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CORRUPTION AND OPTIMAL LAW ENFORCEMENT

A. Mitchell Polinsky
Steven Shavell

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ABSTRACT

This article analyzes corruption of law enforcement agents: payment of bribes to agents so that they will not report violations. Corruption dilutes deterrence because bribe payments are less than sanctions. The state may not be able to offset this effect of bribery by raising sanctions for the underlying offense. Thus, it may be optimal to expend resources to detect and penalize corruption. At the optimum, however, corruption may not be deterred. Nonetheless, it may be desirable to attempt to control corruption in order to raise the offender's costs -- the sum of the bribe payment and the expected sanction for bribery -- and thereby increase deterrence of the underlying violation.

A. Mitchell Polinsky
Stanford Law School
Stanford University
Stanford, CA 94305
and NBER
polinsky@leland.stanford.edu

Steven Shavell
Harvard Law School
1575 Massachusetts Avenue
Hauser Hall 508
Cambridge, MA 02138
and NBER
shavell@law.harvard.edu

1. Introduction

The purpose of this article is to analyze how the possibility of corruption of law enforcement agents affects the theory of optimal deterrence. By corruption of a law enforcement agent, we mean the payment of money by a law violator to the enforcement agent in return for the agent's not reporting the violation or otherwise acting so as to reduce the mandated sanction for the violation. Such corruption would include the payment of a bribe to a police officer for overlooking a speeding ticket, to a building inspector for ignoring a violation of code, or to a detective for not disclosing evidence about a felony.[1]

In Section 2, we consider the basic question of why corruption is socially undesirable in the standard model of law enforcement. The answer is in essence that corruption dilutes deterrence, for corruption results in a lower payment by an offender than the sanction for the underlying offense. But because the bribe paid by the offender depends on the sanction, the issue arises whether the state could increase the sanction to offset the dilution due to corruption. For example, suppose the bribe equals half of the fine and that the fine that will achieve appropriate deterrence in the absence of bribery is $10,000. Although this fine would result in a bribe of $5,000, why couldn't the state double the fine to $20,000, so that the bribe would be $10,000? An answer is that it may not be feasible for the state to raise the fine to $20,000 because the offender's wealth may not be that high.

The preceding point is always relevant in the standard model of law enforcement because, as is well known, the optimal fine in that model is maximal, equal to the offender's wealth (the higher the fine, the more society can conserve enforcement resources by lowering the probability of imposing sanctions). Thus, if the offender's wealth is $10,000, the state can set the fine equal to $10,000 but cannot induce bribes to be that high by raising the fine to $20,000. Instead, bribes will be limited to $5,000 because the effective fine is limited to $10,000, so that deterrence will be diluted by bribery. (The conclusion that bribery dilutes

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[1] We do not analyze certain other practices in law enforcement that would usually be labeled as corrupt, notably (1) payments made to enforcement agents by *innocent* parties who are threatened with penalties for fictitious violations or who are threatened with violence by enforcement agents, and (2) payments made by parties for licenses, government contracts, and other publicly-controlled privileges that are supposed to be awarded according to specific procedures.

deterrence and is therefore socially undesirable carries over to more realistic models in which the optimal sanction in the absence of bribery is not maximal, but then the ability of the government to raise the sanction may alleviate the deterrence-diluting effect of bribery).[2])

Because corruption dilutes deterrence, its control may be socially desirable, and in Section 3 we investigate optimal law enforcement when corruption as well as the underlying offense are penalized. Here our primary conclusions are as follows. First, the optimal sanctions for bribery as well as for the offense itself are maximal. (The essential reason is that the use of high sanctions allows enforcement resources to be conserved, not only in catching offenders, but also in detecting bribery.) Second, when the probability of detecting bribery is chosen optimally, bribery may or may not be deterred. Even if bribery is not deterred, attempting to control it may be desirable in order to raise the offender's costs — the sum of the bribe payment and the expected sanction for bribery — and thereby increase deterrence of the underlying violation.

