Targeting Employees for Corporate Crime and Forbidding Their Indemnification

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Abstract: The literature on corporate crime has focused on crimes committed by employees who are not necessarily acting in the interest of the firm. In this setting it is clear employees should be sanctioned; the question is whether the firm should be as well. The recent wave of corporate scandals has a different character: in many of these cases, the crime serves firm owners' direct interest; employees commit crimes only in response to incentives provided by the firm. In this latter setting it is clear the firm should be sanctioned; the question is whether employees should be as well. We show sanctioning employees solves a number of enforcement problems—increasing deterrence in the presence of a judgment-proof firm; reducing the chance that type-I enforcement errors lead to the bankruptcy of innocent firms by provide the same level of deterrence with lower overall fines. We show that forbidding indemnification is usually inefficient. The one case we find it to be useful is to encourage the employee's cooperation with prosecutors to increase the probability of successful prosecution of the firm.

Keywords: corporate crime, indemnification, principal-agent model

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1. Introduction

Federal indictments were returned in February 2005 against "W.R. Grace and and seven current and former Grace executives for knowingly endangering residents of Libby, Montana, and concealing information about the health effects of its asbestos mining operations."[1] An EPA official characterized this as "one of the most significant criminal indictments for environmental crime in our history."[2] The indictment alleges that the defendants sought to increase profits and avoid liability from the mining operation. Of course, these are merely allegations and may be proven to be unfounded.

New revelations about corporate scandals fill the headlines. Even before the recent wave of corporate scandals, however, there had been a dramatic expansion in the prosecution of corporations for criminal or regulatory violations. The sanctions imposed for violations had increased as well (Cohen 1991). A number of these offenses carry a dual structure of liability, in which both the corporation (i.e. the shareholders) and the manager are liable for fines or imprisonment. For example, a corporation convicted of price fixing faces corporate fines of up to $1 million per count, and more importantly, treble damages.[3] The individual managers face fines up to $100,000 and up to three years in prison. Other examples abound. "The areas of taxation, securities issuance and financing, antitrust, purchasing and sales, environmental safety, worker safety, government contracts, campaign contributions, and international transactions are rife with issues that create potential criminal exposure for a corporation as well as for those who run it" (Webb, Molo, and Hurst 1994, p. 618).

There are two central policy questions. First, should the government sanction or target managers/employees in addition to sanctioning the firm? Second, should firms be allowed to indem-

[1] Department of Justice press release, February 7, 2005, accessed at www.usdoj.gov.

[2] Lori Hanson, Special agent in charge of EPA environmental crime section in Denver, "W.R. Grace indicted in Libby asbestos deaths," *Seattle Post-Intelligencer*, February 8, 2005, accessed at seattlepi.nwsource.com/national/211169_libby08.html.

[3] This paper will often use the term "corporate crime" quite broadly and hence loosely. In particular, here we ignore the distinction between criminal and civil liability.

nify their managers, i.e., to reimburse these employees for legal expenses and fines arising from their work on behalf of the firm? Indemnification is widespread, although with exceptions we discuss below. These are intertwined but distinct questions, as widespread indemnification might simply transform any employee sanction into a firm sanction. Indemnification in particular has become a policy issue in a variety of settings, with the often expressed view that managers need some "skin in the game" to make socially appropriate decisions.

Are there conditions under which the firm does not fully unravel employee-targeted sanctions, so that there are strict social benefits to introducing employee-targeted sanctions? In order for employee-targeted sanctions to have strict social benefits, is it necessary for the government authority to prevent indemnification? For that matter, should the authority allow indemnification at all if indemnification only serves to promote corporate crime?

There is a large literature on corporate crime and governance. But ours is the first formal analysis of indemnification. Our approach also makes a contribution to the literature on employee targeting.

Much of the literature on corporate crime that studies the problem using a principal-agent framework (e.g., Macey 1991, Newman and Wright 1991, Arlen 1994, Chu and Qian 1995, Davis 1996, Arlen and Kraakman 1997, Shavell 1997, Arlen 1998, Garoupa 2000, Gans 2000) postulates that the agent (manager or employee) who commits a corporate crime acts in his own interest and against the interest of the principal (firm owners). In such a model, it is natural that the agent should be sanctioned in the socially-optimal legal regime; the interesting question is whether the principal should be as well. Drawing on the broader literature on vicarious liability (e.g., Sykes 1984, Shavell 1987, Hay and Spier 2004), the articles show that sanctioning the firm increases deterrence if limits to the agent's wealth prevent his paying sanctions sufficient to deter the crime; targeting the firm is particularly effective if it can monitor the agent's actions better than can government authorities.

We do not deny that many corporate crimes involve the agent profiting at the expense of the

firm. The much-publicized case of former Tyco CEO Dennis Kozlowski, who was charged with stealing over $170 million to fund lavish personal consumption, is but one extreme example.[4] Indeed, Alexander and Cohen's (1996, 1999) empirical findings that large firms (presumably with worse shareholder monitoring of management) and firms in which management has a smaller equity stake are more likely to have been convicted of corporate crimes has been taken as evidence that, *on average*, corporate crime is not committed in the interest of the firm. However, we suggest that there are still a broad range of cases, such as the Grace case, in which the alleged employee conduct benefitted the firm (at least before the conduct was detected and government sanctions levied). Another recent example is provided by federal indictments against Energy Services, Inc., and four former and current executives for creating the "false appearance of a shortage" by shutting down generation plants, resulting in higher wholesale electricity prices in California and millions of dollars of extra profit for the firm.[5] The widespread adoption of indemnification policies by firms is puzzling if agents' potentially criminal actions are opposed to the interests of the firm.

In this paper, we employ a principal-agent model to study the case in which the employee obtains no direct benefit from a corporate crime but may be induced to commit it by the structure of the compensation scheme he receives from the firm. In such a model, it is natural that the firm should be sanctioned in the socially-optimal legal regime; the interesting question is whether the employee should be as well. This is the opposite question from that posed by much of the literature on corporate crime cited above.

We propose a model in which an employee and firm owners operate in a principal-agent relationship under a legal regime set by the government authority. The legal regime may impose fines on the firm, on the employee, or on the firm and manager jointly. The crucial element in

[4]See Mark Maremont and Jerry Markon, "Leading the News: Former Tyco Executives Are Charged—New York Prosecutors Say Ex-CEO, Finance Officer Ran 'Criminal Enterprise' " *Wall Street Journal*, September 13, 2002, p. A3.

[5]"U.S. Says Reliant Unit, Officials Gamed Calif. Market," *Megawatt Daily*, April 12, 2004, p. 1–8.

our model is that the government authority is not a perfect enforcer: it makes type-I enforcement errors—i.e., convicting honest firms of corporate crime with some probability—as well as the usual type-II enforcement errors—i.e., not catching criminal firms with some probability. The existence of type-I enforcement errors provides a rationale for firms, even honest firms, to maintain a policy of indemnifying employees. It is a way to shift the risk of sanctions from the high-cost bearer—the risk-averse agent—to the low-cost bearer—the risk-neutral principal. Moreover, it provides a rationale for the government authority to allow such indemnification.

This highlights a potential cost of targeting the employee arising if indemnification is incomplete (either because of limited firm assets or legal prohibition). Offsetting this potential cost of targeting the employee are several social benefits. First, if the firm has limited assets (is judgment-proof in the parlance of the literature), it may not be able to pay a sufficiently high fine to deter the crime. Stronger deterrence can be obtained by targeting the employee with additional fines. A more subtle effect, second, is that employee sanctions indirectly place a heavier burden on criminal than on honest firms. To induce the employee to commit the crime (assumed to be costly to him), the firm has to provide a higher wage contingent on firm performance. This higher wage provides more resources that can be seized if employee fines are set so high that they bankrupt the employee. Therefore, the actual fine paid by an employee of a criminal firm may be higher than that paid by the employee of an honest firm even though the nominal level of the fine is the same. Our model thus provides several rationales for employee-targeted sanctions.

Interestingly, neither effect requires the government authority to forbid indemnification. Considering the first effect, if the firm is up against its liability constraint, it would not have the resources to indemnify the agent even if it wanted to. Considering the second effect, the nominal employee fine can be set sufficiently high so that the firm would choose not to indemnify the agent, letting the employee's limited-liability/bankruptcy constraint serve as a ceiling on the actual fine paid. We are then still left with the puzzle of why the government authority would ever find it socially efficient to forbid indemnification. It has been postulated (Stone 1980, Kraakman 1984,

Privileggi, Marchese, and Cassone 2001) that preventing indemnification magnifies the frictions in the principal-agent relationship, increasing the operating costs of a criminal firm. While our formal analysis shows this postulate is true, our analysis further shows that this does not provide a rationale for forbidding indemnification. In our model, the government authority's problem is not deterring crime: it can always do so with a sufficiently high combination of fines on the firm and employee. The problem is deterring crime *efficiently*, preventing crime without also inducing the exit of an honest firm, a danger because honest firms are subject to fines because of type-I enforcement errors. We show that the ratio of the marginal burden of an employee fine on honest firms relative to criminal firms is higher if indemnification is forbidden than if it is allowed. Therefore, forbidding indemnification harms honest firms more than criminal firms.

The rationale that does survive formal scrutiny is that forbidding indemnification can help secure the cooperation of the employee in prosecuting the firm. Authorities can offer to reduce the employee's fine in return for his cooperation, an offer that would be beneficial for the employee only if he were not fully indemnified by the firm. Assuming the employee cannot fabricate evidence, his cooperation could increase the probability of convicting criminal firms, while leaving the probability of convicting honest firms unaffected. A subtle issue that is addressed in the formal analysis is that by reducing the employee's fine in return for cooperation, the criminal firm's cost of inducing the employee to commit the crime is reduced, an effect which must be offset by the increased probability of convicting the criminal firm.

Whether indemnification should be prevented is of substantial public policy interest. State incorporation laws differ as to what costs the firm may indemnify, but most allow firms to reimburse agents' legal costs and losses from settlements, judgments, and fines. Significantly, Delaware law grants incorporating firms a broad ability to insure their agents, either through direct indemnification payments from the firm itself or through third-party Director and Officer (D&O) insurance (Easterbrook and Fischel 1991). Companies may include mandatory indemnification

in their corporate charters or bylaws.[6] According to a recent survey, 98 percent of U.S. firms with over 500 shareholders had D&O insurance (Tillinghast-Towers Perrin 2002).

While coverage under indemnification and D&O insurance is broad, there are exceptions. In particular, state laws forbid indemnification and D&O insurance coverage in the case of willful criminal misconduct (Harrington and Niehaus 1998). Stone (1980) argues that such *de jure* exclusions do not prevent *de facto* coverage for willful criminal misconduct. First, a number of federal crimes require only limited or no proof of intent or knowledge. State laws specify that conviction for such crimes "shall not, of itself, create a presumption that the person did not act in good faith" (Stone 1980, p. 49). Second, indemnification payments do not need to be reported to government authorities. The case may be handled by a legal counsel who himself is an agent of the firm. It is in the spirit of our model, which has type-I and type-II errors regarding whether a criminal act has been committed, to suppose that there are type-I and type-II errors regarding the employee's knowledge and intent when committing the act. Indeed, it would not be unreasonable to suppose that these latter errors would be larger in magnitude than the former. One can view the question of what standard is required to prove the willfulness of criminal conduct and thereby to prevent indemnification as a subtle variant of the question we analyze, whether indemnification should be prevented. For promises to indemnify or to make D&O insurance payments to have any credibility, the standard of proof for willfulness would need to be sufficiently high.[7]

The debate over indemnification has been particularly active recently. Securities and Exchange Commission (SEC) Chairman William Donaldson reviewed recent enforcement actions against corporate fraud and malfeasance.

