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Agent's liability versus principal's liability when attitudes toward risk differ

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Abstract

This paper studies through an agency model the problem of concealing an illegal activity which benefits the principal. The agent can exert an effort that negatively affects the likelihood of detection. We model such behavior with the assumption that the principal is risk neutral while the agent is risk averse. Two opposite legal regimes are considered: in the first only the principal is strictly liable; in the second, only the agent is. We show that shifting the liability upon the agent, while the monetary sanction and the probability of detection are kept constant, reduces the principal's net benefit thus favoring deterrence of wrongdoing. However, the agent's effort in cheating can either increase or decrease. For a specific model we are able to characterize cases in which a reduction in cheating prevails, and shifting the liability upon the agent has clear-cut beneficial effects on compliance.

1. Introduction

In this paper the problem of illegal activity perpetrated by corporations is examined. Public opinion often considers corporations responsible for damage stemming from illegal activity in the field of environment, taxation, financial markets, social risk, and so forth. We will examine some facets of this problem in the simplified framework of a principal-agent model.

We consider a principal who stands to benefit from an illegal activity and needs the

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cooperation of an agent to implement it.¹ The extent of the agent's cooperation influence the likelihood of detection. Adopting the standard approach of the agency model, we will term this cooperation as the agent's "effort" in covering up. A real world example might be a case of tax evasion by a corporation,² accomplished through manipulation of the accounting. The bookkeeper's skill and effort in cheating can affect the probability of detection.³

Agents who can either facilitate or disrupt misconduct (by withholding their cooperation) are called "gatekeepers" by Kraakman (1986). Sanctions (either civil or criminal) provided by the law upon gatekeepers may be seen as devices for keeping principals honest. Is gatekeeper liability the best way of curbing illegal behavior, or would providing sanctions directly upon the principal work better? Many aspects of this problem have already been explored (Kraakman [1986]). With reference to the specific issue of covering-up corporate crimes, Arlen (1994) has studied the case—symmetric to the one considered here—in which a crime is committed in the pursuit of the agent's self interest. In this case, strict corporate liability may induce corporations to prevent and sanction agents' crimes, but it could also have perverse effects.⁴ That is, corporations could reduce monitoring whenever costs (due to the liability that would ensue from the detection of the employee's violations that cannot be eradicated) are higher than benefit (in terms of deterrence of the potential wrongdoer). The threat of sanctions may in fact induce the principal of the potential perpetrator of an illegal activity to prevent crime, but it could also sometimes induce her to help the wrongdoer in a more careful covering up of the misdeed. This paper examines another perspective of this problem, the case in which illegal activity is conducted in the pursuit of the principal's interest, with special attention to the consequences of different attitudes toward risk of the principal and the agent.⁵

For the sake of simplicity, two extreme alternatives are modeled: that is, either the principal or the agent is strictly liable, while the monetary sanction and the probability of

¹ The corporation owners, who are the decision makers, play the role of the principal. The principal-agent model closely describes the case of a sole-owner corporation. However, it can apply also to multiple-owners or even to publicly traded corporations, as long as incentives align managers' behavior to shareholder interests.

² Other examples are fraud-on-the-market securities fraud, fraud on the government, bribery, violation of regulatory requirements, waste disposal without permission, and so forth. We consider affirmative wrongful acts, committed by the agent because the corporation so desires. According to Cohen (1991), the majority of corporate crimes are "affirmative.

³ In the field of taxation, the agent's effort in concealing evasion can be extremely problematic. For example, Reinganum and Wilde (1991) note that raw evidence suggests a link between taxpayer use of preparers or practitioners and noncompliance. They report US data that show higher noncompliance, both as a percentage of number of reports and as a percentage of the amount of the reported tax, for taxpayers who resorted to third-party assistance. This happens in a legal regime in which the main penalties are provided for the evading taxpayer, but some are also imposed on the practitioner. Erard (1997) quotes survey evidence that indicates that some tax practitioners believe that they are able to prevent detection of tax evasion. The same author, using a 1982 IRS TCMP data file estimates a higher success by examiners in detecting deliberate evasion on self-prepared returns than on paid-prepared returns.

⁴ On this topic, see also Arlen and Kraakman (1997).