In Section 4 we present two extensions of our analysis. First, we consider circumstances in which enforcement is said to be general, that is, when there are a continuum of harmful acts causing different levels of harm and when a single, general probability of apprehension applies to all of them. This situation is often realistic, as when an enforcement agent is able to spot a range of violations (for example, a police officer may detect many different kinds of traffic violations). In this case, optimal sanctions rise with the magnitude of harm, and the problem of bribery worsens as well. Specifically, for harms in a low range, sanctions are low and bribery is deterred; in a middle range of harm and sanctions, bribery occurs but is not socially detrimental because the deterrence-diluting effects of bribery can be offset by higher sanctions for the underlying offense; and for harms and sanctions in the highest range, the deterrence-diluting effects of bribery cannot be offset.

The other extension that we consider in Section 4 is use of jail as well as monetary sanctions. In this case, our major conclusions regarding bribery are as follows. First, jail will be desirable to use as a sanction for bribes whenever this would result in deterrence of

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[2] See part A of Section 4 and comment (c) in Section 5 below.

bribery. Second, even if bribery cannot be deterred, jail terms for bribery may be optimal to employ. And third, it may be optimal to use jail as a sanction for bribery even when it is best to use only monetary sanctions for the underlying offense.

In Section 5, we consider informally several additional factors that bear on corruption and law enforcement: impediments to the making of bribes, risk aversion, the state's ability to offset the deterrence-diluting effects of bribery, variation in whether bribes are paid, compensation of enforcers (including rewarding enforcers on the basis of the number of offenders they report), and plea bargaining versus bribery.[3]

2. Why Bribery is Socially Undesirable

In this section we extend the standard model of enforcement to include the possibility of bribes and we determine optimal enforcement policy within this model when bribery is not controlled. As noted above, we find that bribery is socially undesirable in the standard model of enforcement because it dilutes deterrence.

Assume that individuals can commit an act causing a harm, and that if they commit the act they obtain a gain. The magnitude of the gain varies among them. The state chooses the probability of detecting offenders (individuals who commit the harmful act). To achieve a given probability of apprehension requires an enforcement expenditure, which is increasing in the probability. The state also chooses the sanction to impose on offenders, which we assume for now is a fine. If an offender is caught, he pays the fine if his offense is reported to the state, or a bribe to the enforcer in return for his offense not being reported. Both the fine and the bribe are bounded by the offender's level of wealth. All parties are assumed to be risk

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[3] In the literature on corruption, Bowles and Garoupa (1997) is the article most closely related to ours. However, they do not explicitly consider limits on the fines that can be imposed. Therefore, although they do not state this, the fine on the underlying offense could be raised to offset any dilution of deterrence due to bribery — implying that bribery need not be socially detrimental. Moreover, fines for bribery could be raised to deter bribery completely. Another article of note is Mookherjee and Png (1995), although they, too, implicitly assume that bribery can be deterred completely (in their model, fines for taking bribes can be set arbitrarily high). Other publications on corruption include Becker and Stigler (1974), Pashigian (1975), Rose-Ackerman (1978), Klitgaard (1988), Shleifer and Vishny (1993), and Bardhan (1997). See also Tirole (1986) and Kofman and Lawarrée (1993) on collusion between parties in a multi-level principal and agent setting.

neutral.

The following notation will be used:

h = harm from committing the act;

g = gain an individual obtains from committing the act;

$r(g)$ = density of gains among individuals, $r(g)$ is positive on $[0, \infty)$;[4]

p = probability of detecting offenders;

$e(p)$ = enforcement expenditure to detect offenders, $e'(p) > 0$;

w_o = wealth of an offender;

f = fine imposed on the offender if an offense is reported, $f \leq w_o$;

b = bribe paid to an enforcer for not reporting an offense, $b \leq w_o$.

Note that in assuming that f and b are at most w_o, we are implicitly assuming that the gain to an offender is in utility rather than money, and therefore cannot increase the offender's wealth and his capacity to pay a fine or a bribe. This assumption is made mainly for simplicity.

Now consider the willingness of an offender and of an enforcer to enter into a bribe agreement. Clearly, the offender will be willing to make a bribe if and only if $b < f$,[5] and the enforcer will accept a bribe if and only if $b > 0$. Because there always exist bribes such that $0 < b < f$, a mutually satisfactory bribe always exists. We assume that a bribe will be made and accepted whenever there is a mutually satisfactory bribe, so bribery will always occur.[6] We also assume that the bribe amount will be such that the parties' surplus from entering into a bribe agreement — the avoidance of the fine f — is divided according to their relative bargaining power. Let

[4] The density of gains among individuals is assumed to be known to the state, but not the gain obtained by a particular individual.

