot, but have moderate monitoring costs.

Concerning the capital structure, we show that strict liability without financial responsibility induces firms to increase their leverage with debt which is prior to environmental liability in the case of insolvency. This is easily done under current U.S. law by adding secured debt.[5] Moreover, this paper argues that lender liability alone is not sufficient to eliminate capital structure distortions. In practice, only *large creditors* and creditors with a *lending relationship* with the borrower can be held liable for environmental risks not covered by the firm's equity or insurance policies. Firms typically have substantial discretion to structure their liabilities in such a way that a part of the debt financing cannot be held liable under lender liability and enjoys even priority over damages awards, for example, if widely dispersed bonds are issued so that transaction costs of liability would be prohibitively high. Because lender liability affects different groups of financiers unequally, it leads to distortions in financing decisions and investment.

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[2] The difference of mutual risk-sharing to funds is that no payments are required in advance; see Skogh, 1998.

[3] See e.g. Shavell, 1987.

[4] Throughout this paper, "auditing" and "monitoring" are used synonymously.

[5] Basically, in U.S. bankruptcy proceedings, claims of the Environmental Protection Agency (EPA) for the clean-up of toxic property are ranked as administrative expenses. That is, they are junior to secured claims, but senior to all unsecured claims; see *In re Chateaugay Corporation* 994 F.2d 997 (2nd Circuit Court 1991); *In re Hemingway Transport, Inc.*, 993 F.2d 915 (1st Circuit Court) and *Pennsylvania v. Conroy*, no. 93-3284 (3rd Circuit Court 1994).

The three liability rules analysed in our paper can be ranked with respect to the possibilities to circumvent liability claims: under strict liability only, liability can be avoided by substituting equity with secured debt that is prior to liability claims. Under lender liability, public debt can be substituted for private debt. Financial responsibility differs from both in making it no longer possible to reduce liability risks through changes in the capital structure. In other words, all liability rules except financial responsibility lead to distortions in the capital structure as a means of evading liability claims. This is the first reason why this papers argues in favour of financial responsibility for environmental risks.

Environmental audits or safety monitoring are the second new element of this paper, supplying a second independent argument in favour of financial responsibility. Safety monitoring is relevant: practitioners and lawyers seem to take it for granted that moral hazard problems can be mitigated through monitoring. Big industry insurers and banks have developed considerable competencies in screening environmental risks, in safety consulting and in auditing. In our model, safety monitoring mitigates the moral hazard problem, and hence the disadvantages associated with extended liability.

Our analysis highlights the crucial role played by the manager's wealth endowment. We analyse this in two steps. In the first step, we assume that the manager's initial wealth is sufficient to prove that s/he can pay for the damage themselves if financial responsibility is required. In practice, this can be done through a bank deposit. It is shown that it is in the manager's self-interest to choose this kind of self-insurance to avoid the agency costs caused by moral hazard. Hence, financial responsibility leads to a first-best solution concerning care, capital structure and investment, whereas each other liability rule leads to inefficiently high leverage and to inefficiently low care.

In the second, and presumably more interesting, case, it is assumed that the manager's wealth is too low for self-insurance. As will be shown, whether it is worth paying for monitoring depends on the efficiency of the monitoring technology, the manager's initial wealth (i.e. the significance of the insolvency problem) and the liability rule. Though it is not necessarily true, we demonstrate that financial responsibility leads to the second best under reasonable assumptions. Whereas strict liability only can be superior to financial responsibility in extreme cases, it is shown that lender liability is *always* inferior to at least strict liability *or* financial responsibility.

Related literature

A number of papers have addressed lender liability and compulsory insurance in models with moral hazard. Pitchford (1995) shows that extending liability beyond the manager's wealth reduces her effort and social welfare. With competitive capital markets, the manager prefers to pledge the total wealth endowment towards damages to reduce the agency costs. If the manager's wealth is not sufficient to cover the damages, then lender liability implies an increase in the interest rate, lowering the manager's incentive to avoid environmental harm. Pitchford's result can be viewed as a special case of our model, assuming that monitoring is extremely inefficient. A second argument for partial liability instead of full financial responsibility is developed by Boyer and Laffont (1997). They argue that there are two effects working in opposite directions: extending liability increases the agent's effort implemented by the principal, but higher agency costs can discourage socially valuable projects. Boyer and Laffont also compare lender liability to mandatory insurance, and they prefer (partial) lender liability. This follows from the assumption that the creditor is always better informed than the insurance company, at least with respect to the firm's expected

profits. However, this problem cannot arise under financial responsibility, because the firm will prefer to be covered by the lender if the bank is better informed than the insurance company.