⁵ The role of gatekeepers has often been examined with reference to tax compliance. Most models are based on the approach of game theory (e.g., Reinganum and Wilde [1991]). Risk neutrality of all the parties involved is the standard assumption (e.g., Klepper et al. [1991]).

detection function remain the same. Even if actual legal regimes often provide rules for sharing liability,⁶ the study of extreme alternatives may shed light upon the main issues involved.⁷ In order to focus specifically upon the liability regime, it is also assumed that main enforcement parameters (sanctions and the probability of detection) are given.⁸

A rule providing for the principal's liability seems justified both on moral grounds, with reference to the retributive role of sanctions (since the illegal activity considered benefit the principal), and on efficiency grounds (since the principal can provide incentives for the agent to choose legal behavior). If, however, the principal is a corporation, then it is a person only in legal fiction without a definable mind or intentions. The applicability of the retributive theory of sanctions can thus be questioned in this case (Byam [1982], Khanna [1996]), although efficiency considerations pertaining to the deterrence of future wrongdoing are still relevant.⁹ The alternative approach, which envisages the agent as liable, may also have moral justifications. The agent, who is skilled either on the grounds of technical, legal or deontological rules, may have an even clearer idea than the principal that an activity is illegal.¹⁰

We will focus however on efficiency problems. It has been argued from this point of view that, according to the Coase theorem, liability rules are irrelevant, as long as costless side payments and monetary compensations can be used to neutralize the effects of the liability rule on payoff allocation. It is widely recognized, however, that market imperfections may imply that liability rules do matter. For example, agents may be potentially insolvent with reference to substantial judgments against them (Sykes [1984]). This fact could reduce their incentive to avoid wrongdoing if they are personally liable.

In this paper we assume, again for the sake of simplicity, that both the corporation and the agent can bear unlimited liability. However, in our model, liability rules matter because of transaction costs. We assume that the agreements between the principal and the agent

⁶ For some wrongdoings (such as fraud) sharing of the negative consequences of detection is likely to occur even when only the agent is liable for sanctions, given that the principal loses the benefit as soon as the agent is detected. In other cases (e.g., violations pertaining to health and safety, pollution regulations, price regulations, political contribution to foreign governments), when the agent alone is liable, the principal sometimes keeps the benefit after detection.

We explored several examples to test the validity of a more general approach, which also considers the case of liability sharing in various degrees between the principal and the agent. We discovered that the main results go unchanged, while the theoretical treatment would require significant heavier formalization.

For the sake of simplicity, we model illicit conduct as one-shot, thus not taking into account problems pertaining to the possible continuation of the wrongdoing.

⁷ For a discussion about the use of fines upon employees as partial substitutes for sanctions upon corporations, see Polinsky and Shavell (1993).

⁸ Note that this approach becomes necessary when constraints pertaining to available resources, need for marginal deterrence, and so forth (see, e.g., Stigler [1970]) restrict the number of instruments that can be tuned to secure optimal enforcement.

⁹ However, according to Fischel and Sykes (1996), with reference to corporations, deterrence should never be unconditional, that is, aimed at completely eradicating crime.

¹⁰ From an equity point of view, the agent may be poorer than the principal, and society may assign a higher weight to her utility. However, the reverse case may also arise. For example, a legal advisor may be richer than the owner of a small firm with limited assets.

pertaining to the complete or partial offsetting of the effects of the liability rule cannot be reached or enforced, or, equivalently, that transaction costs of these deals within the agency are prohibitively high. Moreover, it is impossible to buy insurance against sanctions. These are, again, extreme assumptions that are intended to provide insight about more realistic intermediate cases.

Illicit deals generally imply sheer difficulties in negotiating actions and compensation. In the subsequent analysis it is assumed, however, that these difficulties do not preclude the drafting and carrying out of an agency contract, provided that the agent's effort is observable.¹¹ This framework, with inevitable simplifications should depict the fact that, on the one hand, in many fields illicit deals do take place and illicit markets do work;¹² and that on the other hand, detection of wrongdoing would prevent the resorting to legal devices for further enforcement of the contract, and would also disrupt the functioning of self-enforcement or trust mechanisms.¹³ Thus, it is assumed that the agent's remuneration cannot be made conditional on the outcome (i.e., whether the wrongdoing is detected or not).

As far as risk aversion is concerned, according to standard agency theory, it is assumed that the principal is risk neutral and the agent is risk averse. The literature provides many justification for this assumption: for example, a stockholder principal can neutralize risks through the diversification of his portfolio. The generality of this assumption may of course be questioned, in particular with reference to illegal activities. Agency models which consider problems of substitutability or jointness of the principal and agent liability (see e.g., Chu & Qian [1995], Polinsky & Shavell [1993], Shavell [1997], Arlen [1994]) have, however, generally assumed risk neutrality of both,¹⁴ and only put forth some conjecture about the effect of the agent's risk aversion.¹⁵ In this paper the consequences of shifting liability from a risk neutral principal to a risk averse agent are examined in depth.