> Of course, the fight against corporate fraud requires resolve in the boardroom and at all levels of government. I'm concerned about companies that, under permissive state laws, indemnify their officers and directors against disgorgement and penalties

[6] See for example, Dow Chemical Company, a Delaware Corporation. www.dow.com/corpgov/bylaws/indem.htm).

[7] Black, Cheffins, and Klausner (2003) address liability facing outside directors acting in good faith. Outside directors are much less likely to be involved in self-dealing. The authors note that although nominal liability exists for such outside directors, in practice indemnification and D&O insurance makes actual liability quite small.

> ordered by law enforcement agencies, including those brought by the Commission. In my mind, this just isn't good public policy. This is an area in which we may need to consider ways to bring about reform.[8]

Several recent settlements with the SEC contain the requirement that the defendant not seek indemnification or insurance payments to cover the fines. Since most settlement agreements do not involve admission of wrongdoing, insurance coverage would be available, absent the provision in the settlement. SEC Commissioner Harvey Goldschmid indicated that

> It's critical when we take money for a civil penalty, which involves a serious wrong, the money not circle back into the hands of those who have been involved in the wrongdoing. . . . This is a critically important policy change to create appropriate deterrence and accountability.[9]

Treasury Secretary Paul O'Neill suggested requiring CEOs to certify their company financial statements and barring D&O insurance for claims arising out of inadequate disclosure, in "all cases, whether there is a wrongdoing or whether there is a wrongful statement."[10]

The plan of this paper is as follows. Section 2 reviews the literature. Section 3 presents the formal model. In Sections 5 and 6 we consider, in turn, two benefits of targeting employees. First, we show that adding employee sanctions can increase the strength of deterrence if the presence of a judgment-proof firm. Second, we show that adding employee sanctions can maintain the same level of deterrence with a lower chance enforcement errors would lead to the shutdown of honest firms. The issues surrounding indemnification are considered in Section 7. Section 8 concludes.

2. Literature Review

There is a large literature examining corporate crime or corporate torts in a principal-agent framework. As noted in the Introduction, much of the literature is concerned with the question

[8]Chairman William H. Donaldson, "Remarks Before the New York Financial Writers Association," June 5, 2003, www.sec.gov/news/speech/spch060503whd.htm)

[9]Robert Schmidt, "SEC wants Settlements in which Defendants Pay Own Fines," *Chicago Sun Times*, June 17, 2003, p. 49.

[10]Bob Davis, "O'Neill Wants Stiffer Penalties for CEOs," *Wall Street Journal*, February 4, 2002, p. A2.

of when the firm should be made liable in addition to the employee, who should obviously be liable, a question related to the issue of vicarious liability. In our model, the crime benefits the firm, and the employee only commits the crime if the firm gives him the requisite incentives. We are interested in the unique conditions under which the employee should be liable in addition to the firm, which should obviously be liable. Our paper is thus closer to the formal analyses of employee liability by Kornhauser (1982), Segerson and Tietenberg (1992), Polinsky and Shavell (1993), and Privileggi, Marchese, Cassone (2001).

Kornhauser (1982), Segerson and Tietenberg (1992), and Polinsky and Shavell (1993) consider the case of a corporate tort. The employee and perhaps the firm invest in care to prevent an accident. The authors find that the government authority should target the employee for sanctions when the government is better at monitoring care and/or when the government is better at levying sanctions because of its ultimate threat of imprisonment. Our model is quite different. We consider a possibly willful corporate crime which the firm induces the employee to commit through the design of the incentive scheme. In cases in which the government's targeting the employee produces a strict social benefit in these previous papers, the firm obtains no benefit from indemnifying the employee. Indeed, Polinsky and Shavell (1993) demonstrate cases in which the firm prefers higher government sanctions for employees. By implication, there is no need for the government to forbid indemnification. In our setting, the firm would benefit from indemnifying the employee for a broad range of employee fines because indemnification reduces the cost of inducing the employee to commit the crime. Whether the government authority should forbid indemnification then is a non-trivial policy question that can be analyzed in our setting.

Privileggi, Marchese, and Cassone (2001) have a model which, similar to ours, has the firm earn a strict benefit from the employee's crime. Their analysis is fairly informal. In their model, the level of the fine is exogenous (and can only be levied on one party or the other, so joint firm-employee liability is not allowed). The assumption of exogenous sanctions is required for their results to be non-trivial; otherwise, because they do not have limited liability in their model,

crime could be perfectly deterred with sufficiently high sanctions. Indemnification is exogenously ruled out in their model, whereas it is one of the main focuses of our analysis.

A number of the ideas we develop formally in this paper were first noted in law review articles by Stone (1980) and Kraakman (1984). The authors note that firm limited liability provides a rationale for the government's targeting the employee with sanctions. The authors note that type-I errors can lead to undue risks on employees of honest firms if employees are targeted for sanctions and their indemnification forbidden. The authors note that forbidding indemnification can help secure the cooperation of employees in prosecuting the firm. These papers do not have models; our contribution is to provide a formal economic model and analysis. With our formal analysis, we provide additional reasons why targeting the employee can provide social benefits beyond the judgment-proofness of the firm: we show that it can increase the efficiency of deterrence by increasing the burden of sanctions on criminal firms relative to honest firms, thereby reducing the likelihood honest firms are forced to shut down in the face of high sanctions. We show that a suggested benefit of forbidding indemnification does not survive formal scrutiny: while forbidding indemnification increases the burden of a given employee sanction on a criminal firm, it increases the burden on an honest firm even more so. As a result, forbidding indemnification is generally socially inefficient. This same line of reasoning allows us to clarify why increased fines are not a perfect substitute for securing the cooperation of employees in prosecuting the firm and thus why forbidding indemnification can be of social value in this particular context.

The important role of limited liability in our analysis connects our paper to the large literature on the problem of the judgment-proof firm beginning with Shavell (1986). Even more broadly, the three-tiered structure, with the government authority operating above the principal-agent relationship between the firm and employee, connects our paper to the literature on side payments in hierarchies, beginning with Tirole (1986). Our consideration of the complex interplay between simultaneous limits to firm and employee liability is a contribution to these literatures.

Our result that forbidding indemnification helps secure the cooperation of the employee to

increase the chances of successful prosecution of the firm is reminiscent of the work of Arlen (1994), Chu and Qian (1995), and Arlen and Kraakman (1997). They show that partially forgiving firm sanctions can increase the firm's incentive to monitor the employee when such monitoring can increase the likelihood of uncovering criminal acts by employees. In both our work and theirs, the analysis is somewhat delicate because it is not obvious the "cooperating" party would want to trade off a lower sanction for an increased chance of prosecution.[11]

In our work, the indentity of the "cooperating" party is the opposite of theirs, the employee rather than the firm. The costs and benefits of securing cooperation are different in our model. Most importantly, our insight that forbidding indemnification plays a key role in allowing the government to trade reduced sanctions for cooperation did not appear in these previous papers.

It is worth emphasizing that our model differs from the articles cited in this section in its focus on type-I and type-II enforcement errors, which among other things allows for the possibility of a social benefit of indemnification. Our model allows the government to choose both the level of fines and the allocation between firm and employee arbitrarily. Our model is also novel in the generality of its specification of firm and employee limited liability. Both can have limited liability simultaneously, and the limits to liability can be any real value. Since in the real world limited liability corporations are staffed by limited liability employees, our modelling approach helps characterize this empirically relevant environment. To our knowledge, ours is the first formal analysis of the question of whether indemnification should be prohibited.

3. Model

The model has three players. Within the firm, there is a principal and an agent. The principal is the residual claimant of profit who designs the agent's incentive scheme. The agent carries

[11] Related issues arise in the literature on plea bargaining (e.g., Reinganum 1988 and Kobayashi 1990) and on the use of leniency programs in the prosecution of cartels (e.g., Spagnolo 2000a, 2000b, Aubert, Rey, and Kovacic 2003, Ellis and Wilson 2003, and Motta and Polo 2003). Our formal model best captures crimes undertaken within a single firm, so the wrongdoer has no ability to implicate co-conspirators in other firms.

out activities within the firm, including the possibility of committing a criminal act. There are several interpretations of the principal-agent labels in our model. In one interpretation, the firm's shareholders occupy the role of the principal and the firm's management the role of the agent. In another interpretation, one in which shareholders play only a passive role, the role of the principal is taken over by the management and a rank-and-file worker occupies the role of the agent. To cover all these cases, we will call the principal simply the "firm" and the agent simply the "employee". The third player in the model is the government, which sets and enforces sanctions against corporate crime.

The employee chooses action $a \in \{0, 1\}$, an indicator for whether a crime is committed ($a = 1$) or not ($a = 0$). Let $c > 0$ be his cost of committing the crime, including any physical effort required plus any psychic costs of violating a personal ethical code. The firm earns gross return $r \geq 0$ if no crime is committed and $r + b$ if a crime is committed, so that $b > 0$ is the firm's gross benefit from the crime. The crime generates external social harm h. Assume $h > b - c$, implying that the first-best policy is to deter crime. We will often (though not always) take h to be so large that the government wishes to deter crime at all costs (even at the cost of causing the firm to exit entirely).

The employee's wage w can be conditioned on the firm's return. Let $\underline{w}$ be the wage payment conditional on return r and $\bar{w}$ that conditional on return $r + b$. Note that, since the wage can be conditioned on the firm's return, and since there is no uncertainty regarding the firm's return, the wage can effectively be conditioned on the criminal act a. Of course the model could be enriched to allow the firm's return to be a random variable the distribution of which is improved (in the sense of first-order stochastic dominance) by the criminal act, but the present assumption of a deterministic return serves to simplify the analysis without much loss of insight.

The government makes type-I and type-II errors in enforcing corporate-crime laws. Let $\sigma_{\text{I}} \in (0, 1)$ be the probability the government makes a type-I enforcement error, i.e., it convicts when no corporate crime was committed. Let $\sigma_{\text{II}} \in (0, 1)$ be the probability the government makes a type-

Table 1: Conviction Probabilities

	Crime Not Committed	Crime Committed
Probability Government Does Not Convict	$1-\sigma_{\text{I}}$	σ_{II}
Probability Government Convicts	σ_{I}	$1-\sigma_{\text{II}}$

II enforcement error, i.e., it fails to convict when a corporate crime was committed. Table 1 lays out these enforcement probabilities along with their complements. Assume $\sigma_{\text{I}}+\sigma_{\text{II}}<1$, implying both that the probability of not convicting is greater if a crime was not committed ($1-\sigma_{\text{I}}>\sigma_{\text{II}}$) and that the probability of convicting is greater if a crime was committed ($\sigma_{\text{I}}<1-\sigma_{\text{II}}$). Errors σ_{I} and σ_{II} are exogenously given. Conditional on conviction, the government levies sanction (fine) $s_f \geq 0$ against the firm and $s_e \geq 0$ against the employee. These sanctions are an endogenous choice for the government. The employment contract may specify that the firm indemnifies the employee for losses due to the sanction. Let s_i be this indemnification payment, i.e., a payment from the firm to the employee conditional on conviction. In general, employment contracts could specify reverse payments from the employee to the firm ($s_i<0$) or specify indemnification in excess of the sanction ($s_i>s_e$). In our setting, there is no loss of generality in constraining $s_i \in [0, s_e]$.