Boyd and Ingberman (1997) focus on distortions in investment decisions to argue that extended liability can reduce social welfare. Their main idea is that the capital invested by third parties simultaneously reduces the per unit cost of production and increases the assets. If the third party is liable, the incentive to decrease the costs of production is reduced by the fact that the expected liability payments are increasing in the investment. Conversely to Boyer and Laffont, Boyd and Ingberman are of the opinion that mandatory insurance is superior to extended liability. Endres and Lüdeke (1998) derive arguments for partial liability in a somewhat different environment.

These papers make important points in favour of partial liability. But taken in isolation, they tend to overstate the case for partial liability, as our model confirms. The following four important arguments must be weighed against partial liability and in favour of full liability:

First, it has been shown that the effect pointed out by Pitchford crucially depends on the assumption that the manager has full the *bargaining power* (i.e. that capital markets are competitive). By generalizing the models of Pitchford (1995) and Heyes (1996), Balkenborg (1997) shows that the optimal level of extended liability is unambiguously increasing in the bank's bargaining power, and that full extended liability is optimal if the lender has all of the bargaining power.

Second, and perhaps more importantly, *monitoring* reduces the agency costs and hence increases the likelihood that full internalization is superior. In our setting, full financial responsibility is superior to any kind of partial liability (or partial financial responsibility) whenever the firm prefers to be monitored at all.

Third, the *capital structure distortions* caused by any regime but financial responsibility are often underestimated in the literature. Strict liability or partial lender liability will lead to increases in the debt-equity-ratio, and full lender liability which is backed up by mandatory coverage or financial responsibility cannot avoid capital structure distortions since loopholes will exist.

Fourth, full liability is more robustly providing (constrained) efficient incentives for *investment* into projects with environmental risks. With partial liability, these risks are indirectly subsidized and overinvestment is likely.

The benefits in terms of efficient monitoring arising when financial guarantors expose their assets to the liability claims of the firm they underwrite have already been emphasized by Skogh (1991). Lindgren and Skogh (1996) and Skogh (1998) compare different methods of mitigating the insolvency problem, especially mandatory insurance and mutual funds. They conclude that mutual funds can be superior if reliable probabilities for harm cannot be estimated. Transaction costs can then be reduced since *ex ante* payments are not required. Though we restrict our attention to lenders and insurers, it would be interesting to extend our analysis to a richer setting of possibilities to establish proof of financial responsibility, such as mutual risk-sharing, collective funds, or sophisticated market-based risk transfer tools such as disaster bonds.

Jost (1996) emphasizes the benefits of compulsory insurance if insurers can reduce asymmetric information through environmental audits. The regulator observes the insurance contracts and will approve production only if an *efficient* insurance contract has been signed. This is different to financial responsibility, where each insurance contract sufficiently high leads to permission. Shavell (1986) argued that the overall effect of mandatory insurance is ambiguous. While it prevents socially inefficient projects, it also means that the agent bears no

risk and has few incentives for care. Polborn (1998) shows that Shavell's effect is unimportant if the agent's wealth is high enough to pay the insurance premium in advance (given his/her maximum deductible). Both models can be viewed as special cases of our analysis. Finally, it should be mentioned that attention is restricted to strict liability and that negligence rules for the firm (see Demougin and Fluet, 1999) or the third party (see Feess, 1999) are not considered.

In a companion paper (Feess and Hege, 1999) we reconsider the extended liability regimes by opening the black box of "agency costs". Our two papers are related as follows. In this paper, we take for granted the argument of Pitchford (1995) and followers that increasing liability beyond the maximal self-insurance limit leads automatically to strictly increasing agency costs; we confirm then that there can be important cases where liability should be restricted below the level of harm. In Feess and Hege (1999) we analyse a micro-economic model of safety auditing and find that under the optimal insurance contract, expected monitoring costs can be kept to a minimum. As a result, full liability is always optimal. Taken together, both papers are probably the most rigorous accounts to date of the crucial role of the assumptions on agency costs in the full versus partial liability debate.

The paper is organized as follows. The model is laid out in section 2. Section 3 discusses the case where the manager's initial wealth is sufficient to provide self-insurance. Section 4 extends to the case where self-insurance is impossible. Section 5 relates our findings to the legal situation and concludes.

