

SHOULD EMPLOYEES BE SUBJECT
TO FINES AND IMPRISONMENT
GIVEN THE EXISTENCE
OF CORPORATE LIABILITY?

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Abstract: This article studies whether, from the perspective of the economic theory of deterrence, it is socially desirable to impose public sanctions on employees when corporations themselves face liability. We demonstrate that such sanctions may be beneficial. In essence, this is because the magnitude of public sanctions -- fines and imprisonment -- may exceed the highest sanctions that a firm itself can impose on its employees; therefore, the threat of public sanctions often can induce employees to exercise greater -- and socially more appropriate -- levels of care than they otherwise would. However, to the extent that employees face public sanctions, the firm's liability should be reduced; if liability were not lowered, the price of the firm's product would exceed the social cost of production. The article also suggests that sanctions on employees should be imposed only if the employees are negligent, whereas the firm should be strictly liable for the harm.

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I. Introduction and Summary

When corporations cause large harms, the public frequently demands direct punishment of the responsible individuals.¹ There also appears to be a greater willingness by courts to impose sanctions on individual employees.² Evidently, society often believes that punishing a corporation alone is not enough.

These observations raise the question of whether, from the perspective of the economic theory of deterrence, it is socially desirable to punish employees when corporations themselves face liability. This article will demonstrate that publicly imposed sanctions on employees may be beneficial. In essence, the argument is that the magnitude of public sanctions -- fines and imprisonment -- may exceed the highest sanctions that a firm itself can impose on its employees; therefore, the threat of public sanctions can induce employees to exercise greater -- and socially more appropriate -- levels of care than they otherwise would. To the extent that employees face public sanctions, however, a firm's liability should be reduced; if liability were

¹ See, for example, Cathy Trost "Bhopal Disaster Spurs Debate Over Usefulness of Criminal Sanctions in Industrial Accidents," Wall Street Journal, January 7, 1985, p. 14, where it is stated: "... the idea of applying criminal laws to corporate executives is getting increased attention worldwide. The impetus is the mass poisoning in Bhopal, India, where more than 2,000 people died after a Union Carbide Corp., plant accidentally released a cloud of deadly gas."

² Cohen (1991a, p. 268) observes that "... current sanctions against individual offenders are likely to be more punitive than in the past." Segerson and Tietenberg (1991, p. 1) conclude that "Individuals, both corporate employees and officers, have become more common targets for penalties" (footnote omitted). See also Eric Weiner, "Criminal Charges Against Managers Send a Message On Airline Safety," New York Times, July 29, 1990, p. 4E, and David Stipp, "Environmental Crime Can Land Executives in Prison These Days," Wall Street Journal, September 30, 1990, p. A1. By employees, we mean to include officers and managers, as well as lower-level workers.

not lowered, the price of the firm's product would exceed the social cost of production.

The remainder of this introduction amplifies the points made in the preceding paragraph.

If firms are made strictly liable for their harms, they will design rewards and punishments for their employees that will lead employees to reduce the risk of causing harm, since firms will want to reduce their liability payments. Moreover, the prices of firms' products will be appropriate because they will be paying for all of the harms that result from production.

Yet even if a firm is strictly liable, it may not be able to induce its employees to take appropriate care because of its limited ability to discipline them: the effect of dismissal is limited by the presence of alternative opportunities for employees; and the threat of suit by the firm against its employees is limited by the assets that the employees have at stake. In particular, suppose that the highest penalty that a firm can impose on an employee is less than the harm his actions may bring about. Then the employee's incentive to reduce the risk generally will be too small. In other words, even though the firm is strictly liable, the employee's level of care will be inadequate. However, given this suboptimal level of care, the firm will charge the socially appropriate price for its product because it will be paying for all of the harm that results.

Now suppose that the state can impose a financial penalty -- a fine -- on an employee in excess of what a firm can impose. The motivation for this assumption is that, in practice, the state can more easily collect

criminal fines than private parties can obtain civil judgments.³ As a result, if the state imposes fines on employees who cause harm, employees will be induced to take more care than they otherwise would, improving social welfare.

When employees face the risk of fines, they naturally will demand higher compensation from firms, everything else equal. In effect, this will cause firms to pay fines in the form of higher wages. It should not be surprising, therefore, that the level of liability that is optimal to impose on a firm is the harm caused less the fine paid by the employee. In other words, the sum of the employee's fine and the firm's liability should equal the harm. This will lead the firm to price its product so as to reflect the harm that results. If the firm's liability were not reduced by the employee's fine, the price of the product would be too high and consumption would be undesirably discouraged.

Note too that it is in a firm's interest for its employees to be subject to fines when, as we have been assuming, the firm is limited in its ability to discipline employees. This is true even though the firm will have to pay higher wages in order to compensate employees for the risk of paying fines. The reason firms prefer that fines be imposed is that fines lead employees to take more care, making their choice of care closer to the socially optimal

³ Notably, the state can and often does impose a criminal fine with a jail term being the alternative if the fine is not paid. In such a situation, an individual has a strong motive to obtain funds to pay the fine; to do so, he may be willing to exhaust his wealth and to borrow from friends and relatives. In contrast, it would be unusual for an individual facing a civil judgment to go to jail if he does not pay the judgment. The individual may have execution proceedings brought against his assets, but the assets have to be located -- which may be difficult -- before the court can obtain them. Moreover, the individual does not face the risk of going to jail if he fails to borrow funds to pay a civil judgment.

level of care. This implies that the sum of the cost of taking care and the expected harm falls. Since the firm pays this sum (through employee compensation and firm liability), the firm's costs fall.

Even if employees face fines, they may not be led to exercise socially optimal levels of care. For the state also is limited in the fines that it can extract: the state cannot obtain more from an employee than his present and future assets. Consequently, fines may not be able to induce an employee to take optimal care. Consider, therefore, the possibility that the state can impose non-monetary sanctions on employees -- imprisonment -- in addition to fines.