As is usual in the corporate-crime literature, we will assume the government cannot use the wage scheme to infer whether a crime was committed in equilibrium. This may be because the wage scheme is part of an implicit contract unobservable to the government, or else because

the contract and contracting environment are too complicated for the government to make such inferences. In our analysis of the optimality of prohibiting indemnification, we will sometimes allow the government to observe whether the employment contract specifies indemnification and to constrain $s_i = 0$.

The firm is risk neutral. The employee is risk averse. Let $u : \mathbb{R}^+ \to \mathbb{R}^+$ be the employee's utility over wealth, with $u(0) = 0$, $u' > 0$, and $u'' < 0$. Assume the employee's coefficient of absolute risk aversion, $-u''/u'$, is nonincreasing in wealth. This assumption includes the standard cases of constant or decreasing absolute risk aversion as well as constant or decreasing relative risk aversion. Assume the cost of crime if one is committed, c, is additively separable from u in the employee's overall utility function.

Crucial for our analysis is a careful modeling of parties' limited liability. Assume the whole gross benefit from corporate crime b can be liquidated and used to pay obligations due the government (s_f) and employee (w and s_i). Additionally, the firm has ℓ_f liquifiable assets available to pay obligations. These liquifiable assets may come in part from the gross return from operating in the current period r and in part from retained earnings from past (unmodeled) operations. Depending on the relationship between ℓ_f and r, a number of cases can be accommodated: $\ell_f = r$ implies the whole of r can be liquidated to pay obligations but that there are no other liquifiable assets; $\ell_f > r$ implies there are assets in addition to r that can be liquidated; $\ell_f < r$ implies the firm can "consume" some of r (say paid out as dividends if the "firm" represents shareholders or paid out as high salaries and perks if the "firm" represents management) before paying its obligations and thus protect some of its return from seizure. In cases in which the firm does not have sufficient resources to pay its obligations, the firm is bankrupt and the following priority of claims established: the sanction s_f has priority, then the wage w, then the indemnification payment s_i.

The employee's whole wage w and indemnification s_i can be liquidated to pay its sanction s_e. The employee also has additional liquifiable assets $\ell_e \geq 0$. The employee's best option

outside the firm pays a wage normalized to zero. If he takes this outside option, he consumes his liquifiable assets ℓ_e, implying that his reservation utility is $u(\ell_e)$. An alternative interpretation is that the employee has no monetary assets besides payments from the firm, but he can still have his utility reduced below the reservation level $u(\ell_e)$ by non-monetary punishments such as prison. Given utility is bounded below by $u(0) = 0$, the gap between $u(\ell_e)$ and 0 indicates the severity of the non-monetary punishments, perhaps constrained by laws against cruel and unusual punishment or other social conventions.

The timing is as follows. First the government sets the sanctions s_f and s_e. These are observed by the firm. The firm then sets the employment contract $(\underline{w}, \bar{w}, s_i)$. The employee decides to accept the contract or pursue his outside option. Conditional on signing the contract, the employee then chooses whether or not to commit the crime, a. The state of the world determining whether the government convicts is realized, returns are realized, sanctions assessed, and wage and indemnification payments made.

4. Equilibrium Employment Contracts

We will solve for the subgame-perfect equilibrium by backward induction. In the present section, we will take the government's sanction scheme (s_f, s_e) as given, we will solve for the employment contract $(\underline{w}, \bar{w}, s_i)$ maximizing the firm's profit. In Sections 5 and 6, we will fold the game backward and solve for the socially optimal sanction scheme.

Following Grossman and Hart (1983), we will separate the firm's optimal-contracting problem into two steps. In the first step, we will solve for the optimal incentive-compatible and individually-rational contract implementing $a = 0$ (no crime) and that implementing $a = 1$ (crime). In the second step, we will compare these contracts and select the one yielding higher profit for the firm.

Consider, then, the problem of finding the optimal contract for the firm that induces the

employee not to commit a crime. The firm's objective function is

$$r - \sigma_{\mathrm{I}} \min(s_f + s_i + \underline{w}, \ell_f) - (1 - \sigma_{\mathrm{I}}) \min(\underline{w}, \ell_f). \tag{1}$$

The firm's gross return is r if no crime is committed. If the government makes a type-I enforcement error, the firm pays out $s_f + s_i + \underline{w}$, unless this exceeds its liquifiable assets ℓ_f, in which case it is liable only for ℓ_f. If the government does not make a type-I error, the firm just pays the wage $\underline{w}$, again subject to the limit that this payment not exceed the firm's liquifiable assets ℓ_f.

The employee's expected surplus is

$$\sigma_{\mathrm{I}}\ u\Big(\max\Big(0, \ell_e - s_e + \min\big(s_i + \underline{w}, \max(0, \ell_f - s_f)\big)\Big)\Big) + (1 - \sigma_{\mathrm{I}})\ u\big(\ell_e + \min(\underline{w}, \ell_f)\big). \tag{2}$$

If the government makes a type-I enforcement error, the employee receives a payment of $\underline{w} + s_i$ from the firm if the firm is not liquidity-constrained and $\max(0, \ell_f - s_f)$ if it is. The employee puts this payment together with its other liquifiable assets ℓ_e and pays s_e if it has sufficient funds. Otherwise it pays as much as it can and ends up with no income. If the government does not make a type-I error, the employee receives a payment of $\min(\underline{w}, \ell_f)$ from the firm, which he consumes along with his liquifiable assets ℓ_e. For the contract to be individually rational, the employee's surplus in (2) must exceed his reservation utility $u(\ell_e)$. For the contract to be incentive compatible, the employee's surplus in (2) must exceed his surplus if he commits the crime. Incentive compatibility is trivially established by setting $\bar{w} = 0$. To see this, note that if $\bar{w} = 0$ the employee's surplus from committing a crime is strictly less than $u(\ell_e)$, recalling that the employee faces a cost $c > 0$ of crime. The individual-rationality constraint ensures the employee's surplus from not committing a crime, (2), weakly exceeds $u(\ell_e)$, and so strictly exceeds his surplus from committing a crime, establishing incentive compatibility. Incentive compatibility is *trivially* established because $\bar{w}$ is an out-of-equilibrium wage which does not

appear in the objective function or the remaining constraints on the optimal contract inducing the employee not to commit a crime.[12]

In sum, the firm's optimal contract inducing the employee not to commit a crime is the triple $(\underline{w}^*, \bar{w}^*, s_i^*)$, where $(\underline{w}^*, s_i^*)$ maximizes (1) subject to the constraint that (2) exceeds $u(\ell_e)$, and where $\bar{w}^* = 0$.

Next, consider the problem of finding the optimal contract for the firm that induces the employee to commit a crime. The firm's objective function is

$$r - (1 - \sigma_{\text{II}}) \min(s_f + s_i + \bar{w} - b, \ell_f) - \sigma_{\text{II}} \min(\bar{w} - b, \ell_f). \tag{3}$$

This expression is similar to (1) except the probabilities of government enforcement are different, the wage may be different, and the return b has been added to states in which the firm is not liquidity-constrained (when the firm is liquidity constrained, since b is liquifiable by assumption, all of b can be used to pay the firm's obligations).

The employee's expected surplus is

$$\begin{aligned} &(1 - \sigma_{\text{II}})\ u\Big(\max\Big(0, \ell_e - s_e + \min\big(s_i + \bar{w}, \max(0, \ell_f + b - s_f)\big)\Big)\Big) \\ +\ &\sigma_{\text{II}}\ u\big(Le + \min(\bar{w}, \ell_f + b)\big) - c. \end{aligned} \tag{4}$$

This expression is similar to (2). The only differences, besides the different wage $\bar{w}$ and the different probabilities of government enforcement, are the addition of b to the liquifiable assets the firm can use to pay the employee and the subtraction of c, the employee's cost of committing the crime. For the contract to be individually rational, the employee's surplus in (4) must be no less than his reservation utility $u(\ell_e)$. For the contract to be incentive compatibile, the employee's surplus in (4) must be no less than his surplus if he does not commit the crime. By arguments

[12] It is unsurprising that incentive compatibility is trivially established given the setting of the model in which the wage can effectively be conditioned on whether a crime was committed or not.

paralleling those above, incentive compatibility is trivially established by setting $\underline{w} = 0$.

In sum, the firm's optimal contract inducing the employee to commit a crime is the triple $(\underline{w}^{**}, \bar{w}^{**}, s_i^{**})$, where $(\bar{w}^{**}, s_i^{**})$ maximizes (3) subject to the constraint that (4) exceeds $u(\ell_e)$, and where $\underline{w}^{**} = 0$.

Upon substituting the terms from the optimal contracts into (1) and (3), we see that the firm optimally induces the employee not to commit the crime if

$$r - \sigma_{\mathrm{I}} \min(s_f + s_i^* + \underline{w}^*, \ell_f) - (1 - \sigma_{\mathrm{I}}) \min(\underline{w}^*, \ell_f) \tag{5}$$

exceeds

$$r - (1 - \sigma_{\mathrm{II}}) \min(s_f + s_i^{**} + \bar{w}^{**} - b, \ell_f) - \sigma_{\mathrm{II}} \min(\bar{w}^{**} - b, \ell_f) \tag{6}$$

and induces the employee to commit the crime if (6) exceeds (5).

It is easy to see that the relevant individual-rationality constraint binds in the equilibrium contract, since otherwise the firm would benefit from a reduction in the wage. We summarize this observation in a proposition for later reference.

Proposition 1. *The employee's individual-rationality constraint binds, so that $\underline{w}^*$ is the implicit solution to the equation (2) equals $u(\ell_e)$ and $\bar{w}^{**}$ is the implicit solution to the equation (4) equals $u(\ell_e)$.*

5. Optimal Sanctions in the Presence of the Judgment-Proof Problem

Here we show that it can be useful for the government to target employees for corporate crimes if firms are judgment proof (i.e., have limited resources to pay sanctions) by increasing the effective cost of crime to the firms. While results from the previous literature are related, we would argue that there is some novelty in the results of this section. As noted in the Introduction, the bulk

of the corporate-crime literature postulates that employees commit crimes in their own interest in contrast to our postulate that employees must be induced by the firm to commit crimes. This literature finds the government may benefit from targeting the firm in addition to the employee if limited employee wealth prevents employees from paying sanctions sufficient to deter crime. Our result that the government can benefit from targeting the employee in addition to the firm if the firm is judgment proof is in a sense the "flip side of the coin," but is not identical. In particular, we allow for both the firm and employee to be constrained by limited liability, whereas one of the parties in this other literature, the firm, typically is assumed to have unlimited liability. Further, in this other literature, the firm can substitute for the government as a monitor of the employee. In the present setting, there is no analogous role for the employee to be a monitor of the firm; the employee simply carries out the incentive-compatible action as dictated by the employment contract. Previous law review articles have noted that targeting the employee can help deter crime by judgment-proof firms (Stone 1980, Kraakman 1984); the results in this section verify this intuition in a formal model. This may not be surprising in given earlier work, and so the section will be brief so that we can turn to more novel results in Sections 6 and 7.