Liability shifts are often explained using the "deep pocket" argument, that is, identifying the subject who is more vulnerable to the threat of monetary sanction, when the other party has insufficient assets. Risk aversion may, however, provide a different kind of vulnerability. Even if both parties have sufficient assets, when the agent is liable, the sanction is placed upon the subject who is most damaged by it (being risk averse); as a consequence, the decisions of the principal regarding illegal behavior are negatively influenced through the increase in the cost of compensating the agent.

Agent's liability may, however, give rise to efficiency losses. Posner (1992) notes that a

¹¹ Standard agency models assume both uncertainty about the outcome and nonobservability of the agent's effort. In the case studied in this paper, as will become clear in the following, the first assumption alone is enough to originate a non trivial problem.

¹² According to Tirole (1992), the assumption of enforceability of side (illicit) contracts has the advantage of allowing the use of classical contract theory, while offering a realistic description.

¹³ It is often assumed (see Tirole [1992]) that side transfers are not always possible, but instead somehow constrained (for example by technology).

¹⁴ Risk neutrality is also assumed in the literature on disclosure, concealment or forgery of information by agents, as in Dewatripont and Tirole (1999).

¹⁵ For example, Polinsky and Shavell (1993) and Shavell (1997) maintain that risk averse liable agents will tend to exercise more effort than risk neutral ones.

fin imposed with a given probability upon a risk averse agent gives him a disutility in excess with respect to that suffered in the case of risk neutrality, which is not translated into revenue for the state. The same problem is pointed out by Yitzhachi (1987), who assumes risk averse taxpayers, and speaks of an “excess burden” of tax evasion. With reference to corporations, according to Kraakman (1984), managers and employees are undiversified risk bearers (having their assets concentrated) and thus are characterized by a risk-averse bias. Shifting liability upon them is costly and could also produce overdeterrence, as they may refuse running even minor risks, pertaining to legal but ambiguously regulated behavior.

However, government could prefer to bear some efficiency loss to achieve “the highest possible degree of voluntary compliance”.¹⁶ Enforcing law upon risk averse agents could then be a way of securing a degree of compliance that might not otherwise be achieved. We demonstrate, in fact, that the legal regime in which the agent is liable always reduces the principal’s net benefit thus involving at the margin some exit from illegal behavior.¹⁷

On the other hand, one cannot exclude that shifting the responsibility upon the agent involves a greater cheating effort, and thus the public sector is faced by greater problems in repressing illegal activity. On a specific model, however, we are able to characterize the cases in which the agent’s effort in covering up is lower than in the legal regime in which the principal is liable. When these circumstances occur, shifting liability upon the agent has clear-cut beneficial effects on compliance.

The paper is organized as follows. In Section 2 the agency model is introduced and optimal solutions are calculated for the two legal regimes (i.e., either when the principal or the agent is liable). Section 3 shows that, given the principal’s and the agent’s different attitudes toward risk, the principal net benefit is always lower under the second legal regime. Section 4 is dedicated to a specific (exponential) model. For this peculiar case, conditions are put forth under which the second legal regime is the most effective in the repression of wrongdoing. Finally, Section 5 reports the conclusions.

2. A principal-agent model under full information

In this section we set up two different principal-agent models describing the optimal behavior in implementing some illegal action. In the first model, strict liability is assumed only on the principal for any action performed by the agent, while in the second scenario the agent bears all the risks involved in possible detection. First we introduce notation and the assumptions necessary for the description of both cases.

¹⁶ American Bar Association on Taxpayer Compliance, quoted in Reinganum and Wilde (1991).

¹⁷ Moreover, as effort devoted to cheating is generally a waste of resources, discouraging it should also increase efficiency and mitigate the efficiency loss due to the risk bearing by risk averse agents. On concealment inefficiency see Cremer and Gahvari (1994).

2.1. Notation and assumptions

The principal, who is assumed to be risk neutral, may reap benefit that amounts to B from illegal behavior. Illegal activity is implemented by an agent¹⁸ who is paid for her effort to negatively affect the likelihood of detection. The agent is assumed to be risk-averse and receives utility from a remuneration r paid by the principal and faces a “disutility” due to the cost of the effort x . For the sake of simplicity, we assume that the agent’s total utility has the separable form¹⁹ $u(r) - d(x)$. Her reservation utility is denoted by u_0 . Furthermore, we assume that the principal can observe the effort x performed by the agent and has a reservation utility of π_0 .