2.   The model

In our model, a risk-neutral manager owns a project that requires an investment I. The manager has unobservable initial wealth W and chooses between equity and debt to finance I. Let I_D be the part financed by debt and $E = I - I_D$ the part financed through equity. All financial variables are expressed as present values when the financial structure is chosen. The project yields a random pre-tax cash flow x distributed with the cumulative distribution function $F(x)$ over the positive interval. Capital markets are competitive. In case of publicly floated debt, the investment is equally split up among a large number of investors. For the capital structure decision, we invoke a standard static trade-off model. On the one hand, the firm needs to pay a corporate tax rate of τ on the fraction of its cash flow belonging to shareholders, but not on the part owed to debtholders. On the other hand, the higher its financial leverage, the higher the probability that the firm faces bankruptcy with an ensuing loss of bankruptcy costs.

Let b be the bankruptcy costs. Suppose debt with a face value of $\delta(I_D) \geqslant I_D$ is issued, where δ is a strictly increasing function of I_D. Therefore, the capital structure decision is captured by the level of debt funding I_D. The firm goes bankrupt if $x < F(\delta(I_D))$.

Therefore, according to the static trade-off model, the manager's capital structure decision maximizes the expected after-tax cash flow, denoted by R:

$$\max_{I_D} R = E[x - \tau(x - \delta(I_D))] - bF(\delta(I_D)),$$

where $E[\cdot]$ is the mathematical expectations operator. We write this objective function as $R(I_D)$ for short, and we assume that $R(I_D)$ is a strictly concave function of I_D. In the

absence of any distortion, we denote the debt financing level that maximizes the firm value by I_D^f, i.e.

$$I_D^f = \arg\max R(I_D)$$

We assume that $W \geqslant I - I_D^f$. Capital and insurance markets are competitive.

We take explicit account of the manager's discretion to avoid creditors actually being held liable under lender liability. Such avoidance strategies are simple to use: the manager makes sure creditors never build a relationship with the firm (which would put them at risk for liability as operator) or that no single creditor is large enough to be held liable by a court of law, for example by issuing dispersed debt claims or holding large positions of accounts payable. We assume that there is uncertainty whether such an avoidance strategy, once adopted, is effective. It is assumed to be totally effective with a probability α and totally ineffective with probability $1 - \alpha$. There is fixed cost $c > 0$ if the manager adopts the avoidance strategy. The cost c is a deadweight loss.

The project carries an environmental risk D that occurs with probability $p(e)$, where e is the manager's effort cost and $\mathrm{d}p/\mathrm{d}e < 0$, $\mathrm{d}^2 p/\mathrm{d}e^2 > 0$ as usual. The manager's care e is unobservable. Hence, without adding monitoring and the protective strategies against lender liability into the model (see below), social welfare can simply be written as

$$SW = R(I_D) - I - p(e)D - e \tag{2.1}$$

Hence the care level that maximizes social welfare (e^f) is given by $-\mathrm{d}p/\mathrm{d}e^f D = 1$, independent of the capital and debt structure. While the manager is strictly held liable for D, the part of her wealth not invested into the project is protected by limited shareholder liability. Hence there is an insolvency problem unless the environmental risk is insured, a problem captured by the assumption $D > R(I_D^f)$. Damages have strict priority over equity, but debt is secured and is prior to damages.

Under these assumptions, we compare three different legal situations:

- Strict liability only (*SL*): under *SL*, liability is neither extended to third parties nor is insurance coverage required to get a permission for the project;
- Lender liability without financial responsibility (*LL*): with *LL*, strict liability is extended to bank creditors. Lender liability does not extend to the fraction of credit which has been protected against lender liability claims, at an extra cost of $c > 0$ per unit of credit;
- Financial responsibility (*FR*): under *FR,* the investment is only authorized if the manager shows proof that D is fully covered by either her own wealth, an insurance company or by a lender.

An important point to note is that in the cases *LL* and *FR*, the manager ultimately has to bear the full amount of damages D, directly or indirectly, via higher risk premia for credit or fair insurance premia. Nonetheless, moral hazard and the insolvency problem jointly imply that the care level would be below e^f. The manager is looking for a bonding device to increase e when signing contracts with lenders and insurers. We assume that environmental audits or monitoring constitutes such a bonding device. Lenders and insurers can perform audits on the firm to make sure that the required level of care is maintained. The idea is that the probability of detecting a lower quality standard than contracted upon and the fine payable in these cases are high enough that it is in the manager's self-interest to choose the contractual care effort.