We proceed by contrasting two polar-opposite cases. In Proposition 2, we examine the case in which the firm's assets are high enough that its limited-liability constraint is slack. In Proposition 3, we examine the case in which the firm has no assets beyond the return from crime if one is committed to pay sanctions.

Proposition 2. *Suppose* $r = \ell_f > b/(1 - \sigma_{\mathrm{I}} - \sigma_{\mathrm{II}})$. *The government can obtain the first best, deterring corporate crime with no deadweight loss, with a sanction scheme that does not target the employee. In particular, the sanction scheme* $s_f = b/(1 - \sigma_{\mathrm{I}} - \sigma_{\mathrm{II}})$ *and* $s_e = 0$ *suffices.*

The proof of Proposition 2 and all subsequent propositions is provided in the Appendix. The proof hinges on the fact that sufficiently high sanctions can deter criminal behavior as long as there is no barrier to levying the sanctions. If ℓ_f is sufficiently high, the firm's judgment-proofness is not a barrier to levying sufficiently high sanctions. The only possible source of

inefficiency from schemes involving high sanctions (discussed in detail in Section 6) is that the schemes may lead the firm to shut down. The firm's return r is sufficiently high in the statement of the proposition that the firm prefers to operate rather than shut down.

Next, we turn to the case in which the firm's limited-liability constraint is severely binding. For simplicity, Proposition 3 takes the extreme case in which $r = \ell_f = 0$, i.e., the firm has no assets to pay its obligations besides the return from crime if it is committed, b. In this case, it is efficient for the government to deter crime if it can whether or not this leads the firm to shut down: even the operation of an innocent firm produces no social benefit since $r = 0$.

Proposition 3. *Assume* $r = \ell_f = 0$.

(a) If

$$\sigma_{\text{II}} > \frac{u(\ell_e) - c}{u(b + \ell_e)}, \tag{7}$$

the government cannot deter corporate crime with any sanction scheme, whether or not the scheme targets the employee in addition to the firm.

(b) If

$$\sigma_{\text{II}} < \frac{c}{u(b + \ell_e) - u(\ell_e)}, \tag{8}$$

the government can obtain the first best, deterring corporate crime with no deadweight loss, with a sanction scheme that does not target the employee. In particular, the scheme $s_f = \infty$ *and* $s_e = 0$ *suffices.*

(c) If

$$\sigma_{\text{II}} \in \left(\frac{c}{u(b + \ell_e) - u(\ell_e)}, \frac{u(\ell_e) - c}{u(b + \ell_e)} \right) \tag{9}$$

then the socially optimal sanction scheme, which deters crime, must involve a positive employee sanction. In particular, the scheme $s_f = s_e = \infty$ *suffices.*

Under condition (7), the probability of convicting a guilty firm $(1 - \sigma_{\text{II}})$ is so low that it is impossible to deter crime even with infinitely high sanctions. The firm can always induce the employee to commit the crime by giving nearly all of the returns from the crime b to the employee. With probability σ_{II}, b is not seized by the government and is available to pay the employee, providing the employee with sufficient expected compensation to cover his cost c of

the crime and his additional loss up to ℓ_e if there is a conviction and he has to pay an employee sanction.

Under condition (8), the probability of convicting a guilty firm $(1 - \sigma_{\text{II}})$ is sufficiently high that corporate crime can be deterred by targeting the firm alone. The government can levy a sufficiently high sanction against the firm that its assets are taken away, preventing it from making any wage payment to the employee unless the crime goes unconvicted. Even if the firm made the highest payment to the employee possible (b) in the event the crime goes unconvicted, the probability of this event is so low that the expected payment would not be sufficient to cover the employee's cost c of the crime.

For the remaining parameters, characterized by condition (9), it is strictly beneficial for the government to target the employee. While the firm is able to compensate the employee for the cost c of crime by paying up to b in the event its assets are not seized by the government, it cannot compensate the employee for c plus the expected loss due to the employee sanction. Intuitively, it is beneficial to target the employee in addition to the firm because the firm's limited liability constrains how severely it can be punished with direct sanctions. By additionally targeting the employee, the government can increase the cost of crime to the firm by increasing the wage it must pay the employee conditional on committing the crime or else his individual-rationality constraint would be violated.

Note that the set of parameters satisfying (9) is nonempty if and only if $\ell_e > 0$. Under the maintained assumption that $r = \ell_f = 0$, the employee must have assets beyond payments from the firm that can be used to meet its liability or the government must have the possibility of administering additional non-monetary punishments in order for targeting the employee to be beneficial. If the employee does not have this additional liability, targeting the employee does not have any additional value under the maintained assumption $r = \ell_f = 0$.

Note that whether the government forbids or allows indemnification is irrelevant for the results in this section. In Proposition 2, the government can obtain the first best without targeting the

employee, in which case the employee has no sanction to be indemnified. The optimal sanction schemes given in Proposition 3 involve infinite firm sanctions. Whether or not the firm is allowed by law to indemnify the employee, it cannot do so because all of its assets are seized upon conviction. Hence, this section does not provide a rationale for forbidding indemnification.

6. Optimal Sanctions in the Presence of the Shutdown Problem

In order to turn the focus away from the problem of judgment-proof firms covered in the previous section, for the remainder of the paper we will assume $\ell_f = \infty$, implying that the firm has no liability constraints and can pay any finite sanctions.

In this section, we demonstrate another benefit of sanctioning employees for corporate crime that arises even if the firm is not judgment proof. Rather than jumping straight to a discussion of what this benefit is, however, it is instructive to point out what this benefit is not, and we devote Subsection 6.1 to this point. We then turn to a discussion of what this benefit is in Subsection 6.2.

6.1. Alleged Benefit of Employee Sanctions

Successful deterrence schemes have the property that they harm the criminal firm more than the innocent firm. This is true for two reasons. First, obviously, it is necessary for the firm to prefer not to induce a crime to be committed. A second, subtler reason, is since the firm's profit is a component of social welfare, the government is interested in maximizing the innocent firm's profit subject to the constraint that it not prefer crime. Thus, the government prefers schemes that harm innocent firms as little as possible (harm to innocent firms cannot be avoided entirely because of type-I enforcement errors). One might think that sanctioning the employee and forbidding his indemnification contribute to the success of a deterrence scheme. Forbidding indemnification increases the friction in the contracting process between the firm and employee, and this friction presumably harms the criminal firm more because the probability of conviction—

and the probability an indemnification payment would have been made if it were allowed—is higher for the criminal firm. Intuition along these lines was suggested by Stone (1980), Kraakman (1984), and Privileggi, Marchese, and Cassone (2001).

Proposition 4 shows that this intuition is incorrect. While targeting the employee and forbidding his indemnification increases the burden of a given sanction on a guilty firm, it increases the burden on an innocent firm even more than would simple firm sanctions. As a result, targeting the employee and forbidding his indemnification is typically socially inefficient.

Proposition 4. *Assume $\ell_f = \infty$. Consider any crime-deterring sanction scheme that (a) has a positive employee sanction ($s_e > 0$), (b) forbids indemnification, ($s_i = 0$) and (c) does not force the employee's limited-liability constraint to bind along the equilibrium path ($\ell_e \geq s_e - \underline{w}^* - s_i^*$). The government can replace this scheme with another that does not target the employee with sanctions ($s_e = 0$) that strictly increases social welfare.*

Figure 1 provides intuition behind the proof, provided in the appendix. Each panel in the figure is an indifference-curve diagram where the axes correspond to employee income in the two states of the world (no conviction, conviction). The employee's indifference curve at his reservation utility is given by the boldly drawn curve. The downward sloping dotted lines, labeled F', F'', and F''', are indifference curves for the firm. The firm's indifference curves are linear since the firm is risk neutral; the employee's is convex since he is risk averse. The employee's indifference curves reflect increasing utility as one moves out from the origin; the opposite is true for the firm since the employee's income is increased by payments from the firm.

Absent sanctions, the equilibrium contract offered by the firm fully insures the employee, paying a wage sufficient to get the employee to his reservation utility, reflected by point B. Suppose the government imposes sanction s_e, paid of course only if the firm is convicted. Without any compensation relative to the initial firm optimum, this moves the outcome from point B to A in the figure. The length of segment AB equals s_e. Of course A cannot be part of an equilibrium with sanctions since the employee's individual-rationality constraint is violated. The employee needs to be moved back to his reservation utility reflected by the dark indifference curve. If firm

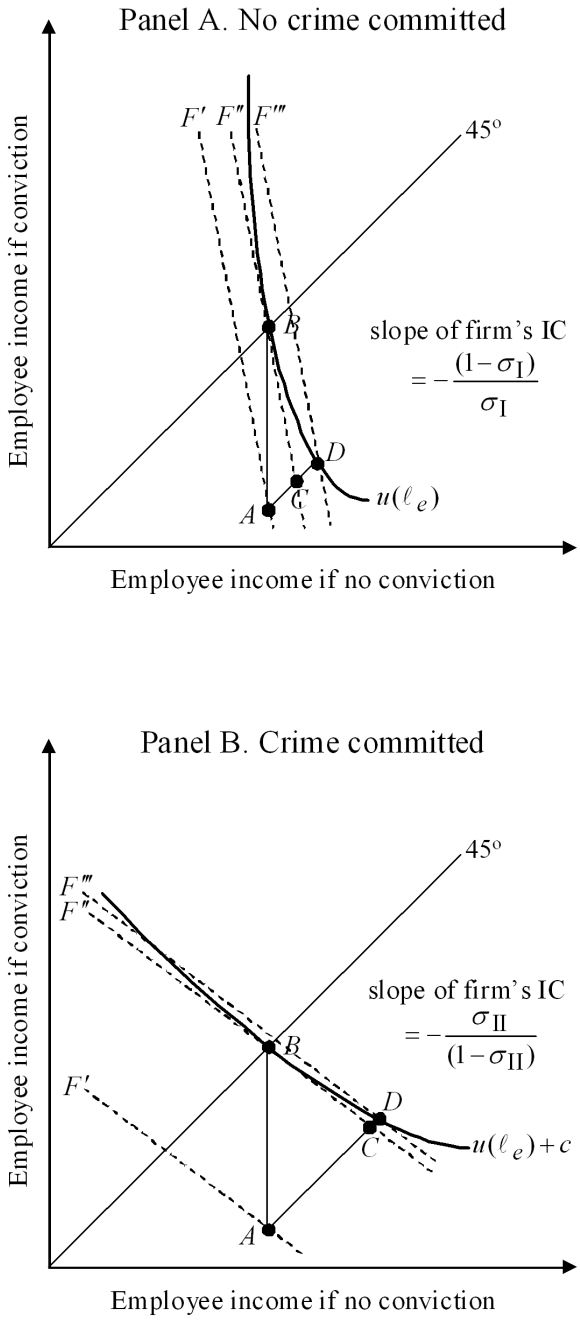

Figure 1: Sanctioning the employee and forbidding his indemnification harms an innocent firm relatively more than a guilty firm.

is unconstrained in how it moves the employee back to his reservation utility, the cheapest way to do this is to indemnify the employee directly, moving along the vertical line back up to point B. The indemnification payment, s_i, equals s_e, and both are equal the length of segment AB. Note that, measured in terms of firm surplus, a move from A to B is the same as a move from A to C since B and C are on the same indifference curve for the firm, F''. The length of AC equals $\sigma_{\text{I}} s_e$ in Panel A and $(1-\sigma_{\text{II}})s_e$ in Panel B. The math and the graphs tell us that AC is longer in Panel B than in Panel A. This is indeed where the deterrent effect of sanctions is coming from: they are paid with higher probability if a crime is committed. If the government constrains the firm not to indemnify the employee, the firm must return the employee back to his reservation utility via the wage. A wage payment can be depicted in the figure as a movement up a 45-degree line since a wage payment involves an equal increase in income in all states. Moving back to the employee's reservation utility along a 45-degree line from A produces the new point D.