We will show that if the social cost of imprisonment is sufficiently low, then it is socially desirable to subject employees to that type of sanction in order to induce them to take greater care. When imprisonment is used, the optimal level of liability on the firm will turn out to be the harm plus the social cost of imprisonment less the private disutility of imprisonment (and any fines that are imposed).

In the discussion to this point, it has been assumed that liability is imposed on a firm and a public sanction is imposed on an employee on a strict liability basis -- that is, whenever an accident occurs, regardless of the employee's care. An alternative standard of liability is the negligence rule, under which a party is liable only if some standard of care is not met.

It will be shown that the negligence rule should govern sanctions on employees but not liability on firms. For reasons to be explained (having to do with the sharpness of the incentive to take care under the negligence rule), a negligence rule can induce employees to take higher levels of care than they would under strict liability, and this is beneficial when the

penalty that can be imposed on the employee is limited. However, because employees will meet the standard of care applicable to them, they will not be found negligent and will not actually have to pay anything (in the absence of errors). Therefore, it is necessary to continue to use the strict liability rule with respect to firms so that product prices will reflect all social costs, including the harm. Moreover, since employees will not be paying anything, the optimal level of liability on firms equals the full harm.

Section II of the article discusses a numerical example illustrating many of the points just discussed. Section III presents a model of employee and firm behavior which is used in sections IV through VI to evaluate the desirability of imposing sanctions on employees given that firms are strictly liable. Section VII considers how our analysis is affected if firm liability and employee sanctions can be based on negligence. Section VIII discusses several interpretations and extensions of the analysis, including the firm's use of an "efficiency wage" to induce employees to take more care, and the appropriateness of imposing punitive damages on firms.⁴

⁴ A recent article by Segerson and Tietenberg (1991) independently derived several results similar to ours, although we put greater emphasis on the problem of limited assets of employees as well as on the state's superior (relative to employers') ability to sanction employees. Other studies of liability for corporate harms include Arlen (1991), Cohen (1991a; 1991b), Coffee (1981), Kornhauser (1982), Kraakman (1984), Newman and Wright (1990), and Sykes (1981; 1984). The focus of these articles differs from ours. For example, Kraakman emphasizes the allocation of risk between managers and their employer, as well as the possibility that the corporation's assets are inadequate to pay for the harm; and Newman and Wright derive the optimal level of liability in a principal-agent setting, assuming that liability is imposed solely on the principal. Also of related interest are articles that consider harms caused by employees to their corporation (such as through employee shirking or employee theft) rather than to third parties. See, for example, Shapiro and Stiglitz (1984) and Dickens, Katz, Lang, and Summers (1989).

II. Numerical Example

The example in this section will illustrate the main results of our analysis assuming that firms and employees are strictly liable and that the state can impose a fine on employees. An employee is assumed to have a simple choice about care -- either he does not take care or he takes care (in the formal model, care is continuously variable). Furthermore, employees and firms are assumed to be risk neutral.

Suppose that an accident that will cause harm of \$500,000 will occur with a probability of .04 if an employee does not take care and with a probability of .01 if the employee does take care. Thus, if an employee does not take care the expected harm is \$20,000 ($= .04 \times \$500,000$), and if he does take care it is \$5,000. Assume that an employee's cost of taking care is \$2,000. Clearly, it is socially desirable for care to be taken since taking care reduces the expected harm by \$15,000 ($= \$20,000 - \$5,000$).

For simplicity, assume that the only input in the firm's production process is employees' labor, and that the disutility of work to an employee is equivalent to \$30,000. Let an employee's output per year be 1 unit of the product sold by the firm, so the direct cost of production is \$30,000 per unit, the disutility of work. In addition to this production cost, if an employee takes care there is the \$2,000 cost of care and the \$5,000 expected harm; the total social cost of the product then is \$37,000 ($= \$30,000 + \$2,000 + \$5,000$). Ideally, therefore, an employee will take care and the price of the product will be \$37,000 per unit. However, if an employee does not take care, the expected harm is \$20,000, so the total social cost of the product is \$50,000 ($= \$30,000 + \$20,000$).

Now consider the compensation package that will be offered to an

employee by a firm when the firm is strictly liable for \$500,000 in the event of an accident and the state does not impose fines on employees. Assume for simplicity that the greatest penalty the firm can impose on an employee if an accident occurs is the denial of the employee's wages. Because the firm's unit costs will be lower if employees take care (see below), the firm will want to impose such a penalty if an accident occurs in order to give employees the greatest incentive to take care. Thus, an employee will receive nothing if he causes an accident.

Let w represent an employee's wage if there is no accident. A firm has to guarantee that an employee's expected compensation net of his cost of taking care is \$30,000, to induce the employee to work.⁵ Thus, if an employee takes care, w must be such that

$$(1) \quad .99w - \$2,000 = \$30,000;$$

solving for w gives \$32,323.

However, it is easy to see that the prospect of losing \$32,323 if an accident occurs does not provide enough of an incentive to an employee to take care. For if the employee does not take care, his expected wage is

$$(2) \quad .96(\$32,323) = \$31,030,$$

which exceeds his expected wage (net of his cost of taking care) if he does take care, \$30,000. Thus, a firm's use of even the largest possible internal sanction -- the denial of an employee's compensation -- is not sufficient to induce the employee to take care. Given that an employee does not take care, w must be such that $.96w = \$30,000$, or, solving for w , \$31,250.

⁵ In this example, it can be shown that the firm would not want to give an employee expected net wages exceeding \$30,000 -- an efficiency wage -- in order to induce him to take care. For a discussion of efficiency wages in the context of our analysis, see comment (a) in section VIII.

Because a firm pays an expected wage of \$30,000 to an employee and, in addition, faces expected liability costs of \$20,000 (the \$500,000 harm occurs with a probability of .04 since employees do not take care), the firm must charge \$50,000 for its product in order to cover its costs. Given that employees do not take care, this amount reflects the total social cost of the product. Thus, when firms are strictly liable for harm and the state does not fine employees, they will not take care but the price of the product will be socially appropriate, given employees' lack of care.