Monitoring solves the moral hazard problem, but at a cost. With monitoring, total costs of implementing an effort level e are $m(e)$, where (*i*) $m(e) > e$, for all e, and (*ii*) $m(e)$ is strictly

convex in e. Note that $m(e) > e$ captures both the costs of effort and the costs of monitoring. For simplicity, it is assumed that $m(e)$ is directly borne by the manager, for instance because she has to pay the monitoring costs anyhow.[6] For our model, it plays no role whether the auditing is carried out by a bank, an insurer or any other institution.[7]

Our setting with monitoring costs increasing in the desired care level seems to be especially suitable in cases where environmental harm is caused by lack of organization or other deficits of supervision – the more rampant the lack of organization, the larger the effort needed to detect it. There are, however, also cases where monitoring costs depend on the size of the investment, for example if costs are largely determined by technical devices.[8]

If the manager and a third party (insurer, lender or anybody else) agree upon a positive level of monitoring, then social welfare is

$$W = R(I_D) - I - p(e)D - m(e) \tag{2.2}$$

where the second best level of effort is given by $-\mathrm{d}p/e^S D = \mathrm{d}m/e^S$. Obviously, $e^S < e^f$, because $m(e) > e$ for all e.

To summarize, the model addresses a moral hazard problem about the care level e that can be solved by costly auditing technologies. The crucial point is that the liability rules analysed in the following sections influence both the incentive to audit and the capital structure. Hence several distortions have to be taken into account when assessing the efficiency of different regimes.

3. Manager's initial wealth is high

In this section we assume that the manager has enough initial wealth W to prove that s/he can pay for the damage themselves if financial responsibility (FR) or lender liability (LL) is required. In practice, this can be done through a bank deposit and is possible if and only if $W + R(I_D) - I \geqslant D$.

Strict liability only (SL)

First, we show which distortions are caused by the insolvency problem if neither extended liability nor financial responsibility exists. First note that there is no risk for lenders. The manager's objective function is

$$M^{SL} = [1 - p(e)][R(I_D) - I_D] - (I - I_D) - e \tag{3.1}$$

Without accident, the manager gets $R(I_D) - I_D$, otherwise she goes bankrupt. The first order condition for I_D is given by[9]

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[6] It would make no difference if we assumed that the manager bears e directly and has to pay for an additional part $a(e)$, where $m(e) = e + a(e)$.

[7] In reality, either banks or insurance companies might have the superior auditing technology. While insurance companies have substantial experience in environmental monitoring, it is by now also common bank practice to assess the environmental risks of potential borrowers.

[8] We are grateful to an anonymous referee for pointing out these differences.

[9] Subscripts SL denote the case with strict liability only.

$$[1 - p(e^{SL})]\frac{\mathrm{d}R}{\mathrm{d}I_D^{SL}} + p(e^{SL}) = 0 \tag{3.2}$$

Comparing I_D^{SL} to the first best debt level I_D^f shows immediately that the debt level is too high, because debt is prior to damages and hence the part of harm borne by victims is the higher, the higher the level of debt. Moreover, the FOC for effort is

$$-\frac{\mathrm{d}p}{\mathrm{d}e^{SL}}[R(I_D^{SL}) - I_D^{SL}] = 1 \tag{3.3}$$

Hence, $e^{SL} < e^f$, and the distortion is increasing in the level of debt. This is a limited liability effect: the safety level is too low whenever harm exceeds the firm's solvency. Moreover, the distortion is aggravated by the incentive to increase leverage.

Financial responsibility (FR)

Next we prove that *FR* leads to the first best levels of effort and capital structure if $W + R(I_D) - I \geq D$. The reason is that since capital markets and insurance markets are competitive, they will give the right price signals so that the manager finds it his/her best interest to pledge the full value of W as a liability deposit to avoid the agency costs caused through insurance coverage or lender liability. Suppose the manager deposits a part of his/her wealth $\tilde{W} = D + I - R(I_D)$, so that she can definitely pay for total damages. His/her objective function is then

$$M^{FR} = R(I_D) - I - p(e)D - e \tag{3.4}$$

Since $M^{FR} = W$, it follows that $e^{FR} = e^f$. Note that the risk borne by the manager is independent of the capital structure, so that s/he also chooses the efficient level of debt. Obviously, the manager's expected utility is lower in each other case, because s/he has to bear the total welfare loss if capital and insurance markets are competitive, and if it is not possible to externalize part of the harm to victims. Without monitoring, s/he will always choose $e < e^f$ because of the moral hazard problem and pays accordingly high insurance premia or interest rates. But with monitoring, s/he bears $m(e) > e$.