To summarize, sanctioning the employee and forbidding his indemnification is captured by a move from A to D. Sanctioning the employee and allowing his indemnification is captured by a move from A to C.

The difference between Panel A (no crime committed) and Panel B (crime committed) is that the slope of the employee's and firm's indifference curves are steeper in Panel A than in Panel B. In Panel A, segment AD is almost twice the length of AC. Thus it is very costly to the firm to compensate the employee for a sanction through the wage rather than through direct indemnification if no crime is committed. In Panel B, by contrast, segment AD is hardly longer than AC. Thus, it is not very costly to compensate the employee through the wage rather than direct indemnification for a sanction if a crime is committed.

Hence, Figure 1 illustrates that, for a given sanction scheme, it is inefficient for the government to forbid indemnification since it increases the cost of operating if the firm is innocent, increasing its likelihood of exit, more than it increases the firm's cost of inducing crime.

A remark on the role of indemnification in Proposition 4 is in order. Since the firm has

no liability constraint, if the employee's limited-liability constraint does not bind and indemnification were allowed, employee sanctions would be equivalent to firm sanctions. Employee sanctions would be passed through to the firm fully. Employee sanctions become inefficient if indemnification is forbidden as assumed in the conditions of Proposition 4.

6.2. True Benefit of Employee Sanctions

We next turn to a discussion of the true benefit of employee sanctions (that is, in addition to solving the judgement-proof problem, as analyzed in Section 5). In light of Proposition 4, it is easy to see that employee sanctions do not strictly benefit the government if the employee's limited-liability constraint does not bind in equilibrium and the firm is not judgment proof. To see this, note that if the government forbids indemnification, social welfare can be increased by removing the employee sanction and increasing the firm sanction as directly stated in the proposition. On the other hand, if the government does not forbid indemnification, employee sanctions are equivalent to firm sanctions. The firm would fully indemnify the employee, and so employee sanctions would be fully passed through to the firm.

This result suggests that in the absence of the judgment-proof problem, the only possible case in which employee sanctions can have a strict benefit is if the employee's limited-liability constraint binds in equilibrium. Proposition 5 shows that, indeed, employee sanctions can provide a strict benefit in this case. The benefit of employee sanctions in this case stems from the fact that the government can set such a high employee sanction that all the employee's assets are seized if there is a corporate crime conviction. Since the employee must be paid a higher wage to induce him to commit the crime, the employee has more assets available to seize if a crime is committed than not, and so the employee sanction harms the firm relatively more if a crime is committed. Though the *nominal* employee sanction may be the same, the *effective* employee sanction is higher if a crime is committed than if not.

Proposition 5 goes beyond simply pointing out cases in which employee sanctions provide a

strict benefit. The proposition characterizes a socially optimal sanction scheme for all parameters given the firm is not judgment proof (i.e., given $\ell_f = \infty$).

Proposition 5. *Assume $\ell_f = \infty$. Consider the following four expressions:*

$$K + \left(\frac{1 - \sigma_{\text{I}} - \sigma_{\text{II}}}{\sigma_{\text{I}}}\right) r - b \tag{10}$$

$$h - r - b + K \tag{11}$$

$$b - \left(\frac{1 - \sigma_{\text{I}} - \sigma_{\text{II}}}{\sigma_{\text{I}}}\right)(\ell_e + r) - u^{-1}\left(\frac{u(\ell_e) + c}{\sigma_{\text{II}}}\right) + \left(\frac{1 - \sigma_{\text{II}}}{\sigma_{\text{I}}}\right) u^{-1}\left(\frac{u(\ell_e)}{1 - \sigma_{\text{I}}}\right) \tag{12}$$

$$(1 - \sigma_{\text{I}}) u^{-1}\left(\frac{u(\ell_e)}{1 - \sigma_{\text{I}}}\right) - K + \ell_e - h + b, \tag{13}$$

where $K = u^{-1}(u(\ell_e) + c) - \ell_e$. We have four exhaustive cases:

(a) If (10) is positive, then the government can obtain the first best, deterring corporate crime with no deadweight loss, with a sanction scheme that does not target the employee. In particular, the scheme $s_f = r/\sigma_{\text{I}}$ and $s_e = 0$ suffices.

(b) If (10) is negative and (11) and (12) are positive, then the socially optimal sanction scheme deters crime by shutting down the firm. In particular, the scheme $s_f = \infty$ and $s_e = 0$ suffices.

(c) If (10) and (11) are negative and (13) is positive, then the socially optimal sanction scheme does not deter crime. In particular, the scheme $s_f = s_e = 0$ suffices.

(d) For the remaining cases in which expressions (10) through (13) are nonzero, the socially optimal sanction scheme, which deters crime and does not lead to the shutdown of the firm, must involve a positive employee sanction. In particular, the scheme

$$s_f = \frac{1}{\sigma_{\text{I}}}\left[\ell_e + r - u^{-1}\left(\frac{u(\ell_e)}{1 - \sigma_{\text{I}}}\right)\right] \tag{14}$$

and $s_e = \infty$ suffices.

The last case in Proposition 5 is the most interesting. In this case alone, the optimal sanction scheme requires the government to sanction the employee. Employee sanctions increase the efficiency of deterrence in Proposition 5 because, even though the nominal fine paid by the employee is the same whether or not a crime is committed, the actual fine paid by the employee is higher if a crime is committed. A similar effect could be obtained by conditioning the nominal

fine on the employee's income. For example, Conard (1972) advocates capping the employee's liability by his after-tax net income from the firm in the year of violation. In our model, if the fine were set equal to this cap, the fine would increase with the commission of a crime.

Note that employee sanctions provide the benefit revealed in Proposition 5 whether or not indemnification is forbidden by law. As mentioned in the previous paragraph, the employee sanction works by forcing the employee's limited-liability constraint to bind. If the employee's limited-liability constraint binds anyway, the optimal scheme may as well specify an unboundedly large employee sanction, in which case the firm would prefer not to indemnify the employee whether or not indemnification is forbidden by law. Hence, in this section as in the previous section, there is no public-policy rationale for forbidding indemnification. Such a rationale will be provided in the next section.

7. Forbidding Indemnification as a Prosecutorial Tool

Whether firms should be allowed to indemnify employees for corporate crime sanctions is an important public policy question. So far we have found a negative answer to the question. We have found that for any sanction scheme that prevents indemnification, there exists another scheme that does not forbid indemnification that improves social welfare at least weakly and sometimes strictly. We have found that indemnification policy is irrelevant for optimal schemes: either the scheme does not target the employee, or if it does, it specifies such a high employee sanction that the firm would choose not to indemnify the employee even if it could. How then can a policy of forbidding indemnification be rationalized? In this section, we extend the model to allow for the possibility that prosecutors seek the cooperation of the employee in convicting the firm. We show that for some parameters, the optimal scheme forbids indemnification in order to secure the employee's cooperation with prosecutors, increasing the probability the firm is convicted for the corporate crime, reducing the attractiveness of crime. This allows the government to deter

crime with lower fines, reducing the probability that an innocent firm is bankrupted by a type-I enforcement error (a similar benefit to what we saw in Section 6).

Consider an extension of the basic model in which the government also has a prosecutorial function. In this extension, the prosecutors can use the cooperation of the employee to increase the probability the firm is convicted. We will maintain the probabilities σ_{I} and $1 - \sigma_{\text{II}}$ but reinterpret them as probabilities the government initiates an investigation of the crime rather than the probability of conviction. Conditional on an investigation being initiated, the probability of conviction is $\alpha \in (0, 1)$ if the employee does not cooperate with the prosecutors and one if he does. (It is sufficient to assume only that cooperation increases the probability of conviction; assuming it increases the probability from $\alpha < 1$ to one is a pedagogical simplification.) One can interpret cooperation by the employee as revealing a piece of hard information proving the crime, a "smoking gun". Consistent with this interpretation, the employee can only cooperate if a crime has actually been committed; if the government has committed a type-I enforcement error by investigating an honest firm, it is impossible for the employee to increase the probability of conviction by cooperating since there is no "smoking gun" to reveal. Combining the probability of investigation with the probability of conviction conditional on investigation, the unconditional probability of conviction equals $\sigma_{\text{I}}\alpha$ if no crime was committed, $(1 - \sigma_{\text{II}})\alpha$ if a crime was committed and the employee does not cooperate with prosecutors, and $1 - \sigma_{\text{II}}$ if a crime was committed and the employee cooperates with prosecutors. Table 2 lays out these enforcement probabilities along with their complements.

Even if crime is deterred in equilibrium, so the employee's cooperation is not actually used along the equilibrium path, the employee's cooperation off the equilibrium path, following the commission of a crime, increases the probability of conviction, reducing the appeal of the crime in the first place. Prosecutors induce the employee to cooperate by promising to forgive a portion of the sanction in return for cooperation. Let $s_c \in [0, s_e]$ be the amount of the sanction forgiven. If the firm fully indemnifies the employee, by setting $s_i = s_e - s_c$, the prosecutors' strategy will

Table 2: Conviction Probabilities When Employee May Cooperate with Prosecutors

	Crime Not Committed	Crime Committed	
		Cooperation	No Cooperation
Probability Government Does Not Convict	$1-\alpha\sigma_{\text{I}}$	σ_{II}	$1-\alpha+\alpha\sigma_{\text{II}}$
Probability Government Convicts	$\alpha\sigma_{\text{I}}$	$1-\sigma_{\text{II}}$	$\alpha(1-\sigma_{\text{II}})$

not work since the employee will not care about reducing the sanction.[13] The government thus needs to forbid full indemnification to induce the employee to cooperate. There are two ways for the government to do this. One is simply to set the employee sanction so high that the firm chooses not to indemnify the agent even if it were allowed to. Setting a high employee sanction may be inefficient if this increases the wages an honest firm needs to pay so much that honest firms shut down in equilibrium. If the shutdown of honest firms is a concern, it may be efficient for the government to prohibit indemnification directly.

The following proposition fully characterizes the optimal sanction scheme in this extended model.