Next assume that the state can impose fines on employees if accidents occur, beyond the penalties that firms can impose on employees. Suppose that each employee has assets of \$100,000 that he can be made to pay in a fine (but which a firm cannot obtain). Then employees can be induced to take care. To see this, let the fine be the full \$100,000 and continue to assume that firms do not pay employees anything if an accident occurs. If an employee does take care, his wage w must satisfy

$$(3) \quad .99w + .01(-\$100,000) - \$2,000 = \$30,000.$$

Solving for w gives \$33,333. If the employee were to not take care, his expected wage then would be

$$(4) \quad .96(\$33,333) + .04(-\$100,000) = \$28,000.$$

Thus, given the loss of wages and the fine, it is in the employee's interest to take care.

A firm's expected wage payment to an employee now is $.99(\$33,333) = \$33,000$. This payment can be decomposed into three parts: \$30,000 to compensate the employee for the disutility of working; \$2,000 to compensate the employee for the cost of taking care; and \$1,000 to compensate the employee for the risk of being fined ($= .01 \times \$100,000$). If, in addition, the

firm were made strictly liable for the entire \$500,000 harm when an accident occurs, it would face expected liability costs of \$5,000 ($= .01 \times \$500,000$). Thus, to cover its expected wage and liability costs, the firm would have to charge \$38,000 for its product -- more than the total social cost of the product when employees take care, which was seen to be \$37,000.

This socially excessive price results from the fact that the firm is being made to pay more than the harm it causes. The firm pays the full harm directly, because it is strictly liable for \$500,000. But the firm pays an additional amount indirectly, by having to compensate employees for the risk of being fined. Because fines are needed to induce employees to take care, the problem of a socially excessive price is best solved by reducing the firm's liability by the amount of the employees' fines. Thus, in the example, the firm should be liable for \$400,000 instead of \$500,000 since the employee pays a fine of \$100,000. Then the firm's expected liability costs are \$4,000 instead of \$5,000, and the firm's total costs are \$37,000 instead of \$38,000.

Finally, note in this example that it is in the firm's interest for its employees to be subject to fines even though the firm has to compensate them for bearing this risk. If employees are not subject to fines, we saw that they will not take care and, as a result, the firm's total expected wage and liability cost is \$50,000. If employees are subject to fines, the firm's total expected wage and liability cost is \$38,000 if the firm remains liable for the full harm, and \$37,000 if the firm's level of liability is set optimally (reduced by the amount of the employee's fine). By inducing employees to take care, the fine lowers the firm's liability costs more than it increases the firm's wage cost.

III. The Model

Risk-neutral firms hire identical, risk-neutral employees to produce a product. Employees are the only individuals in the model. Each employee suffers disutility from working and produces one unit of the product per period that he works. The employee also selects a level of care; the higher is the level of care, the lower is the probability of an accident that causes harm to others. Let

k = disutility of work per period; $k > 0$;

x = level of care of an employee per period;

$p(x)$ = probability of an accident per period; $p'(x) < 0$; $p''(x) > 0$;

h = harm if an accident occurs.

Each employee is assumed to consume the same amount of output, and thus the amount that he produces. When we speak of employees in their capacity as consumers, we will refer to them simply as consumers. Define

q = level of output per employee;

$u(q)$ = utility of a consumer from q ; $u'(q) > 0$; $u''(q) < 0$.

Social welfare is defined to be the utility a representative consumer derives from output less the disutility of work, less the cost of care, and less the expected accident costs associated with production. Thus, social welfare is given by

$$(1) \quad u(q) - q[k + x + p(x)h].$$

The socially optimal outcome is the level of care x^* and the output q^* that maximize (1). It is apparent that x^* minimizes

$$(2) \quad k + x + p(x)h,$$

and therefore is determined by the first-order condition

$$(3) \quad -p'(x)h = 1.$$

Consequently, q^* maximizes $u(q) - q[k + x^* + p(x^*)h]$ and is determined by the condition

$$(4) \quad u'(q) = k + x^* + p(x^*)h.$$

This has the usual interpretation that marginal utility equals marginal cost, which in the present context is the sum of the disutility of work, the cost of care, and expected accident losses.

It is assumed until section VII that firms are strictly liable when harm is caused by their employees -- that is, firms pay damages regardless of the care exercised by their employees. Let

d = damages that a firm must pay if there is an accident.⁶

Firms select the wage that they pay their employees. The wage is assumed to depend only on whether an accident occurs (because firms cannot observe their employees' care). Specifically, define

w_a = wage if there is an accident;

w_n = wage if there is not an accident.⁷

Also, let

y = collectible assets of an employee, exclusive of wages; $y \geq 0$.

By collectible assets of an employee we mean the assets that a firm is able to obtain from the employee. We therefore have the constraints

$$(5) \quad w_a \geq -y \quad \text{and} \quad w_n \geq -y.$$

A firm chooses wages w_a and w_n to minimize its expected total costs

⁶ Damages are assumed to be paid with probability one, since the firm is assumed always to be seen as responsible for harm. Also, note that it is irrelevant whether the damages are paid to a private plaintiff or to the state (say in the form of a fine). All that matters to a firm is how much it pays, not who receives the payment.

⁷ One can think of w_n as a base wage from which a wage penalty is subtracted in the event of an accident.