Note that the advantage of *FR* compared to extending liability to the manager's wealth is that it is in the manager's self-interest to deposit his/her wealth in the first case, whereas endless litigation would be necessary to get the manager's assets in the second case.

Lender liability only (LL)

Recall that lender liability is restricted to bank debt, because it is neither current practice nor theoretically convincing to make small creditors liable for environmental harm.

Suppose first that the costs of avoiding lender liability are so high as to make this option unattractive. If this is the case, then the situation is identical to *FR*, because harm is fully internalized and the manager deposits sufficient money as to guarantee that the bank faces no risk in the end. This is again the only way to avoid agency costs.

However, if the cost c permitting to avoid the impact of lender liability is low, then the equilibrium is radically different. In fact, it will be similar to *SL*: the manager increases the leverage to reduce his/her liability risk and chooses too low a care level. If the manager finds it optimal to pay c and use the avoidance strategy, then the manager's payoff will be:

$$M^{LL} = (1 - \alpha)[R(I_D^{LL}) - I_D^{LL} - p(e^{LL})D] + \alpha(1 - p(e^{LL}))[R(I_D^{LL}) - I_D^{LL}]$$

$$- (I - I_D^{LL}) - e^{LL} - c$$

$$= R(I_D^{LL}) - I - p(e^{LL})D - e^{LL} + \alpha \, p(e^{LL})[D - (R(I_D^{LL}) - I_D^{LL})] - c$$

where e^{LL} and I_D^{LL} are the manager's optimal choices of effort and leverage in this case. The second to last term measures the expected gain for the manager from avoiding lender liability: with probability $\alpha \, p(e^{LL})$, the victims will see their compensation falling by $[D - (R(I_D^{LL}) - I_D^{LL})]$ short of their losses (recall that α was defined as the probability that lenders cannot be held liable in court). The manager will optimally hold this gain against the cost c of pursuing the avoidance strategy, and also take into account additional distortionary effect. Thus, the manager uses the protective strategy whenever this gives the higher expected payoff, or

$$M^{LL} > M^{FR} \Leftrightarrow [p(e^f) - p(e^{LL})]D + \alpha \, p(e^{LL})[D - (R(I_D^{LL}) - I_D^{LL})] - c > R(I_D^f)$$

$$- R(I_D^{LL}) - (e^f - e^{LL}) \tag{3.5}$$

Clearly, for given parameters α and c of this operation, inequality (3.5) will be satisfied for high values of damages D and be violated for low values of D. If (3.5) is satisfied, then the only effect of lender liability is a distortion in the debt structure, whereas the care level remains inefficiently low. Thus, extending liability to creditors will be better than strict liability only if D is sufficiently low, otherwise it will do strictly worse. To summarize, if the advantage of bank debt is high enough, the first best levels of debt and care are restored through lender liability, but if $M^{LL} > M^{FR}$, then the manager will actually use the avoidance strategy and shield creditors from lender liability, making the overall allocation even worse than under SL. LL is therefore weakly dominated by FR.

4. Manager's wealth is low

In the preceding section, FR led to the first best because the manager had enough wealth to avoid the agency costs caused by the unobservability of e. With $W < D - R(I_D) + I$, no rule leads to the first best. First, note that nothing changes under SL, and the same holds for LL if the costly strategies protect I_D against lender liability are adopted. This follows from the fact that the manager has no incentive to deposit her wealth, hence W is irrelevant as long as $W \geqslant I - I_D^f$. Under FR, note first that the optimal capital and debt structure is chosen, because the total liability risk is always D. The crucial point is hence whether the manager prefers to be monitored or not.