Let $p(x)$ be the probability of being detected in performing the illegal activity and S the pecuniary sanction applied if offense is detected. Both the principal and agent know the function $p(x)$. To prove our results we need the following assumptions:

- (A1) $B > 0, S > 0, u_0 > 0$ and $\pi_0 > 0$;
- (A2) $u: \mathbf{R} \rightarrow \mathbf{R}$ is differentiable, strictly increasing and strictly concave;
- (A3) $d: \mathbf{R}_+ \rightarrow \mathbf{R}$ is differentiable, strictly increasing and weakly convex;
- (A4) $p: \mathbf{R}_+ \rightarrow \mathbf{R}$ is differentiable, strictly decreasing, strictly convex and $0 < p(x) < 1$ for all x ;
- (A5) $u(0) - d(0) \leq u_0$ and $d'_+(0) = 0$.

In (A2) we use standard assumptions for a risk averse agent utility function. In (A4) we assume that detection is neither certain nor impossible, and the probability $p(x)$ of detection is decreasing in effort. Assumption (A5) is needed to obtain interior solutions: the first inequality means that the agent can at most obtain her reservation utility by performing no effort and receiving nothing as remuneration.

2.2. The case where the principal is liable

In the first model the principal wants to maximize her expected net benefit

$$\begin{aligned} \mathbf{E}\pi(x, r) &= [1 - p(x)](B - r) + p(x)(B - r - S) \\ &= B - r - p(x)S \end{aligned}$$

subject to two constraints: the agent participation constraint and a “moral” constraint. Thus the problem of the principal is

¹⁸ It is assumed that the principal can never dispense with the agent altogether, either for organizational or legal reasons (e.g., only the agent can certify or sign documents etc.). The focus in this paper is thus on a side-contract between the principal and the agent about covering-up. In a more general setting one should also consider the likely interactions with the main contract that links the agent to the principal (e.g., the agent could be an employee, an outside consultant, etc.). On this topic see Kraakman (1986).

¹⁹ It is straightforward to extend Proposition 2 to the case where utility is described by any function $H(x, r)$ decreasing in x , strictly increasing and strictly concave in r . This general model has been tackled by Privileggi et al. (1998).

$$\begin{aligned}
\pi_1 &= \max_{x,r} [B - r - p(x)S] \\
&\text{s.t. (i) } u(r) - d(x) \geq u_0 \text{ and} \\
&\text{(ii) } B - r - p(x)S \geq \pi_0.
\end{aligned} \tag{1}$$

Constraint (ii) may be interpreted as follows: if the expected net benefit equals zero, then the principal chooses not to undertake any illegal action. Clearly, such a constraint becomes determinant in the choice of the principal: if r and $p(x)S$ are large enough, legal behavior will ensue. Note that $p(x)S$ is the expected value of the sanction if the effort in hiding the offense is x : $p(x)S = \mathbf{E}_x(S)$.

2.3. The case where the agent is liable

Now let us assume that the legal regime changes. The agent can be punished with the same sanction previously applied to the principal, and the principal is no longer liable. As the possibility of resorting to insurance (provided either by the principal or by a third party) has been excluded by assumption, the agent will consider the sanction as a cost or loss component, to be kept in mind when deciding whether to accept a contract which does not entail reimbursement of the sanction in case of detection.

Provided that the agent behaves according to the expected utility approach, in the legal regime where the agent is liable, her utility is

$$\begin{aligned}
U(x,r) &= [1-p(x)][u(r) - d(x)] + p(x)[u(r - S) - d(x)] \\
&= [1 - p(x)]u(r) + p(x)u(r - S) - d(x) \\
&= u(r) - p(x)[u(r) - u(r - S)] - d(x).
\end{aligned} \tag{2}$$

Under this new legal regime, the principal is no longer liable, and is therefore not interested in the effort of hiding the illegal action. Net benefit will be maximized independently of the effort x performed by the agent. Hence, the principal problem under this legal regime is:

$$\begin{aligned}
\pi_2 &= \max_r (B - r) \\
&\text{s.t. (i) } U(x,r) \geq u_0. \\
&\text{(ii) } x \in \arg \max_x U(x,r) \text{ and} \\
&\text{(iii) } B - r \geq \pi_0.
\end{aligned} \tag{3}$$

Constraint (ii) shows that, while in the previous legal regime the only contract available to the agent requires an amount of effort chosen by the principal, in this case the agent chooses a level of effort which maximizes her expected utility.