(including liability costs) per unit of output, for this is necessary to maximize profits. Expected unit costs are

$$(6) \quad (1 - p(x))w_n + p(x)(w_a + d).$$

Firms minimize (6) over w_a and w_n subject to (5) and two additional constraints. First, an employee's expected net wage -- his expected wage net of the cost of care -- equals his disutility of work k ,

$$(7) \quad (1 - p(x))w_n + p(x)w_a - x = k.$$

(This constraint is written as an equality because we assume that the firm would not want to give employees an expected net wage that is more than enough to induce them to work.⁸) Second, the employee chooses care x to maximize his expected net wage. Since an employee's expected net wage is the left-hand side of (7), x is determined by

$$(8) \quad -p'(x)(w_n - w_a) = 1,$$

which has the interpretation that the marginal expected enhancement in the wage due to a reduction in the likelihood of an accident equals the marginal cost of care, 1.

Assuming that the firms are in a perfectly competitive industry, the price of the product will be (6), since under competition price must equal expected unit cost. The amount of the product consumed, q , therefore will be such that

$$(9) \quad u'(q) = (1 - p(x))w_n + p(x)(w_a + d) = k + x + p(x)d,$$

where the second equality follows from (7).

The second-best outcome is defined to be the best outcome that can be obtained by a benevolent dictator who can choose consumption but who can

⁸ See comment (a) in section VIII below for a discussion of when the firm would want to give employees an expected net wage in excess of k (an efficiency wage).

influence care only by setting wages for employees, where the wages must be sufficient to induce them to work. Formally, this is equivalent to choosing q , w_a , and w_n to maximize social welfare (1) subject to the constraints that x is determined by (8) and that w_a and w_n satisfy (5) and (7).

The following sections analyze the desirability of imposing sanctions on employees given the existence of liability on firms. It is initially assumed that firms alone are liable for damages, and then that employees can be sanctioned as well, either by fines only or by imprisonment too. Finally, the model is extended to allow for the possibility that firm liability and employee sanctions can be based on negligence.

IV. Firms Alone Are Liable

We first wish to show that the second-best outcome can be achieved by imposing an appropriate level of damages on firms:

Proposition 1: Suppose that firms alone face liability. If the level of damages d imposed on firms is equal to the harm h , the second-best outcome will result.

Proof: Substitute (7) into (6), to obtain that a firm chooses w_a and w_n satisfying (5) and (7) to minimize $k + x + p(x)h$, where x is determined by (8). Also, q will be determined by (9), which is equivalent to $u'(q) = k + x + p(x)h$. From this it is apparent that q and x are second-best. ◀

Let us now investigate the nature of the outcome when damages equal the harm. Here and below, we will refer to wages w_a and w_n as feasible if they satisfy the constraints (5) and (7), where it is understood that x is determined by (8).

Proposition 2: Suppose that firms alone face liability and that the level of damages d imposed on firms equals the harm h .

(a) Assume that there are feasible wages w_n and w_a whose difference is h , that is, such that⁹

$$(10) \quad w_n - w_a = h.$$

Then the firm will choose wages satisfying (10) and the outcome will be socially optimal: $x = x^*$ and $q = q^*$.

(b) Assume, alternatively, that there do not exist feasible wages w_n and w_a satisfying (10). Then an employee's collectible wealth will be taken from him in the event of an accident, that is,

$$(11) \quad w_a = -y.$$

Also, the outcome will not be socially optimal. In particular, the level of care will be too low,

$$(12) \quad x < x^*;$$

but the level of output will be socially optimal, given the level of care.

Proof: (i) As noted in the proof of Proposition 1, a firm's problem is equivalent to minimizing $k + x + p(x)h$ over feasible w_a and w_n . The unconstrained minimum of $k + x + p(x)h$ over x occurs when $x = x^*$. Hence, if a firm can obtain x^* with feasible w_a and w_n , such w_a and w_n must be best for the firm. But if (10) holds for feasible w_a and w_n , x^* must be chosen, since then (8) reduces to (3). Also, at x^* , it is apparent that (9) is equivalent to (4), so that the level of output is q^* . This proves part (a).

(ii) To demonstrate part (b), we first show that if (10) does not hold for any feasible w_n and w_a , then $w_n - w_a < h$ for all feasible w_a and w_n .

⁹ Because (7) is assumed to hold with equality, it may not be possible to satisfy (10) simply by setting w_n high enough.

Otherwise, there must exist a feasible w_n and w_a such that $w_n - w_a > h$ (because (10) cannot hold). But if $w_n - w_a > h$, there exist feasible w_n and w_a such that $w_n - w_a = h$ by the following reasoning. As w_n falls and an employee continues to choose x according to (8), his expected net wage falls; similarly, as w_a rises and he chooses x according to (8), his expected net wage rises. Thus, we can raise w_a and reduce w_n so as to maintain his expected net wage equal to k ; and we can do this until $w_n - w_a = h$. This is a contradiction, so that all feasible wages are such that $w_n - w_a < h$. Thus, using (8), it follows that (12) holds.

Now assume that $w_a > -y$. Then w_a can be lowered slightly and still exceed $-y$, and w_n can be raised so that (7) is preserved. But this means that alternative feasible w_a and w_n can be chosen such that $w_n - w_a$ is larger, which implies that x can be increased and thus made closer to x^* ; this in turn means that $k + x + p(x)h$ can be reduced, a contradiction. Hence, at the optimum, $w_a = -y$.

Finally, that q is optimal given x is clear since, from (9), q is determined by $u'(q) = k + x + p(x)h$.⁴

The condition of interest in Proposition 2 is whether there exist feasible w_a and w_n such that (10) holds. Clearly, (10) will be satisfied if an employee's collectible assets y exceed the harm h ; for then, the wage if an accident occurs w_a can be set sufficiently low (as low as $-y$) so that the gap between w_a and w_n equals h . More generally, it can be shown that (10) will hold if and only if y is sufficiently large:¹⁰

¹⁰ If (10) holds for feasible w_a and w_n , then from (7) we obtain $w_n = p(x^*)h + k + x^*$. But by (10), $w_n = w_a + h$, and we know that $w_a \geq -y$, so that $w_n \geq h - y$. Hence, $p(x^*)h + k + x^* \geq h - y$, which is equivalent to (13). On the other hand, let us show that if (13) holds, there exist feasible w_a and w_n obeying (10). Begin by choosing $w_a = -y$ and $w_n = -y + h$, so that the employee

$$(13) \quad y \geq (1 - p(x^*))h - x^* - k,$$

where, note, the right-hand side of (13) is less than h . Thus, if the employee's collectible assets are sufficiently low, liability on firms alone will not lead the employee to take optimal care.