First suppose that the manager chooses e without monitoring. For reasons similar to those elaborated in section 3, she deposits her total wealth, so that the insurance company has to pay only $D + I - R(I_D) - W$ if an accident happens.[10] With π as the insurance premium on a competitive insurance market, the manager maximizes

[10] The reader might wonder why we restrict our attention to insurance contracts, since financial responsibility allows also for guarantees attached to loan contracts etc. In this model, however, there is no difference whether loan contracts or insurance contracts are considered, because the *expected* risk borne by the third party and hence the agency costs $m(e) - e$ are identical.

$$M = [1 - p(e)][R(I_D^f) + W - I - \pi] - e \tag{4.1}$$

leading to the FOC

$$-\frac{\mathrm{d}p}{\mathrm{d}e^{\tilde{W}}}[R(I_D^f) + W - I - \pi] = 1 \tag{4.2}$$

where $e^{\tilde{W}}$ is the effort in case of FR and a wealth-constrained manager who prefers not to be monitored, and where the insurance premium is given by

$$\pi = \frac{p(e^{\tilde{W}})}{1 - p(e^{\tilde{W}})}[D + I - R(I_D^f) - W] \tag{4.3}$$

Obviously $e^{\tilde{W}} < e^f$, because $R(I_D^f) + W - I - \pi < D$. Hence FR does not give rise to the first best care allocation, in contrast to the case where the manager is not wealth-constrained. Moreover, without monitoring it would be better to restrict financial responsibility to $R(I_D^f) + W - I$, because the manager's care is decreasing through the insurance contract ($\partial e / \partial \pi < 0$). This is the situation pointed out by Pitchford in the context of lender liability – the higher π, the lower the manager's net return in the good state, and the lower her incentive to avoid harm. As stated in the introduction, this is the reason why many other authors opt for *partial* extended liability instead of (full) financial responsibility.

The situation is very different if monitoring is adopted. With monitoring, the manager maximizes

$$M = [1 - p(e)][R(I_D^f) + W - I - \pi] - m(e) \tag{4.4}$$

where the insurance premium is given by

$$\pi = \frac{p(e)}{1 - p(e)}(D + I - R(I_D^f) - W) \tag{4.5}$$

Substituting π into the manager's objective function yields

$$M = R(I_D^f) - p(e)D - I - m(e) + W \tag{4.6}$$

This means that the manager's objective function is identical to the social welfare function *if* s/he prefers to be audited, and hence the manager chooses the second best effort e^S. This follows simply from the fact that the total risk is borne by the manager, and that she can costly commit to the care level e^S. Obviously, the manager prefers this solution if

$$p(e^S)D + m(e^S) < p(e^{\tilde{W}})D + e^{\tilde{W}} \tag{4.7}$$

There are two ambiguous effects determining whether 4.7 holds: on the one hand, $e^{\tilde{W}} < e^S < e^f$. On the other hand, $m(e) > e$ explains why inequality (4.7) does not necessarily hold.

However, the following conclusions are possible when assessing the performance of SL, LL and FR in reality:

1. The higher W, the higher $e^{\tilde{W}}$. Hence for values of W beyond some threshold, say W_1, no monitoring is preferred. This follows from the fact that $p(e^{\tilde{W}})D + e^{\tilde{W}}$ is strictly decreasing in $e^{\tilde{W}}$ since $e^{\tilde{W}} < e^f$. Hence the inefficiently low level of care $e^{\tilde{W}}$ is only chosen if W is relatively high.

2. If the manager prefers to be monitored, then full financial responsibility is strictly superior to partial financial responsibility, i.e. setting damages below the level of harm.

3. If the manager prefers no monitoring, then partial financial responsibility can indeed be superior to full financial responsibility. However, there are at least four important arguments against partial FR. First, the optimal level of partial FR depends on W, so the informational requirements for the court are very high. Second, knowing that the level of liability is adjusted to W leads to distortions caused by hiding part of W. Third, projects with negative expected social welfare are undertaken. Fourth, partial FR strictly reduces social welfare if monitoring takes place, and this seems very likely.

4. In theory, it *cannot* be excluded that the manager's effort is higher under SL than under FR. Two conditions must simultaneously hold for this to be the case. First, $p(e^S)D + m(e^S) > p(e^{\bar{W}})D + e^{\bar{W}}$ must hold (otherwise e^S is chosen). This is the case for high W, namely for $W > W_1$. Second, compare e^{SL} to $e^{\bar{W}}$. Under SL, the manager chooses e according to $-\mathrm{d}p/\mathrm{d}e^{SL}[R(I_D^{SL}) - I_D^{SL}] = 1$; and under FR according to $-\mathrm{d}p/\mathrm{d}e^{\bar{W}}[R(I_D^f) + W - I_D^f - \pi] = 1$. Hence, we have $e^{SL} > e^{\bar{W}}$ for $W - \pi + [R(I_D^f) - R(I_D^{SL}) - (I_D^f - I_D^{SL})] < 0$. But this is the case for W *below* some threshold, say W_2. To summarize, for both requirements to be fulfilled simultaneously, it must be the case that $W_2 > W_1$, i.e. the monitoring technology must be rather inefficient. Moreover, social welfare can be lower even if $e^{SL} > e^{\bar{W}}$ because of the distortion in the capital structure.