2.4. Characterization of optima

Under Assumptions (A1)–(A5) it is straightforward to obtain conditions which characterize solutions of problems (1) and (3). To exclude trivial cases, both constraint (ii) in (1) and constraint (iii) in (3) are assumed to hold with strict inequality.

Proposition 1: Under (A1)–(A5), the unique optimal solutions of problems (1) and (3) are two pairs (x_1, r_1) and (x_2, r_2) respectively such that

$$\begin{cases} u(r_1) - d(x_1) = u_0 \\ -p'(x_1)S = \frac{d'(x_1)}{u'(r_1)} \end{cases} \quad (4)$$

$$\begin{cases} [1 - p(x_2)]u(r_2) + p(x_2)u(r_2 - S) - d(x_2) = u_0 \\ -p'(x_2)[u(r_2) - u(r_2 - S)] = d'(x_2) \end{cases} \quad (5)$$

Furthermore $x_1 > 0$, $r_1 > 0$, $x_2 > 0$ and $r_2 > 0$.

Proof: By concavity and differentiability assumptions, the unique solution (x_1, r_1) of problem (1) is completely characterized by K. T. conditions, which lead to (4). The first equation in (5) follows from monotonicity of both the objective function and the function $U(x, r)$ with respect to r which implies that constraint (i) in (3) is binding. Weak convexity of $d(\cdot)$ and strict convexity of $p(\cdot)$ imply strict concavity of function $U(\cdot, r)$ (see last line in (2)); hence, for each given r , FOC expressed in the second equation of (5) is necessary and sufficient for optima. Finally, strict monotonicity of functions $d(\cdot)$ and $p(\cdot)$ plus assumption (A5) are sufficient for interiority of both (x_1, r_1) and (x_2, r_2) . ■

The first equations in both (4) and (5) imply that, when the principal maximizes her expected net benefit the agent receives her reservation utility. The second equation in (4) establishes that, at the optimum, the marginal benefit of the principal due to a reduction of the expected sanction must equal the marginal rate of substitution between the effort disutility and the reward utility of the agent. The second equation in (5) simply states that the incremental benefit of the agent must be equal to her marginal disutility at the optimal effort x_2 .

Thanks to strict monotonicity of $u(\cdot)$, from the first equality in (4), the optimal remuneration received by the agent for the effort performed x_1 is:

$$r_1 = u^{-1}[u_0 + d(x_1)].$$

Since effort is observable, the principal can fix the contract with the agent by setting the payment function:

$$w(x) = \begin{cases} r_1 = u^{-1}[u_0 + d(x_1)] & \text{if } x = x_1 \\ 0 & \text{otherwise.} \end{cases}$$

Similarly, since $U(x, \cdot)$ is strictly increasing for each fixed x , the first equation in (5) leads to:

$$r_2 = U^{-1}(x_2, u_0),$$

where, for each fixe x , $U^{-1}(x, \cdot)$ denotes the inverse function of $U(x, \cdot)$. Since the agent is liable, the principal is not interested in the effort performed by the agent and a contract will be set such that the payment function is:

$$w(x) \equiv r_2 = U^{-1}(x_2, u_0).$$

3. The “moral” constraint effect of the agent’s liability

Given the setting of Section 2, we are now ready to prove that when liability is charged on the agent rather than on the principal, there is a monetary disincentive in pursuing illegal initiatives: that is, the net benefit earned by the principal under the legal regime of Section 2.3 is always smaller than the net benefit of the case in Section 2.2.

Proposition 2: Under (A1)–(A5),

$$\pi_2 < \pi_1, \tag{6}$$

where π_1 and π_2 are define in (1) and (3) respectively.

Proof: By assumption (A2), (2) may be rewritten as

$$U(x, r) = u[r - p(x)S] - d(x) - \varepsilon(x, r),$$

where

$$\varepsilon(x, r) = u[r - p(x)S] - \{[1 - p(x)]u(r) + p(x)u(r - S)\} > 0$$

represents the cost, in terms of utility, of the risk of being liable in case of detection, which is strictly positive for all $x \geq 0$ and for all r since, under (A1)–(A4), $u(\cdot)$ is strictly concave, $S > 0$ and $0 < p(x) < 1$.