Proposition 6. *Consider the extended model in which the employee may cooperate with prosecutors. Assume $\ell_f = \infty$. Consider the following two expressions in addition to (10) and (11) from Proposition 5:*

$$K - b + \left(\frac{1-\alpha\sigma_{\text{I}}-\sigma_{\text{II}}}{\alpha\sigma_{\text{I}}}\right) r \tag{15}$$

[13] In the basic model, we took s_i to be a constant without loss of generality. In the extended model of the present section, we will take s_i to be proportional to the employee's realized liability, $s_e - s_c$. Full indemnification is equivalent to $s_i = s_e - s_c$

$$b - \left(\frac{1-\alpha\sigma_{\mathrm{I}}-\sigma_{\mathrm{II}}}{\alpha\sigma_{\mathrm{I}}}\right)(\ell_e + r) - u^{-1}\left(\frac{u(\ell_e)+c}{1-\alpha(1-\sigma_{\mathrm{II}})}\right) + \left(\frac{1-\sigma_{\mathrm{II}}}{\alpha\sigma_{\mathrm{I}}}\right)u^{-1}\left(\frac{u(\ell_e)}{1-\alpha\sigma_{\mathrm{I}}}\right) \tag{16}$$

$$u^{-1}\left(\frac{u(\ell_e)+c}{1-\alpha(1-\sigma_{\mathrm{II}})}\right) - K + \ell_e - h + b. \tag{17}$$

We have four exhaustive cases:

(a) If (10) is positive, then the government can obtain the first best, deterring corporate crime with no deadweight loss, with a sanction scheme that does not target the employee and does not seek employee cooperation with prosecutors. In particular, the scheme $s_f = r/\sigma_{\mathrm{I}}$ *and* $s_e = s_c = 0$ *suffices.*

(b) If (10) is negative and (15) is positive, then there exists $\epsilon > 0$ *such that the scheme forbidding indemnification and setting* $s_f = (r-\epsilon)/\alpha\sigma_{\mathrm{I}}$ *and* $s_e = s_c = \epsilon$ *deters crime without shutdown of the firm. The social surplus from this scheme approaches the first best in the limit as* $\epsilon \to 0$*.*

(c) If (15) is negative and (11) and (16) are positive, then the socially optimal sanction scheme deters crime by shutting down the firm. In particular, the scheme $s_f = \infty$ *and* $s_e = s_c = 0$ *suffices.*

(d) If (11) and (15) are negative and (17) is positive, then the socially optimal sanction scheme does not deter crime. In particular, the scheme $s_f = s_e = s_c = 0$ *suffices.*

(e) For the remaining cases in which (10), (11), and (15) through (17) are nonzero, the socially optimal sanction scheme has the properties that it deters crime, does not lead to the shutdown of the firm, involves a positive employee sanction, and forgives some of the employee's sanction in return for cooperation. In particular, the scheme

$$s_f = \frac{1}{\alpha\sigma_{\mathrm{I}}}\left[\ell_e + r - u^{-1}\left(\frac{u(\ell_e)}{1-\alpha\sigma_{\mathrm{I}}}\right)\right], \tag{18}$$

$s_e = M$*, and*

$$s_c = M - u^{-1}\left(\frac{u(\ell_e)+c}{1-\alpha(1-\sigma_{\mathrm{II}})}\right) + u^{-1}\left(\frac{(1-\alpha)[u(\ell_e)+c]}{1-\alpha(1-\sigma_{\mathrm{II}})}\right) \tag{19}$$

suffices, where M *is a sufficiently large number, e.g.,* $M = r + b$*.*

The optimal sanction scheme in Proposition 6 is qualitatively similar to that in Proposition 5 except for cases (b) and (e). In case (b), the government can increase the probability of conviction with virtually no deadweight loss by levying a vanishingly small employee sanction which it forgives if the employee cooperates. Indemnification must be forbidden for the forgiveness

strategy to work. Otherwise, because the employee sanction is so small, it would be virtually costless for the firm to indemnify the employee. If the employee is indemnified, he would not gain from cooperation. The government could lead the firm not to indemnify the employee by setting such a high employee sanction that the firm would choose not indemnify the employee even if allowed by law. However, such a high employee sanction would harm the innocent firm, leading it to shut down or to have to pay a risk premium as part of the wage. While the sanction could be partially or fully forgiven if the employee were to cooperate with the prosecutors, by assumption the employee cannot cooperate if a crime was not committed. Thus, the employee of an innocent firm would face the full sanction.

The last case of Proposition 6 is similar to the last case of Proposition 5. In both, the employee sanction is so high that it forces the employee's limited-liability constraint to bind in equilibrium. We discussed the merits of such a scheme in the previous section. If the employee sanction is set sufficiently high, the employee of a criminal firm ends up paying a higher effective sanction because he has more assets to seize than the employee of an innocent firm. The last case in Proposition 6 differs from the last case in Proposition 5 in that the government is able to elicit cooperation with prosecutors by partially forgiving the employee sanction. The amount of forgiveness in (19) is calculated to compensate the employee for increasing the probability of conviction and hence the probability that he himself is fined. It is not necessary for the government to forbid indemnification for the sanction scheme in case (e) to work. The employee sanction is sufficiently high that the firm would not choose to indemnify the employee fully even if it were allowed by law.

8. Conclusion

Our paper complements the existing literature on corporate crime by analyzing the case in which the crime is in the direct interest of the firm, not the employee, and so the firm must induce the

employee to commit the crime through the structure of the employment contract. Besides being understudied, such a framework is required to study the question of considerable policy interest, that is whether firms should be forbidden to indemnify employee sanctions. Our model represents a unique combination of elements including government enforcement errors and simultaneous limits on firm and employee liability; these elements emerged as key determinants of the socially-optimal sanctions and indemnification policy.

We showed that there are only limited circumstances under which it is strictly beneficial for the government to sanction the employee in addition to the firm. First, sanctioning the employee is useful if the firm is judgment-proof. Second, sanctioning the employee can help avoid the problem of the shutdown of innocent firms. The employee sanction can be set so high that all his assets are seized in the event of conviction. The effective employee sanction is then higher if a crime is committed because the employee must receive a higher wage to induce him to commit a crime, and so the employee has more assets to seize. Neither of these benefits of sanctioning the employee requires the government to forbid indemnification. If the firm is judgment-proof, it does not have the assets to indemnify the employee even if allowed by law; if the employee is targeted with such a high sanction that his limited-liability constraint binds, this sanction can be set high enough that the firm would not choose to indemnify the employee even if allowed by law.

Indeed, we showed that it is typically inefficient for the government to forbid indemnification. To provide a rationale for forbidding indemnification, we extended the model to allow the probability of conviction to increase if the employee cooperates with prosecutors. In this extension, we found a limited set of parameters for which the socially optimal sanction scheme involved a small employee sanction which is forgiven if the employee cooperates with with prosecutors. The firm would have an incentive to indemnify the employee fully to induce him not to cooperate, so indemnification must be prevented for this sanction strategy to work.

For simplicity, in our model the opportunity for corporate crime is always available to the

firm. It would be straightforward to add a probability that the firm has no opportunity for or interest in corporate crime. In such an event, indemnification would reduce the deadweight loss of type-I enforcement errors by allowing the firm to insure the employee against such errors inexpensively. A policy of preventing indemnification could potentially be quite socially costly.

Interestingly, SEC officials were among those seeking to set aside indemnification. Since the SEC conducts investigations of wrongdoing, these officials are naturally interested in securing cooperation of employees in prosecuting the firm, as consistent with our results. From an overall public policy perspective, however, it may be more appropriate to adjust current sanctions rather than forbidding indemnification. Given the limited circumstances under which the social optimum required the government to forbid indemnification, our results suggest that officials should adopt a policy of forbidding indemnification only with great caution.

In future work we will adapt the model to consider the distinction between direct corporate indemnification and (third-party) D&O insurance. The present paper has assumed direct indemnification for simplicity. As Holderness (1990) notes, D&O insurance has the benefit of having another party, the insurance company, as a monitor to ensure the payouts are for acts taken in good faith. Our further work will also consider the costs of D&O insurance relative to indemnification.

In future work, we will consider the related issue of D&O coverage and indemnification for outside directors, who serve as monitors of management and are not directly involved in managing the firm. Interestingly, in March 2005, 11 former WorldCom directors agreed to pay over $20 million of their own funds to settle a class-action shareholder lawsuit.[14] Their personal financial sacrifice, while unusual, may set a precedent, and illustrates that the broad issues of employee targeting and indemnification remain active.

[14]"WorldCom Ex-Leaders Reach Deal in Lawsuit," *Washington Post*, March 19, 2005, p. E1.

Appendix

Proof of Proposition 2: Let $r = \ell_f > b/(1 - \sigma_{\text{I}} - \sigma_{\text{II}})$. We will show that the government can obtain the first best, deterring corporate crime with no deadweight loss, by setting sanctions $s_f = b/[1 - \sigma_{\text{I}} - \sigma_{\text{II}}]$ and $s_e = 0$.

If the firm wishes to induce the employee not to commit the crime, it will optimally set $\underline{w}^* = \bar{w}^* = s_i^* = 0$. The employee earns $u(\ell_e)$ from this contract, so his individual-rationality constraint is satisfied. The assumptions imply $s_f < \ell_f$. Hence expression (1) implies the firm earns

$$r - \sigma_{\text{I}} s_f. \tag{A1}$$

If the firm wishes to induce the employee to commit the crime, it will earn no more than

$$r + b - (1 - \sigma_{\text{II}}) s_f. \tag{A2}$$

To see this, expression (A2) is the value of the firm's objective function (3) substituting zero for the payments to the employee: $\bar{w}^* = s_i^* = 0$. Of course, to induce the agent to expend $c \geq 0$ to commit the crime, the firm must pay the employee a non-negative amount (indeed, strictly positive if $c > 0$), so (A2) is an upper bound on the firm's profit.

The firm prefers the employee not to commit the crime if (A1) exceeds (A2), or, rearranging,

$$s_f \geq \frac{b}{1 - \sigma_{\text{I}} - \sigma_{\text{II}}}. \tag{A3}$$

Condition (A3) is satisfied by the government's sanction $s_f = b/(1 - \sigma_{\text{I}} - \sigma_{\text{II}})$.

To show that there is no deadweight loss in equilibrium, we need to verify that the firm does not have an incentive to shut down. We showed the firm's equilibrium profit is (A1). This is positive since $r > b/(1 - \sigma_{\text{I}} - \sigma_{\text{II}}) = s_f$, implying $r > \sigma_{\text{I}} s_f$. *Q.E.D.*

Proof of Proposition 3: Assume $r = \ell_f = 0$. Since $h > b - c$ and since $r = 0$, it is efficient for the government to deter crime regardless of the consequences, in particular, regardless of whether this leads to a shutdown of firm operations.