5. *LL* is never optimal. It is always (weakly) dominated by either full FR or an appropriately defined SL. If the manager would prefer not to use the costly avoidance strategy shielding creditors from lender liability, then lender liability is identical to FR. If the costly avoidance strategy is attractive for the manager, she limits the total expected liability exposure to

$$D' \equiv (1 - \alpha)D + \alpha[(R(I_D^{LL}) - I_D^{LL})] \tag{4.8}$$

Adopting a strict liability rule, but fixing the damages at the level of $D' < D$ will do strictly better than LL since the extra cost c can be saved.

5. Applying the results to the legal situation

We compared strict liability only, lender liability and financial responsibility in a model where environmental harm leads to the manager's insolvency. The manager's care was assumed to be unobservable, but the moral hazard problem can be solved through costly monitoring. Under these circumstances, financial responsibility leads to the first best whenever the manager has enough initial wealth for self-insurance. This assumption seems to be restrictive, but we demonstrate that full financial responsibility leads to the second best under plausible circumstances even if the manager's initial wealth is insufficient for self-insurance. Moreover, we showed that lender liability alone is inferior to at least strict liability only or financial responsibility.

In our opinion, a *revealed preference argument* provides the most powerful defence of extending liability to full financial responsibility. In practice, most firms use their freedom of contracting and opt to be monitored. This reveals that the agency costs, captured by the monitoring costs $m(e) - e$, are not exorbitant in comparison to the gains from better care incentives. But then, limiting liability to less than the full social cost can never be optimal.

The inferiority of *partial* financial responsibility in case of monitoring follows from the

assumption that the manager's effort is independent of the insurance premium or the interest rate whenever monitoring is carried out. Whether this assumption is justified is clearly an empirical question. However, practitioners of environmental audits report that our modelling of the working of environmental auditing is the most plausible one: it is in the firm's self-interest to carry out the obligations that are written in its insurance contract; control mechanisms seem to be well enough developed, and the risk of losing insurance coverage is too high. Hence, the moral hazard-problem can be solved through auditing. But the costs for it can be so high as to vindicate the wisdom for partial liability, at least for some cases.

Against this background, we wish to compare our findings to the actual legal situation. The concept of financial responsibility is already applied under the Resource Conservation and Recovery Act (RCRA) in the United States where the owners and operators of landfills and underground petroleum storage tanks must prove "adequate" levels of capital as a precondition to get approval. The same holds for the Oil Pollution Act of 1990 that requires financial responsibility for tankers, offshore pipelines, and oil and gas terminals.[11] Under RCRA, there are different possibilities for demonstrating financial responsibility, namely Corporate and Local Government Financial Tests, Trust Funds, Letters of Credit and Insurance that differ in important respects.[12] The main problem with RCRA is that the different mechanisms are not equally efficient, and that firms are allowed to choose which mechanism they prefer. First, letters of credit and surety bonds can be withdrawn be their issuers before environmental losses are detected. Second, the schedule of payments under the trust fund mechanism does not make sure that the money is sufficient if harm occurs before the end of the pay-in period. Hence, there are some loopholes that decrease the power of financial responsibility under RCRA.

Concerning lender liability in the United States, CERCLA is most important. According to section 107(a) CERCLA, *owners and operators* of hazardous plants are jointly and strictly liable. Since our emphasis is on distortions in debt structure brought about by lender liability, our focus is on the circumstances under which a creditor may be regarded as owner or operator.

Of course, there are even more cases where companies have been held liable for damages caused by a subsidiary ("piercing the corporate veil"),[13] but these cases are beyond the scope of our paper. The difficulties in this case are, loosely speaking, similar to those encountered with lender liability: only if the relationship between the owner company and the subsidiary is close, is liability extended. First, this may mean that necessary governance functions are distorted. Second, firms are likely to look for strategies to evade the "piercing the corporate veil".