Hence, the first equation in (5) can be rewritten as follows:

$$u[r_2 - p(x_2)S] = u_0 + \varepsilon(x_2, r_2) + d(x_2).$$

By applying the inverse function $u^{-1}(\cdot)$ to both sides we have:

$$r_2 = u^{-1}[u_0 + \varepsilon(x_2, r_2) + d(x_2)] + p(x_2)S.$$

Therefore, the following holds:

$$\begin{aligned} \pi_2 &= B - r_2 \\ &= B - u^{-1}[u_0 + \varepsilon(x_2, r_2) + d(x_2)] - p(x_2)S \\ &< B - u^{-1}[u_0 + d(x_2)] - p(x_2)S \\ &\leq \max_{x \geq 0} \{B - u^{-1}[u_0 + d(x)] - p(x)S\} \\ &= \pi_1, \end{aligned}$$

where strict inequality holds as $\varepsilon(x_2, r_2) > 0$ and $u^{-1}(\cdot)$ is strictly increasing. ■

An important consequence of (6) is that, under the new legal regime, the “moral” constraint (ii) could no longer be satisfied and the principal problem (3) could turn out to have no solution while (1) may have. In other words, under a legal regime that charges the agent rather than the principal for committing an illegal activity, the principal may find that the same illegal activity that was profitable under the previous legal regime is no longer profitable.

The role played by the difference in attitudes toward risk exhibited by the principal and the agent should be evident: strict concavity of utility function $u(\cdot)$ versus linearity of the principal preferences plays the major role in reducing profit opportunities of the latter under the second legal regime.²⁰ Clearly, by assuming linearity of function $u(\cdot)$, that is risk neutrality also of the agent, the optimal effort turns out to be the same under both legal regimes, while the difference between the optimal remunerations is exactly the same amount as the expected sanction.

Unfortunately, systems (4) and (5) are not enough to establish general conditions under which effort x_2 turns out to be larger or smaller than effort x_1 . In the next section we discuss a particular model where effort x_2 may be either greater or smaller than effort x_1 , depending on the magnitude of parameters involved.

4. A specific case: the exponential model

Let the functions discussed in Section 2 be the following:

$$\begin{aligned} -u(r) &= 1 - e^{-\alpha r}, \quad \alpha > 0; \\ -d(x) &= \beta(e^x - 1), \quad \beta > 0; \\ -p(x) &= \gamma e^{-x}, \quad 0 < \gamma < 1. \end{aligned}$$

Moreover, let $0 < u_0 < 1$, $S > 0$ and $B > 0$ be given, and assume for simplicity that B is large enough to let constraint (ii) in problem (1) always be satisfied.²¹ The interpretation of the parameters α , β , γ is immediate: α denotes the (constant) absolute risk aversion of the agent, β characterizes the magnitude of the disutility function of the agent²² and γ is a rough indicator of the “average” probability of detection.²³

²⁰ Proposition 2 is consistent with Shavell (1982) results about the cost increase of liability for accidents that arises when the liable party, instead of being risk neutral, is risk averse.

²¹ Note that (A1)–(A5) are all satisfied apart from interiority of the optimal efforts x_1 , x_2 (since $d'_+(0) \neq 0$), which can be reached through an *ad hoc* assumption on the parameters α , β , γ , u_0 and the sanction S .

²² Parameter β is not particularly meaningful for our analysis, since we are interested in comparing variations of the optimal solutions rather than their values. Indeed, we do not introduce any measure of the effort; that is its size (and therefore the magnitude of the disutility) could be anything.

²³ Values of γ close to one represent an efficient monitoring by the authority upon illegal behavior, while values close to zero imply inefficient monitoring.

Table 1
The exponential model: a numerical example

γ	r_1	r_2	x_1	x_2	$p(x_1)$	$p(x_2)$	π_1	π_2
0.3	0.1022	0.5653	0.5987	0.8292	0.1648	0.1309	0.7330	0.4347
0.8	0.1846	0.8239	0.9655	0.9317	0.3046	0.3151	0.5108	0.1761

Note: $B = 1$, $S = 1$, $\alpha = 3$, $\beta = 0.2$, $u_0 = 0.1$

In the following analysis we will show how the parameters α , β , γ , u_0 , as well as the size of the sanction S , affect the optimal efforts x_1 and x_2 in both models. In other words, our goal is to study how specific features of the agent (parameters α and β), as well as the parameters controlled by the authority (γ and the sanction S), determine whether the optimal effort in the model with agent liability is larger or smaller than the optimal effort in the case under principal liability. We shall see through an example that with different, but in both cases reasonable, values for the parameters above, effort x_2 can be either larger or smaller than effort x_1 . We will then establish a condition under which the optimal effort in the model where the agent is liable is not larger than the optimal effort in the model where the principal is liable. This situation appears to be particularly attractive from the point of view of the decision-maker since, with respect to the model where the principal is liable, the model based on the agent liability exhibits not only the advantage of reducing the net benefit of the principal discussed in the previous section, but also the advantage of an increased probability of detection originated by a reduced effort in covering up the illegal action.