First, we will solve for the optimal government sanction when the government is constrained to target only the firm. Under this constraint, it is optimal for the government to set $s_f = \infty$ and $s_e = 0$. If the firm wishes to induce the employee not to commit a crime, the most it can earn is zero, using the contract $\underline{w}^* = \bar{w}^* = s_i^* = 0$. If the firm wishes to induce the employee to commit a crime, the wage $\bar{w}$ must satisfy individual rationality for the employee. Note that the firm cannot make an indemnification payment to the employee because its only asset is the gain from criminal activity, b, which is confiscated upon conviction. Substituting zero for s_i and the rest of our parametric assumptions into (4), the employee's individual-rationality constraint reduces to

$$(1 - \sigma_{\text{II}})\ u(\ell_e) + \sigma_{\text{II}}\ u\big(\ell_e + \min(b, \bar{w})\big) - c \geq u(\ell_e). \tag{A4}$$

The lowest wage satisfying (A4) is optimal:

$$\min(b, \bar{w}^{**}) = u^{-1}\left(u(\ell_e) + \frac{c}{\sigma_{\text{II}}}\right) - \ell_e. \tag{A5}$$

For a solution $\bar{w}^{**}$ to (A5) to exist requires

$$b \geq u^{-1}\left(u(\ell_e) + \frac{c}{\sigma_{\text{II}}}\right) - \ell_e. \tag{A6}$$

For the firm to earn strictly more from inducing crime than from not inducing crime the inequality in (A6) must be strict. Rearranging (A6) and treating it as a strict inequality,

$$\sigma_{\text{II}} > \frac{c}{u(\ell_e + b) - u(\ell_e)}. \tag{A7}$$

In sum, if (A7) holds, the corporate crime cannot be deterred targeting the firm alone. If the inequality in (A7) is reversed, crime can be deterred by targeting the firm alone.

Next we will analyze the optimal scheme for the government if it is allowed to target the employee along with the firm. It is optimal for the government to set $s_f = s_e = \infty$. If the firm wishes to induce the employee not to commit a crime, the most the firm can earn is zero. To see this, note that if $\ell_e = 0$, the firm can obtain zero with the contract $\underline{w}^* = \bar{w}^* = s_i^* = 0$. If $\ell_e > 0$, the firm can obtain zero by shutting down. As an aside, the firm is forced to shut down since it has no assets to make a positive payment to the employee, but a positive payment would be required to satisfy the employee's individual-rationality constraint given the sanction $s_e = \infty$. If the firm wishes to induce the employee to commit a crime, the wage payment $\min(\bar{w}, \ell_f + b)$ must satisfy the employee's individual-rationality constraint:

$$(1 - \sigma_{\text{II}})\ u(0) + \sigma_{\text{II}}\ u(\ell_e + \min(\bar{w}, b)) - c \geq u(\ell_e). \tag{A8}$$

Rearranging, and noting the optimal payment will force (A8) to hold with equality,

$$\min(\bar{w}^{**}, b) = u^{-1}\left(\frac{u(\ell_e) + c}{\sigma_{\text{II}}}\right) - \ell_e. \tag{A9}$$

For a solution $\bar{w}^{**}$ to (A9) to exist requires

$$b \geq u^{-1}\left(\frac{u(\ell_e) + c}{\sigma_{\text{II}}}\right) - \ell_e. \tag{A10}$$

Condition (A10) must hold as a strict inequality for the firm to benefit strictly from having the crime committed. Rearranging the strict inequality,

$$\sigma_{\text{II}} > \frac{u(\ell_e) - c}{u(\ell_e + b)}. \tag{A11}$$

In sum, if (A11) holds, corporate crime cannot be deterred even by general schemes that target both the firm and employee. If the reverse inequality holds, there exists a sanction scheme that can deter corporate crime. Putting conditions (A7) and (A11) together gives the statement of the proposition. *Q.E.D.*

Proof of Proposition 4: Let (s'_f, s'_e) be a crime-deterring sanction scheme with $s'_e > 0$. Suppose the government forbids indemnification. Suppose further the employee's limited-liability constraint is not binding in equilibrium; i.e., $\ell_e \geq s'_e - \underline{w}^*(s'_e)$, where $\underline{w}^*(s'_e)$ is the equilibrium wage in the continuation game if no crime is committed. We will show that social welfare can be increased by substituting a new sanction scheme with a lower employee sanction.

Before proceeding, we will investigate some conditions characterizing equilibrium under the original sanction scheme that will be useful later in the proof. Substituting $\ell_f = \infty$, $s_i = 0$, and $\underline{w} = \underline{w}^*(s'_e)$ into (1), we have that the firm's profit in equilibrium is

$$r - \underline{w}^*(s'_e) - \sigma_{\text{I}} s'_f. \tag{A12}$$

By Proposition 1, the employee's individual-rationality constraint binds in equilibrium. Substituting $\ell_f = \infty$ and $s_i = 0$ into the equation formed by setting (2) equal to $u(\ell_e)$, we have that $\underline{w}^*(s'_e)$ is the implicit solution for w in the following equation:

$$\sigma_{\text{I}} u(\ell_e - s'_e + w) + (1 - \sigma_{\text{I}}) u(\ell_e + w) = u(\ell_e). \tag{A13}$$

Since sanctions (s'_f, s'_e) deter crime, the firm's profit in (A13) must exceed the greatest profit the firm can earn from inducing a crime to be committed, which, upon substituting $\ell_f = \infty$ and $s_i = 0$ into (3), can be shown to equal

$$r + b - \bar{w}^{**}(s'_e) - (1 - \sigma_{\text{II}}) s'_f, \tag{A14}$$

where $\bar{w}^{**}(s'_e)$ is the wage at which the employee's individual-rationality constraint holds with equality. Substituting $\ell_f = \infty$ and $s_i = 0$ into the equation formed by setting (4) equal to $u(\ell_e)$, we have that $\bar{w}^{**}(s'_e)$ is the implicit solution for w in the following equation:

$$(1 - \sigma_{\text{II}}) u(\ell_e - s'_e + w) + \sigma_{\text{II}} u(\ell_e + w) - c = u(\ell_e). \tag{A15}$$

Thus, (A12) must exceed (A14), or, rearranging,

$$\bar{w}^{**}(s'_e) - \underline{w}^*(s'_e) - b + (1 - \sigma_{\text{I}} - \sigma_{\text{II}}) s'_f \geq 0. \tag{A16}$$

Consider replacing (s'_f, s'_e) with the new sanction scheme (s''_f, s''_e), where $s''_f = s'_f + ds_f$, $s''_e = s_e - ds_e$, ds_e is an infinitesimal decrease in the employee sanction, and

$$ds_f = \left(\frac{1}{1 - \sigma_{\text{I}} - \sigma_{\text{II}}} \right) \left[\frac{d\bar{w}^{**}(s'_e)}{ds_e} - \frac{d\underline{w}^*(s'_e)}{ds_e} \right]. \tag{A17}$$

(As an aside, it can be shown that players' surpluses under the new scheme have the same functional forms as expressions (A12) through (A15), the only difference being that the new sanctions are substituted in. The only reason the functional forms would change is if the employee's limited-liability constraint began to bind in equilibrium under the new scheme. However, because $s_e'' < s_e'$, the employee's limited-liability constraint continues to be slack under the new scheme.) By construction, in particular by equation (A17), the left-hand side of (A16) remains the same if the new sanctions are substituted in, so the new scheme also deters crime in equilibrium.

It remains to be shown that the new sanction scheme strictly increases equilibrium firm profit. Taking the total differential of (A13), the change in firm profit in moving to the new sanction scheme is

$$\frac{d\underline{w}^*(s_e')}{ds_e} ds_e - \sigma_{\text{I}} ds_f \tag{A18}$$

$$= ds_e \left\{ \frac{d\underline{w}^*(s_e')}{ds_e} - \frac{\sigma_{\text{I}}}{1-\sigma_{\text{I}}-\sigma_{\text{II}}} \left[\frac{d\bar{w}^{**}(s_e')}{ds_e} - \frac{d\underline{w}^*(s_e')}{ds_e} \right] \right\} \tag{A19}$$

$$= \frac{\sigma_{\text{I}}(1-\sigma_{\text{II}})ds_e}{1-\sigma_{\text{I}}-\sigma_{\text{II}}} \left[\frac{1}{\sigma_{\text{I}} + (1-\sigma_{\text{I}})G(\underline{w}^*(s_e'))} - \frac{1}{(1-\sigma_{\text{II}}) + \sigma_{\text{II}} G(\bar{w}^{**}(s_e'))} \right], \tag{A20}$$

where

$$G(w) = \frac{u'(\ell_e + w)}{u'(\ell_e - s_e' + w)}. \tag{A21}$$

Equation (A19) holds by substituting for ds_f from (A17) and rearranging. Equation (A20) hodls by applying the implicit function rule to (A13) and (A15), respectively, to compute the derivatives

$$\begin{aligned} \frac{d\underline{w}^*(s_e')}{ds_e} &= \frac{\sigma_{\text{I}} u'(\ell_e - s_e' + \underline{w}^*(s_e'))}{\sigma_{\text{I}} u'(\ell_e - s_e' + \underline{w}^*(s_e')) + (1-\sigma_{\text{I}}) u'(\ell_e + \underline{w}^*(s_e'))} \\ \frac{d\bar{w}^{**}(s_e')}{ds_e} &= \frac{(1-\sigma_{\text{II}}) u'(\ell_e - s_e' + \bar{w}^{**}(s_e'))}{(1-\sigma_{\text{II}}) u'(\ell_e - s_e' + \bar{w}^{**}(s_e')) + \sigma_{\text{II}} u'(\ell_e + \bar{w}^{**}(s_e'))}, \end{aligned}$$

substituting these derivatives into (A19), and rearranging. Because $u'' < 0$ and $s_e' > 0$, $G(w) > 1$ for all $w \geq 0$. The facts that $G(\underline{w}^*(s_e')) > 1$ and $1 - \sigma_{\text{I}} > \sigma_{\text{II}}$ imply that expression (A20) strictly exceeds

$$\frac{\sigma_{\text{I}}(1-\sigma_{\text{II}})ds_e}{1-\sigma_{\text{I}}-\sigma_{\text{II}}} \left[\frac{1}{\sigma_{\text{I}} + (1-\sigma_{\text{I}})G(\underline{w}^*(s_e'))} - \frac{1}{\sigma_{\text{I}} + (1-\sigma_{\text{I}})G(\bar{w}^{**}(s_e'))} \right]. \tag{A22}$$

We will prove (A22) is nonnegative by showing $G(\underline{w}^*(s_e')) \leq G(\bar{w}^{**}(s_e'))$. This requires two steps. First, we will prove $\underline{w}^*(s_e') \leq \bar{w}^{**}(s_e')$ using monotone comparative statics results. Expression (A13), the implicit function whose solution is $\underline{w}^*(s_e')$, can be nested with expression (A15), the implicit function whose solution is $\bar{w}^{**}(s_e')$, using the parameter θ as follows:

$$(\sigma_{\text{I}} + \theta) u(\ell_e - s_e' + w) + (1 - \sigma_{\text{I}} - \theta) u(\ell_e + w) - \frac{\theta c}{1-\sigma_{\text{I}}-\sigma_{\text{II}}} = u(\ell_e), \tag{A23}$$

where if $\theta = 0$ the solution for w equals $\underline{w}^*(s_e')$ and if $\theta = 1 - \sigma_{\text{I}} - \sigma_{\text{II}}$, the solution for w equals