To define activities that do not trigger lender liability, the Environmental Protection Agency (EPA) has published a "Final Rule on Lender Liability under CERCLA", issued 29 April 1992,[14] which is known as the EPA Rule. To overcome the uncertainty about the significance of the EPA Rule, the Asset Conservation, Lender Liability, and Deposit Insurance Protection Act of 1996 deems the EPA Rule to have been validly issued, and specifically prohibits any further judicial review of it.

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[11] 33 USC §2716.
[12] See 40 CFR 258, subpart G.
[13] See e.g. Barr, 1990 for an overview of these cases, and Buente and Crough, 1998 for a more recent discussion.
[14] Published at 57 Fed. Reg. 18, 344 and found in 40 CFR § 300.1100.

As far as lender liability as *owner* is concerned, creditors are held liable for the clean-up of contaminated land plots on which they foreclose in the process of a default. Since rational creditors will not use the option to foreclose on land if its value including clean-up costs is negative, their liability is effectively limited to the minimum of the residual face value of their debt outstanding and the clean-up costs. Lender liability as *operator* requires that the creditor is involved in the day-to-day-management of the insolvent firm. Interestingly, it is neither necessary nor sufficient that the creditor participates in the environment-related management decisions. In particular, the EPA rejects the liability of a lender as operator if the participation in the environment-related day-to-day management is deemed "reasonable". The EPA emphasizes that otherwise creditors would face undesirable incentives to refrain from socially valuable environmental audits for fear of infringing the secured creditor exemption.

But even after 1996, when the EPA Rule became law, there are many cases where a liability was rejected because the bank did not participate in the day-to-day-management (see for instance *United States v Pesses*). Conversely, creditors (see e.g. *Axel Johnson, Inc. v Carroll Carolina Oil Co.*) have been held liable as owner even though they bought a site with the exclusive goal to protect their loan.[15] On the whole, it seems fair to conclude that lender liability in the U.S. leads to two sorts of problems – those discussed in this paper, but also the disruption of vital monitoring-functions.

Environmental liability varies considerably among the members of the European Union. While some countries like Germany and the Netherlands have moved to strict liability, other countries like Italy and France restrict strict liability to a few groups of risks (in France, for example, for neighbourhood disturbance). Important differences notwithstanding, all drafts for a harmonized environmental liability within the E.U. seem to favour strict liability without mandatory coverage or lender liability.[16]

Most member countries do not require compulsory insurance for environmental damage.[17] In Finland, insurance is compulsory for operators of nuclear installations and for owners of ships carrying more than 2000 tons of oil. In Sweden, activities which are required to be licensed under the Environmental Protection Act 1969 have to contribute to a compulsory insurance fund run by a group of insurance companies in accordance with the Ordinance of 1 July 1989 (Environment Civil Liability Damage Fund).

Analogously to RCRA, Article 19 of the German Environmental Liability Law 1990 requires compulsory coverage for all hazardous plants listed in an appendix ("Anhang II") that can be proven by either an insurance policy or a bank guarantee. However, Article 19 has not been enforced yet. The situation in the Netherlands is very similar: the Environmental Control Act 1979 and the Soil Protection Act 1994 provide that liability insurance can be made compulsory for activities that can cause deleterious environmental damage.

While lender liability is a theoretical possibility in most E.U. member countries if creditors foreclose on property or are actively involved in management decisions, all attempts to sue creditors have failed so far.[18] All country reports agree that lender liability is very

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[15] See Feess, 1997 for an overview until 1996, and Buente and Crough, 1999 for recent cases.

[16] See Commission of the European Communities (1993), 13–18. In 1996, a comprehensive study mandated by the European Commission on the subject of harmonization was published, consisting *inter alia* of the "Study of Civil Liability Systems for Remedying Environmental Damage. Final Report" (European Commission, 1995) and "Economic Aspects of Liability and Joint Compensation Systems for Remedying Environmental Damage. Volume II: Topic Papers" (European Commission, 1996).

[17] See European Commission, 1995, 369–374 and the country reports in European Commission, 1996.

[18] See European Commission, 1995, 168–178 and European Commission, 1996.

unlikely to gain significance. Only British and German banks voice some anxiety about this prospect.

To conclude, it seems plausible that the legal solution in the E.U. will converge either to a fund solution or to financial responsibility analgous to Article 19 of the German Environmental Liability Law. Liability extensions to third parties are generally viewed much more sceptically in the European legal context, similar to the persistent legal difference when it comes to the attribution of punitive damages.

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