The exponential model allows for a direct computation of the optimal solutions (x_1, r_1) and (x_2, r_2) under both legal regimes as solutions of the two systems of Eqs. (4) and (5) respectively (see Privileggi et al. [1998]).

4.1. A numerical example

Table 1 presents a numerical example of the working of the exponential model, which shows that the optimal effort x_2 can be either larger or smaller²⁴ than effort x_1 , depending on whether parameter γ , which stands for the “average” probability of detection, assumes a low or a high value.

This scenario should not be surprising, since it is not clear if, in the new legal regime, the agent will maximize her utility through harder work (which reduces the probability of detection) or, on the contrary, by reducing effort (when this would generate a “disutility effect” larger than the positive effect upon the expected sanction).

This example anticipates what will be shown in the next subsection: the difference $x_2 - x_1$ turns out to be a decreasing function of parameter γ , that is, of the “average” probability of detection. In particular, if γ is large enough, this difference becomes negative, that is, x_1

²⁴ Similar examples (available from the authors upon request) can also be constructed with reference to cases in which the principal loses the benefit when detected, while liability for sanctions is only partially shifted from the principal to the agent.

$> x_2$. Under certain conditions, a similar pattern will be observed whenever sanction S grows larger. The interpretation of this situation may be the following: if the probability of detection (or the sanction) is sufficiently high, the agent requires enough compensation from the principal for the (high) risk of being detected to balance even a reduction in the effort of hiding the illicit activity. From the principal's point of view, this is equivalent to saying that the cost of compensating the agent for his effort to hide the action becomes higher than the cost of compensation for the risk of incurring the sanction.

This result is in line with the finding of the literature about self-protection activities (Ehrlich & Becker [1972], Lee [1998]), that is, activities that reduce the probability of a loss. Self-protection differs from insurance, which reduces the amount of the loss while not changing its probability. While more risk-averse people *ceteris paribus* always prefer greater insurance than the less risk-averse, the same is not true for self-protection. In fact self-protection reduces the income both in favorable and unfavorable states of the world (as it absorbs resources), while insurance increases income in the unfavorable states. Thus more risk-averse people can demand either higher or lower self-protection than less risk-averse. Quoting Shavell (1982, p. 1), who refers to liability for accidents, "Even though a risk averse injurer has a greater motivation to reduce the probability of a loss than does a risk neutral injurer, spending to reduce the probability exposes him to a larger risk (for if he loses l , his final income will be lower by l plus his expenditures)."

Our model shows that this classical result carries over to an agency model. In the following we examine the factors which can induce the agent to choose a lower effort than the principal, when liability is shifted from the latter to the former.

4.2. A comparative static analysis²⁵

By using the explicit solutions for the optimal efforts x_1, x_2 obtained in Privileggi et al. (1998), let us define the difference $x_2 - x_1$ as a function of the parameters of the model:

$$x_2 - x_1 = f(\alpha, \beta, \gamma, u_0, S). \quad (7)$$

Proposition 3: Under the assumptions of the exponential model, function f defined in (7) is strictly decreasing with respect to γ . As a consequence, variable γ can be globally explicitated with respect to the other variables for $f(\alpha, \beta, \gamma, u_0, S) = 0$ obtaining the implicit function

$$\gamma^*(\alpha, \beta, u_0, S) = \frac{1}{\beta} (1 - u_0 + \beta) \frac{(e^{\alpha S} - 1 - \delta)^2}{\alpha S (2e^{\alpha S} - 2 - \delta)(e^{\alpha S} - 1)}, \quad (8)$$

that is, for each fixed α, β, u_0, S , there exists a unique value $\gamma^*(\alpha, \beta, u_0, S)$ for the parameter γ such that $x_1 = x_2$.

Thanks to monotonicity of f with respect to γ , the following corollary holds.

²⁵ Proofs of all the statements in this subsection have been omitted. All technical details can be found in Privileggi et al. (1998).

Corollary: The inequality $x_1 \geq x_2$, that is all the cases where the optimal effort in the regime of agent liability is not larger than the optimal effort under principal liability, is characterized by

$$x_1 \geq x_2 \Leftrightarrow \gamma \geq \gamma^*(\alpha, \beta, u_0, S).$$

This is in tune with the intuition given by our example: if the probability of detection is (on average) large enough, switching the burden of liability from the principal to the agent causes a reduction in the effort of hiding the wrongdoing, thus enhancing the probability of detection.