Whether condition (13) holds can readily be determined. For example, if $h = \$1,000,000$, $x^* = \$1,000$, $p(x^*) = .01$, and $k = \$50,000$, the right-hand side is $\$939,000$. Thus, if the collectible assets of an employee are less than $\$939,000$, he cannot be induced to take optimal care.

V. Firms Are Liable and Employees Face Fines

Now assume that employees also are subject to fines whenever accidents occur, and define

f = fine imposed on an employee if there is an accident; $f \geq 0$.¹¹

Then the constraint (7) that an employee's expected net wage equals k becomes

$$(14) \quad (1 - p(x))w_n + p(x)(w_a - f) - x = k,$$

and the condition (8) determining care x becomes

$$(15) \quad -p'(x)(w_n + f - w_a) = 1.$$

Suppose initially that the state can take no more away from employees than firms can. That is, assume that

$$(16) \quad w_a - f \geq -y.$$

Then we have

will select x^* . Hence, the left-hand side of (7) is $(1 - p(x^*))h - x^* - y$. If this quantity equals k , (10) is satisfied; and if the quantity is less than k , say by the amount δ , then it is clear that by raising w_a and w_n each by δ , the quantity will equal k , and (10) will be satisfied. In other words, (10) will be satisfied if $(1 - p(x^*))h - x^* - y \leq k$; but this is equivalent to (13).

¹¹ It would not matter to the employee if, instead of paying a fine to the state, he had to pay the same amount in liability to a private plaintiff.

Proposition 3: Suppose that firms are liable and employees face fines, but that the amount that can be taken from an employee is no greater than the amount that can be taken from him if he is penalized only by his firm (that is, (16) holds). Then

(a) social welfare cannot be higher than when firms alone are liable.

(b) The second-best outcome will be achieved if the sum of the fine f imposed on employees and the damages d imposed on firms equals the harm h ; that is, the firm should be liable for the harm less the employee's fine.

Proof: (i) By Proposition 1, if firms alone are liable and damages are h , the second-best outcome is achieved. The outcome when firms are liable and a fine f is imposed on employees cannot be socially superior to the second-best outcome, since it is still true that x is chosen by employees, their expected net wage must be k , and the most that can be taken from them if an accident occurs is y . Hence, part (a) follows.

(ii) Assume that $f + d = h$. Then substituting (14) into (6), we see that the firm minimizes $k + x + p(x)f + p(x)d = k + x + p(x)h$, which is (2). Furthermore, it is clear that if $w_n = \alpha$ and $w_a = \beta$ are feasible for a benevolent dictator, then $w_n = \alpha$ and $w_a = \beta + f$ are feasible for a firm and result in the same x . It follows that the outcome when firms choose w_a and w_n must result in the second-best x . Also, q will be best given x , for $u'(q) = k + x + p(x)h$ determines q . This proves part (b). ◀

Next, assume that the state can impose fines on employees in addition to the penalties imposed by firms on their employees. Therefore, assume that some amount beyond y can be taken from an employee. Let

b = assets in addition to y that the state alone can obtain from an employee; $b > 0$.

For simplicity, assume that¹²

$$(17) \quad f \leq b,$$

and that the constraint on wages is (5). We then have

Proposition 4: Suppose that firms are liable and employees face fines, and that the most that can be taken from an employee exceeds what can be collected from him if he is penalized only by his firm. Assume as well that if firms alone are liable, the socially optimal outcome cannot be obtained (in other words, assume that part (b) of Proposition 2 applies). Then

(a) it is socially desirable for fines to be imposed on employees and for the damages imposed on firms to equal the harm h less the fine f .

(b) In particular, suppose that there exists an $f \leq b$ for which there are feasible wages w_a and w_n such that

$$(18) \quad w_n + f - w_a = h.$$

Then firms will choose w_a and w_n satisfying (18), and the socially optimal outcome will result.

(c) If, however, there does not exist any $f \leq b$ such that there are feasible w_a and w_n satisfying (18), then it is optimal for the state to set $f = b$, firms will choose $w_a = -y$, and the outcome will not be socially optimal because the level of employee care will be too low, $x < x^*$.

(d) Firms prefer that the state imposes the socially optimal fine f and that they face liability of $h - f$ rather than that employees face no fines and that firms alone face liability of h . This is because a firm's unit costs

¹² A more general assumption, which allows for the possibility that $f > b$, is that f satisfies $w_a - f \geq -(y + b)$. If we were to make this assumption, the nature of the conclusions would not be altered because the total amount that an employee could pay still would be $y + b$, but the statement of the propositions and their proofs would become unnecessarily complicated.

will be lower in the former situation.

Proof: (i) Assume that $d = h - f$.

(ii) Suppose that there exists an $f \leq b$ and feasible w_a and w_n satisfying (18). From (15), it is clear that x^* will be chosen. Also, because $d = h - f$, a firm will minimize $k + x + p(x)h$, so that it will select the w_a and w_n satisfying (18). In addition, output will be q^* . Thus, the socially optimal outcome will occur. Note also that f must be positive, for if $f = 0$, the socially optimal outcome is not achievable, by hypothesis. (If $f < b$, it is not unique, since if w_n , w_a , and f are optimal, so will be w_n , $w_a + \epsilon$, and $f + \epsilon$, for any $\epsilon > 0$ such that $f + \epsilon \leq b$.) This proves part (b).