$\bar{w}^{**}(s'_e)$. Denote the left-hand side of (A23) by $H(w,\theta)$, supressing the dependence of H on the variables besides w and θ for brevity. Now $\partial^2 H/\partial w\partial\theta = u'(\ell_e - s'_e + w) - u'(\ell_e + w) > 0$ because $u'' < 0$ and $s'_e > 0$. By Theorem 2.2 of Athey, Milgrom, and Roberts (1998), $\partial^2 H/\partial w\partial\theta > 0$ implies H has increasing differences. Thus, by Theorem 2.3 of Athey, Milgrom, and Roberts (1998), the implicit solution for w is nondecreasing in θ. Hence, $\underline{w}^*(s'_e) < \bar{w}^{**}(s'_e)$. Second, we will prove $G'(w) \leq 0$. Differentiating equation (A21) and rearranging, we have

$$G'(w) = \frac{u'(\ell_e + w)}{u'(\ell_e - s'_e + w)} \left[\frac{u''(\ell_e + w)}{u'(\ell_e + w)} - \frac{u''(\ell_e - s'_e + w)}{u'(\ell_e - s'_e + w)} \right] \tag{A24}$$

$$= \frac{u'(\ell_e + w)}{u'(\ell_e - s'_e + w)} [\rho(\ell_e - s'_e + w) - \rho(\ell_e + w)], \tag{A25}$$

where ρ is the employee's coefficient of absolute risk aversion $\rho(x) = -u''(x)/u'(x)$. By assumption $\rho(x)$ is nonincreasing. Hence (A25) is nonnegative. *Q.E.D.*

Proof of Proposition 5: Assume $\ell_f = \infty$. By Proposition 4, without loss of generality, the socially optimal employee sanction can be taken to be either zero or so high it forces the employee's limited-liability constraint to bind in equilibrium. In the latter event, without loss of generality, the socially optimal employee sanction can be taken to be $s_e = \infty$. In the remainder of the proof, we will analyze the two cases separately in two steps, and in a third step combine and extend the results.

Step 1: Compute the socially optimal sanction scheme constraining $s_e = 0$. We first compute the firm's maximum profits as functions of s_f if no crime is induced and if a crime is induced. If no crime is induced, substituting $\ell_f = \infty$ and $s_e = 0$ into (1) and (2) and applying Proposition 1 implies $\underline{w}^*(s'_e) = 0$, employee surplus is $u(\ell_e)$, and maximum firm profit is

$$r - \sigma_{\mathrm{I}} s_f. \tag{A26}$$

If a crime is induced, substituting $\ell_f = \infty$ and $s_e = 0$ into (3) and (4) and applying Proposition 1, we have $\bar{w}^{**}(s'_e) = u^{-1}(u(\ell_e) + c) - \ell_e = K$, employee surplus equals $u(\ell_e)$, and maximum firm profit is

$$r + b - K - (1 - \sigma_{\mathrm{II}}) s_f. \tag{A27}$$

Comparing (A26) and (A27), we see that if $s_e = 0$, the socially optimal firm sanction can be taken, without loss of generality, to be one corner, $s_f = 0$, the other corner, $s_f = \infty$, or the value at which the innocent firm is just indifferent between shutting down and not, $s_f = r/\sigma_{\mathrm{I}}$. If (10) is positive, substituting $s_f = r/\sigma_{\mathrm{I}}$ implies (A26) is nonnegative and (A26) exceeds (A27). Thus, the sanction scheme $s_f = r/\sigma_{\mathrm{I}}$ and $s_e = 0$ deters crime with no deadweight loss. If (10) is negative, deterring crime involves a deadweight loss. Among schemes with $s_e = 0$, the two possibilities are that crime is not deterred or that crime is deterred by shutting down the firm. (Among schemes with $s_e > 0$, it is possible that crime is deterred without shutting down the firm, but there is still a deadweight loss because the employee will bear some risk. This last possibility is discussed in step 3.) If (11) is positive, the social surplus from setting $s_f = \infty$ and

thereby shutting down the firm, $u(\ell_e)$, exceeds that from setting $s_f = 0$ and thereby allowing crime, $r + b - h - K + u(\ell_e)$.

Step 2: Compute the socially optimal sanction scheme constraining $s_e = \infty$. Throughout this step, maintain the assumption that (10) is negative. In step 1, we already found the first best scheme if (10) is positive. As in step 1, we begin by computing the firm's maximum profits as functions of s_f if no crime is induced and if a crime is induced. If no crime is induced, substituting $\ell_f = s_e = \infty$ and $s_e = 0$ into (1) and (2) and applying Proposition 1 implies $\underline{w}^*(s'_e) = u^{-1}(u(\ell_e)/(1-\sigma_{\text{I}})) - \ell_e$, employee surplus is $u(\ell_e)$, and maximum firm profit is

$$r - u^{-1}\left(\frac{u(\ell_e)}{1-\sigma_{\text{I}}}\right) + \ell_e - \sigma_{\text{I}} s_f. \tag{A28}$$

If a crime is induced, substituting $\ell_f = s_e = \infty$ into (3) and (4) and applying Proposition 1 implies that $\bar{w}^{**}(s'_e) = u^{-1}((u(\ell_e)+c)/\sigma_{\text{II}}) - \ell_e$, employee surplus is $u(\ell_e)$, and maximum firm profit is

$$r + b - u^{-1}\left(\frac{u(\ell_e)+c}{\sigma_{\text{II}}}\right) + \ell_e - (1-\sigma_{\text{II}}) s_f. \tag{A29}$$

Comparing (A28) and (A29), we see that if $s_e = \infty$, the socially optimal firm sanction can be taken, without loss of generality, to be one corner, $s_f = 0$, the other corner, $s_f = \infty$, or the value at which the innocent firm is just indifferent between shutting down and not, (14). If (12) is positive, even if s_f is set to the value in (14), (A29) exceeds (A28), implying that the value of s_f in (14) cannot deter crime; hence, the optimal firm sanction is either $s_f = \infty$ (if, as shown in step 1, (11) is positive) or $s_f = 0$ (if, as shown in step 1, (11) is negative). If (12) is negative, setting s_f to the value in (14) is sufficient to deter crime without shutting the firm down; hence, $s_f = \infty$ is suboptimal.

Step 3: Comparison and extension. The preceding steps provide a complete characterization of the socially-optimal sanction scheme in all but one subcase. If (12) is negative, we showed $s_f = s_e = \infty$ is suboptimal. Thus, the optimal scheme must either involve $s_f = s_e = 0$ and allow crime or involve s_f equal to the value in (14) and $s_e = 0$ and deter crime as efficiently as possible. If (13) is positive, the former scheme generates higher social welfare and if (13) is negative, the reverse is true. *Q.E.D.*

Proof of Proposition 6: Assume $\ell_f = \infty$ in the extended model in which the employee can increase the probability of conviction by cooperating with prosecutors. Following the calculations in the proof of Proposition 5, it can be verified that the first best can be obtained if (10) is positive, using the scheme in case (a) and can be approached arbitrarily closely if (10) is negative and (15) is positive using the scheme in case (b). Arguments analogous to those in the proof of Proposition 4 can be used to show that if the firm operates and crime is deterred, an interior value of s_e is suboptimal. Thus, if the firm operates and crime is deterred, the sanction scheme must be as in cases (a) or (b) or must force the employee's limited-liability constraint to bind in equilibrium.

Therefore, if (10) and (15) are negative, we are left with three strategies for the optimal

sanction scheme. The scheme either shuts the firm down, allows crime, or deters crime without shutting the firm down by forcing the employee's limited-liability constraint to bind. We computed the maximum social surplus from the first two strategies in the proof of Proposition 5. It remains to compute the social surplus from the optimal scheme using the third strategy.

We first compute the firm's maximum profit from the third strategy if no crime is induced. Substituting $\ell_f = \infty$ into (1) and (2), noting $s_i = 0$ because the employee sanction will be so high the firm will prefer not to indemnify the employee, noting the employee's limited-liability constraint binds so that $\ell_e - s_e + w \leq 0$, and replacing the probability of conviction and not, σ_{I} and $1 - \sigma_{\text{I}}$, respectively by $\alpha\sigma_{\text{I}}$ and $1 - \alpha\sigma_{\text{I}}$, and applying Proposition 1, we have

$$\underline{w}^*(s'_e) = u^{-1}\left(\frac{u(\ell_e)}{1 - \alpha\sigma_{\text{I}}}\right) - \ell_e,$$

employee surplus is $u(\ell_e)$, and maximum firm profit is

$$r - u^{-1}\left(\frac{u(\ell_e)}{1 - \alpha\sigma_{\text{I}}}\right) + \ell_e - \alpha\sigma_{\text{I}} s_f. \tag{A30}$$

Next, we compute the firm's maximum profit if a crime is induced. The firm's profit depends on whether the employee cooperates with prosecutors or not. The socially optimal sanction scheme will obviously induce cooperation. We need to see what this implies for the employee's compensation and the structure of the optimal sanction scheme. If the employee cooperates, he earns

$$(1 - \sigma_{\text{II}})u(\ell_e - s_e + s_c + \bar{w}^{**}(s'_e)) + \sigma_{\text{II}} u(\ell_e + \bar{w}^{**}(s'_e)) - c. \tag{A31}$$

If he does not cooperate, he earns

$$\alpha(1 - \sigma_{\text{II}})u(0) + [1 - \alpha(1 - \sigma_{\text{II}})]u(\ell_e + \bar{w}^{**}(s'_e)) - c \tag{A32}$$

since s_e forces the employee's limited-liability constraint to bind, so that all the employee's assets are seized if there is a conviction. The optimal value of s_c forces (A31) to equal (A32), implying

$$s_c = s_e - \bar{w}^{**}(s'_e) - \ell_e + u^{-1}((1 - \alpha)u(\ell_e + \bar{w}^{**}(s'_e))),$$

in turn implying the employee's surplus from cooperating is

$$[1 - \alpha(1 - \sigma_{\text{II}})]u(\ell_e + \bar{w}^{**}(s'_e)) - c \tag{A33}$$

since $u(0) = 0$. The employee cooperates in equilibrium, so (A33) characterizes the employee's equilibrium surplus. By Proposition 1,

$$\bar{w}^{**}(s'_e) = u^{-1}\left(\frac{u(\ell_e) + c}{1 - \alpha(1 - \sigma_{\text{II}})}\right) - \ell_e.$$

The firm's maximum profit if it induces crime thus is

$$r + b - u^{-1}\left(\frac{u(\ell_e) + c}{1 - \alpha(1 - \sigma_{\text{II}})}\right) + \ell_e - (1 - \sigma_{\text{II}})s_f. \tag{A34}$$

It is feasible for the sanction scheme considered above to deter crime if (A34) is negative when evaluated at the highest value of s_f for which (A30) is nonnegative. Expression (A30) equals zero when s_f equals the value in (18). Substituting into (A34) and rearranging, (A34) is negative if (16) is positive. If it is feasible for this scheme to deter crime, this scheme generates higher social surplus than shutting the firm down. Straightforward calculations show that this scheme generates higher social surplus than allowing crime if (17) is negative.

Our usual specification of a high employee sanction, i.e., $s_e = \infty$, will not work here since forgiving a finite amount from an infinite sanction leaves an infinite sanction. Instead, we will set s_e to a finite number M that is large enough that the firm chooses not to indemnify the employee even if allowed by law. For example, it suffices to set $M = r + b$. *Q.E.D.*

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