Now we study how changes in the parameters α, β, u_0, S affect the threshold γ^* defined in (8). It is sufficient to study the sign of the partial derivatives of function $\gamma^*(\alpha, \beta, u_0, S)$ with respect to each parameter to see in which direction the threshold moves as the single parameter increases.

Proposition 4: Given the assumptions of the exponential model, whenever x_1 and x_2 are strictly positive the following hold:

- (i) $D_\beta \gamma^*(\alpha, \beta, u_0, S)$ and $D_{u_0} \gamma^*(\alpha, \beta, u_0, S)$ are always negative,
- (ii) $D_\alpha \gamma^*(\alpha, \beta, u_0, S)$ and $D_S \gamma^*(\alpha, \beta, u_0, S)$ are both positive if $\alpha S < 1.93$ and both negative whenever $\alpha S > 1.93$,

where $D_\alpha \gamma^*$, $D_S \gamma^*$, $D_\beta \gamma^*$ and $D_{u_0} \gamma^*$ denote the partial derivatives of γ^* .

Negativity of the partial derivatives of γ^* with respect to β and u_0 implies that the threshold γ^* decreases as β or u_0 increases; that is, as the cost of effort rises and/or the agent becomes more demanding, a lower probability of detection is enough to switch from a situation where $x_1 < x_2$ to the case where $x_1 > x_2$. In other words, positive variations in the cost of effort and/or in the reservation utility of the agent act in favor of law enforcement under the agent liability regime, since a smaller probability of detection is necessary to favor a reduction in effort of hiding the wrongdoing with respect to the other legal regime.

Different is the case of variations of the threshold as either the absolute risk aversion of the agent α or the sanction S increase. For small values of the product αS , an increase of α and/or S shifts the threshold γ^* upward. That is, for low absolute risk aversion of the agent and/or small sanctions, an increase of one or both of them has a negative effect (from the point of view of the effective probability of detection) on law enforcement in the regime which puts liability on the agent, thus making the other regime comparatively more efficient. The opposite happens for higher values of αS (greater than 1.93). In other words, the higher the sanction (or the risk aversion) is, the more efficient the second legal regime becomes with respect to the first one through a further increase in the sanction (or the risk aversion) itself.

5. Conclusions

The results must be considered cautiously, as solvency of both the principal and the agent was assumed and only the efficiency issue was examined. To relax the solvency assumption,

one should consider other policy devices, such as imprisonment as an alternative to fines piercing of the corporate veil, and so forth. Examination of a very simplified model, however, has been useful in shedding light upon the main problems at stake.

The increase in the expected cost of illegal behavior seems to be the feature on which legal systems focus when penalties for agents that perform illegal activities benefit their principal are devised. The beneficial effect of tightening the principal “moral” constraint is confirmed in this paper, in a setting where the principal is risk neutral and the agent is risk averse. The legal regime in which the agent is liable reduces the principal’s net benefit thus involving at the margin some exit from illegal behavior. These advantages must however be assessed against the costs of burdening a risk averse agent with risk.

The case for shifting responsibility onto agents is also generally not clear-cut for another reason: while it can provide a way of inducing some operators to renounce illegal behavior, it can also worsen the problem of repressing those who still find illegal behavior worthwhile. Nevertheless, as we have shown in Section 4, it is not self-evident that the probability of detection eventually decreases; there are also cases where the opposite occurs, and both the greater cost for the principal and the reduced agent care in concealing the wrongdoing may favor law enforcement. This case occurs, in our specific model, when enforcement policy is characterized by high values of either sanctions or probability of detection.²⁶ Thus, under a “strong” enforcement policy, the shift of the responsibility upon the agent is beneficial although it could fail—and even produce adverse effects—if it is considered as a remedy for insufficient public intervention.²⁷ The agent liability may in fact be the most effective regime in securing compliance, but specific conditions must be met, as theoretical analysis has shown. Particularly relevant for policy design is the case of strong enforcement through high probabilities (instead of high penalties). While this is certainly a costly policy, its benefit could be enhanced by shifting liability onto agents. Typical shortcomings of agent responsibility (such as agent insolvency or inequity in income distribution) would be mitigated in this case.

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²⁶ Other favorable conditions are a high agent absolute risk aversion or reservation utility.

²⁷ Our results suggest some *caveat* about policies that increase the agent liability as a substitute for tighter enforcement parameters. As an example of this kind of policy, one may quote Decree number 472, December 18, 1997, issued by the Italian Government, which reduces monetary sanctions for tax evasion, while increasing the agent (i.e., corporate executives, tax practitioners etc.) liability.

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