(iii) Suppose that there does not exist an $f \leq b$ such that there are feasible w_a and w_n satisfying (18). This implies that the outcome is not optimal, since (18) must hold for x^* to result. It follows that, for any f , $w_n + f - w_a < h$ for all feasible w_a and w_n by an argument analogous to that given in step (ii) in the proof of Proposition 2. Hence, $x < x^*$ must be true at any f , and therefore at the optimum. Also, by another argument analogous to one used in step (ii) in the proof of Proposition 2, it follows that $w_a = -y$ if a firm seeks to minimize $k + x + p(x)h$ (which will be true because liability is $h - f$).

Now let us demonstrate that, given $d = h - f$, it is optimal for the state to set $f = b$. Assume to the contrary that the best f is less than b and consider the w_n that a firm chooses given this f (we now know that $w_a = -y$). Observe that if f is raised, the expected net wage of an employee falls, whereas if w_n is raised, the expected net wage of an employee rises (in both cases assuming x changes according to (15)). Therefore, f and w_n can be raised so that (14) continues to hold. But this means that at the new f ,

there is a feasible combination of w_a and w_n such that $w_n + f - w_a$ is larger, which implies that x is larger. But since x was lower than x^* , the increase in x must reduce $k + x + p(x)h$. Furthermore, given $d = h - f$, the firm will want to minimize $k + x + p(x)h$. Hence, given $d = h - f$, $f < b$ cannot be optimal.

Finally, let us demonstrate that the optimal level of liability to impose on the firm is $h - f$. The second-best problem now is to maximize social welfare (1) subject to the constraints (5), (17), (14) and (15). But when liability is $h - f$, it is clear that the outcome of firm and consumer behavior is such that (1) is maximized subject to (5), (17), (14), and (15), so that the outcome is second best subject to the additional constraint that $f = b$. Yet in the previous paragraph, we showed that if $f < b$, the second-best outcome given such an f must be inferior to when $f = b$. This proves part (c).

(iv) Part (a) follows from steps (i), (ii), and (iii).

(v) Part (d) also follows from what we have shown. For when $d = h - f$, a firm's unit costs are $k + x + p(x)h$, and these are reduced at the optimal f . ◀

VI. Firms Are Liable and Employees Face Fines and Imprisonment

Next, suppose that the state can impose an imprisonment sanction on employees in addition to a fine; let

t = time period of imprisonment; $t \geq 0$,

and assume that t represents the disutility of imprisonment to an employee.

Assume in addition that there is a cost to society associated with imprisonment; let

α = social cost per unit of imprisonment term; $\alpha \geq 0$,

so that αt is the social cost of imprisonment for term t . The social cost may be interpreted to include the cost of operating prisons as well as the disutility suffered by individuals who are imprisoned. If the latter disutility is included, then $\alpha \geq 1$ (since the disutility from an imprisonment term of length t is t).

When employees face imprisonment as well as fines, a firm's problem is the same as before, but in (14) the second term becomes $p(x)(w_a - f - t)$, and (15) becomes $-p'(x)(w_n + f + t - w_a) = 1$. The social problem now involves the maximization of

$$(19) \quad u(q) - q[k + x + p(x)(h + \alpha t)],$$

since when there is an accident, not only does the harm h occur, but the social cost of imprisonment αt is borne as well. We have

Proposition 5: Suppose that firms are liable, that employees face fines and imprisonment, and that in the absence of imprisonment, the highest possible fine would result in inadequate care, $x < x^*$ (in other words, suppose that part (c) of Proposition 4 applies). Then

(a) if the social cost per unit of imprisonment α is sufficiently low, it is socially desirable for a positive imprisonment term t to be imposed on employees.

(b) When imprisonment is socially desirable, the optimal level of liability to impose on firms is the harm plus the social cost of imprisonment, less the fine and less the employee's disutility from imprisonment, $h + \alpha t - b - t$.

(c) The firm prefers this situation to not having imprisonment imposed on employees, because its unit costs will be lower.

Proof: Suppose that $\alpha = 0$. Then a positive t is socially desirable

because that will result in an increase in x , making it closer to x^* . This follows by essentially the argument given in the second paragraph of step (iii) of the proof to Proposition 4. By continuity, it follows that if α is sufficiently low, $t > 0$ must be socially desirable. That liability should be $h + \alpha t - b - t$ follows because, if liability is set at this level, a firm will set wages so that the resulting x minimizes $k + x + p(x)(h + \alpha t)$. Finally, observe that the minimized value of $k + x + p(x)(h + \alpha t)$ must be less than the value of $k + x + p(x)h$ when $f = b$ and $t = 0$, for otherwise it would not have been socially optimal for t to exceed 0. Thus, a firm's unit costs are lower given the socially optimal t .◀

Note that if α is interpreted as including the employee's disutility of imprisonment, so that $\alpha \geq 1$, then the socially optimal imprisonment term t could be zero.

Also, observe that when employees face imprisonment as well as fines, the optimal level of liability on firms could be greater or less than when fines are used alone. In the circumstances of Proposition 5, if fines are used alone, optimal firm liability is the harm less the fine, $h - b$ (see part (c) of Proposition 4). If imprisonment is used in addition to fines, optimal firm liability has been shown to be $h + \alpha t - b - t = h - b + (\alpha - 1)t$. Thus, if the social cost of imprisonment is relatively high, $\alpha > 1$ (as when employees' disutility is included in α), a firm's liability rises when imprisonment is used in addition to fines; but if $\alpha < 1$, a firm's liability falls.

The general principle for determining a firm's liability is clear: the firm should pay the full social costs resulting from an accident -- the harm

plus the social cost of imprisonment -- less the sanctioning costs borne by the employee -- the fine plus the employee's disutility from imprisonment.

VII. Liability on Firms and Sanctions on Employees May Be Based on Negligence

To this point, it has been assumed that firms were made liable and employees were sanctioned whenever an accident occurred, regardless of the employee's care. It was in this sense that firms and employees were said to be strictly liable.

Now suppose that firm liability and employee sanctions can be based on an employee's level of care.¹³ In particular, consider imposing liability on firms and sanctions on employees according to a negligence rule -- that is, only if employees do not take some minimum level of care. Let this minimum level of care, known as the standard of care, be

\hat{x} = standard of care under negligence.

Thus, if firm liability is based on negligence, a firm pays damages d when an accident occurs if and only if $x < \hat{x}$. Similarly, if employee fines or imprisonment are based on negligence, sanctions are imposed on employees for accidents if and only if $x < \hat{x}$. Of course, for a negligence rule to be feasible, it must be assumed that courts are able to observe the employee's level of care x .

In this section we will explain why it is socially desirable to make firms liable according to a strict liability rule but to impose employee sanctions according to a negligence rule. This explanation will be relatively informal because much of it builds on the analysis in sections IV through VI

¹³ The arguments to be developed below do not depend on whether the wage too is based on employees' care.

as well as on previous literature analyzing the negligence rule.

To begin, assume that employees' care will be inadequate when firms are strictly liable and employees face fines that depend only on the occurrence of an accident (in other words, assume that part (c) of Proposition 4 applies). If this were not the case -- that is, if the socially optimal outcome could be achieved in these circumstances -- there would be no need to consider basing firm liability or employee sanctions on the negligence rule.

Now suppose that when an accident occurs employee fines are imposed only if employees are negligent. Because employees will then avoid fines altogether if they take the amount of care mandated by the standard of care, but will face fines otherwise, they have a strong incentive to satisfy the standard of care. It is well known from prior analyses of the negligence rule that this discontinuity -- the complete elimination of liability if the negligence standard is met -- allows the standard of care that will be met to be set at a higher level of care than would result under the strict liability rule.¹⁴ In other words, by basing employee fines on a negligence rule, employees can be induced to take higher levels of care, which, by hypothesis, is beneficial.

Next, reconsider the standard of liability applicable to firms, assuming that employee fines are based on negligence. Strict liability is preferable to negligence for the following reason. The price of a firm's product should reflect the expected accident costs that occur given employees' care, so that consumers will purchase an appropriate amount of the firm's product. If firm liability is based on negligence and firms are not found liable because employees take the required level of care, expected accident

¹⁴ See, for example, Shavell (1987, pp. 179-182).

costs will be ignored. But if firms are strictly liable, they will take accident costs into account in their pricing.¹⁵

The discussion in the preceding two paragraphs also suggests what the level of firm liability should be. Since employees will meet the standard of care applicable to them and therefore will not be liable, it is necessary to make the firm strictly liable for the full harm when an accident occurs in order for the price to reflect expected accident costs.¹⁶ This result is consistent with the conclusion in section V that a firm's liability should be offset by the amount of the fine paid by the employee; there, employee fines were imposed whenever an accident occurred, whereas now employee fines are based on negligence and are not actually imposed because employees will meet the standard of care.

The reasoning used to explain why employee fines should be based on negligence also applies to imprisonment. By imposing an imprisonment sanction when an accident occurs only if an employee did not take some minimum level of care, employees can be induced to take more care than if the sanction is imposed regardless of their care.

There is an additional argument for basing imprisonment on negligence. The sanction of imprisonment is socially costly -- society incurs the cost of prisons and loses the benefit of the employee's labor. Under a negligence rule, the threat of imprisonment can be used to induce employees to take more

¹⁵ See generally Polinsky (1980) and Shavell (1980, pp. 12-14) on the point that the product price is too low under negligence but not under strict liability.

¹⁶ However, if there are errors in the operation of the negligence rule (for example, with respect to observing employees' care), employees will be found negligent with some probability when an accident occurs; then the firm's liability should be reduced by the fines paid by employees.

care without actually having to imprison anyone. Under the strict liability rule, however, the imprisonment sanction would be imposed.

Note that, if imprisonment is based on negligence, it should be used as a threat regardless of its potential social cost (provided it will not actually be applied), and therefore more liberally than was suggested in Proposition 5, where imprisonment was implicitly assumed to be based on the strict liability rule.

VIII. Concluding Remarks

This section discusses several extensions and interpretations of the model, and the significance of the issues raised in the article.

(a) Efficiency wages

An issue not addressed in the model is that a firm may want to pay a higher wage than is necessary to attract employees; for the higher the wage, the more an employee will lose if he causes an accident, and thus the more care he will exercise. Specifically, a firm will want to pay such a super-normal wage when the extra wage cost is smaller than the savings in liability payments due to enhanced employee incentives to take care. Compensation of this sort is known as an "efficiency wage" in the labor economics literature, where such wages have been studied in the context of the problem of employee shirking.¹⁷

In our analysis, it is possible to show that firms may or may not want

¹⁷ For a survey of the early efficiency wage literature, see Yellen (1984).

to pay an efficiency wage.¹⁸ For simplicity, we implicitly assumed that firms would not want to. However, if firms were to pay efficiency wages, the main conclusions of our article would not be altered. It would still be true that the level of care of employees could be inadequate, in which case it may be beneficial for the state to impose sanctions directly on employees for the reasons we describe.

(b) Risk aversion

The presence of risk aversion on the part of employees is relevant to our analysis for several reasons. First, risk-averse employees will tend to exercise more care than risk-neutral employees, making it less likely, everything else equal, that public sanctions on employees would be needed. Second, if employees are risk averse, a negligence rule is preferable to strict liability in terms of risk allocation, since under the negligence rule no risk is imposed on employees when they meet the standard of care (in the absence of legal error). This reinforces the argument discussed in section VII for using a negligence rule with respect to employees. Third, risk-averse employees will want to be insured against liability, raising the question of whether such insurance is socially desirable. It seems that employees should be permitted to insure themselves (or to be indemnified by their firms)

¹⁸ Suppose that without an efficiency wage, employees choose a level of care $x < x^*$, in which case $w_a = -y$, so that the firm's unit costs are $(1 - p(x))w_n + p(x)(d - y)$. Consider these unit costs as a function of w_n , where x is viewed as determined by w_n through (8), which becomes

$$(i) \quad -p'(x)(w_n + y) = 1.$$

Using (i), it is straightforward to show that the derivative of unit costs with respect to w_n will be negative when

$$(ii) \quad x' + (1 - p) < -p'x'd.$$

If (ii) is satisfied, the firm will want to increase w_n -- that is, use an efficiency wage. When $d = h$, (ii) is $x' + (1 - p) < -p'x'h$, which is satisfied less often than $x' < -p'x'h$, which is equivalent to $1 < -p'h$, the condition that $x < x^*$. Thus, the firm may or may not want to pay an efficiency wage even though $x < x^*$.

provided that the sum of the employees' liability and the firm's liability equals the harm. For then, any decision to purchase insurance by employees will properly balance the beneficial effect of reducing risk against the detrimental effect of diluting the incentive to take care. (The same point applies to an indemnification agreement between the firm and the employee.)

(c) Legal error

The possibility of erroneous legal decisions about employee behavior generally weakens the argument for imposing employee sanctions, because legal errors can lead employees to act in socially undesirable ways. Notably, if employee sanctions are based on negligence, the possibility that an employee will mistakenly be found negligent even when he has met the standard of care may lead him to exceed the standard in order to reduce this risk; consequently, he may take socially excessive care, or may avoid certain activities that are socially worthwhile and profitable for the firm. Moreover, if the employee is risk averse, these effects will be magnified.

(d) Punitive damages and criminal fines on the corporation

In response to the problem of employees taking too little care, it might seem natural to consider imposing additional liability on the corporation. This liability could take the form of punitive damages or criminal fines in addition to actual damages. (In fact, both punitive damages and criminal fines increasingly appear to be imposed on corporations.) However, a corollary of our analysis is that imposing additional liability on the corporation -- beyond that necessary to induce the corporation to fully take into account the actual harm -- is socially undesirable.

We showed in Propositions 1 and 2 that if the firm is made strictly liable for the full harm, it will do what it can to induce employees to take

socially desirable care. Although Propositions 4 and 5 demonstrated that imposing public sanctions on employees can improve employee care, there is no benefit from imposing additional liability on the corporation. The corporation already will be encouraging its employees through internal firm incentives to take as much care as possible (up to the socially optimal level of care); imposing additional liability on the firm will not improve its ability to control its employees.¹⁹

Further, it generally is detrimental to make the firm liable for more than the harm. For if the firm is made to pay more than the harm, it will set the price of its product above the sum of production costs and expected accident costs; consequently, consumption will be too low relative to the socially desirable level of consumption.

One well-known qualification to the preceding reasoning should be mentioned. If the firm can escape liability with some probability, then the firm should be made to pay more than the harm when it is found liable. The level of liability should equal the harm divided by the probability of being found liable (so that the firm's expected liability equals the harm), and this may necessitate imposing punitive damages or criminal fines on the firm.

(e) Significance of the problem of employee incentives

It was shown in section IV that if employees' collectible assets are less than the harm that could result from their actions, imposition of

¹⁹ This statement presumes that the firm is not using an efficiency wage. However, if the firm is made liable for more than the harm, the firm might be induced to use an efficiency wage when it otherwise would not, or to raise its efficiency wage if it already is using one to some extent. Then, increasing the firm's liability would lead to greater employee care. (Also, if the firm needs to monitor its employees in order to determine their care, then increasing the firm's liability would lead the firm to spend more on monitoring, which in turn would lead employees to take more care.)

liability on firms alone will not lead employees to take optimal care. We believe that this problem is likely to be significant in a wide range of circumstances.

Even the highest-level operating officers of a corporation -- the president, the chief executive officer, the chief operating officer -- are unlikely to have a net worth of several million dollars (except perhaps in the very largest corporations). And even if they did, it is not probable that the corporation could obtain anything approaching that amount in the event of a major accident. Also, middle and lower level managers, who may have more direct control over decisions that ultimately lead to accidents, can be expected to have substantially lower collectible assets. More significantly, often the worst punishment the corporation can inflict is to fire an employee, and the consequence of that might be quite limited because of the availability of other employment opportunities.

In contrast, many potential corporate accidents can result in harms exceeding multiple millions of dollars, if not hundreds of millions of dollars or more. One only has to think of examples like the Union Carbide chemical plant explosion in Bhopal, the Johns Manville Corporation's asbestos-containing products, the Dalkon Shield IUD injuries, or the Exxon Valdez oil spill. Clearly, no employee of the relevant corporations, including the highest-level officers, had assets anywhere near the resulting harms. The contrast is even greater when one considers the assets of lower level employees who may be more directly responsible for the harm. For example, the captain of a supertanker may cause an oil spill resulting in millions of dollars in damage, but have collectible assets that are a tiny fraction of the harm. Or, to pick a less dramatic example, a driver of a passenger bus could

easily cause harm that far exceeds the driver's assets.

There is another reason to expect that the problem of employee incentives often may be significant. The preceding discussion implicitly presumed that an employee responsible for causing harm would for sure be punished in some way by the corporation; then the relevant comparison is between the employee's collectible assets and the harm caused. But an employee may reasonably believe that he may not be sanctioned internally by the firm because the blame for causing the harm might not be attributed to him (for example, he might be able to conceal his bad act, or he might be part of a team with respect to which individual responsibilities are difficult to establish). Then, to induce the employee to take appropriate care, it is necessary to raise the internal sanction to make up for the chance of not having to bear it. Clearly, since this increases the gap between the employee's collectible assets and the internal sanction that he should bear, the problem of employee incentives will be even worse than initially suggested.²⁰

²⁰ The discussion in this comment may explain why there seem to be so many situations in which corporations cause large harms where cost-justified preventive steps were not taken: the individuals in the corporation have incentives that are inadequate, and not coincident with those of the corporation.

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