[5] If $b = f$, the offender will be indifferent between paying a bribe and the fine; we assume for concreteness that bribery does not occur in this circumstance, and we adopt similar conventions elsewhere in this article without further comment.

[6] In assuming that bribes are made whenever they are feasible, we are abstracting from the problem that the enforcer might be able, *after* receiving a bribe payment, to threaten to report the offender unless he pays more. If the offender expects this to happen, he might not be willing to make any bribe payments. We discuss this and related issues in comment (a) of Section 5.

λ = bargaining power of the enforcer, $0 < \lambda < 1$,

so that the bribe amount is

$$b = \lambda f. \tag{1}$$

Thus, the bribe is increasing in f, but only up to the maximum feasible fine, the offender's level of wealth, w_o.[7]

Next consider the critical value of the gain below which an individual will not commit the harmful act and above which he will. Let

$\hat{g}$ = critical value of gain.

Observe that $\hat{g}$ equals the expected value of the payment that an individual faces if he commits the harmful act. Because offenders pay bribes equal to λf if they are caught by an enforcer, which occurs with probability p, their expected payment is $p\lambda f$, so

$$\hat{g} = p\lambda f. \tag{2}$$

Social welfare is assumed to equal the gains that offenders derive from committing the harmful act, minus the harm they cause, and minus enforcement costs:

$$\int_{\hat{g}}^{\infty} (g - h)r(g)dg - e(p), \tag{3}$$

where $\hat{g}$ is given by (2).[8] The social problem is to choose the fine f (which appears in (3) through $\hat{g}$) and the probability of apprehension p to maximize (3). Optimal values of these variables are indicated by an asterisk, and we assume here and in subsequent sections that p^* is positive (otherwise the issue of bribery would not arise).

First observe that, as in the enforcement problem in the absence of bribery, the optimal fine equals the maximum fine, w_o.[9] To see this, assume that f is less than w_o and that p is

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[7] For any fine in excess of w_o, the surplus from avoiding the fine is just w_o because the offender cannot pay more than w_o. Hence, for all such fines, the bribe would equal λw_o.

[8] Social welfare can be expressed in this way because, if individuals are risk neutral, the bribes paid by offenders who are caught are simply transfers of money, as are taxes that are needed to finance the cost of enforcement.

[9] See, for example, Polinsky and Shavell (1998, pp. 14-15) on the standard result that the fine should be maximal when individuals are assumed to be risk neutral.

positive. Raise f to w_o and lower p to a level p' such that $p'w_o = pf$. It is clear from (2) that $\hat{g}$ does not change, and it is clear from (3) that the only effect on social welfare is that $e(p)$ declines, which raises social welfare. Hence, $f^* = w_o$.

The optimal probability is then determined by maximizing

$$\int_{p\lambda w_o}^{\infty}(g - h)r(g)dg - e(p) \tag{4}$$

over p. This yields the condition

$$r(p\lambda w_o)\lambda w_o[h - p\lambda w_o] = e'(p), \tag{5}$$

which has the familiar interpretation that the marginal benefit from raising p — deterring more individuals, where the number deterred is $r(p\lambda w_o)\lambda w_o$ and the saving per individual deterred is the harm net of benefits obtained ($p\lambda w_o$ is the gain the marginal offender obtains) — equals the marginal cost of raising p.

When the probability of apprehension is chosen optimally, there is underdeterrence. This is clear from (5) because $[h - p\lambda w_o]$ must be positive or, equivalently, $p\lambda w_o < h$ — the expected bribe payment of those who commit the harmful act is less than the harm they do. The explanation is a familiar one: were the expected payment equal to h and behavior first best, it would be worthwhile saving enforcement expenses by lowering p because there would be no loss on the margin from underdeterrence (for if the expected payment initially equals h, the marginal offender obtains a benefit equal to h).

The optimal probability p^* in the presence of bribery could be higher or lower than the optimal probability in the absence of bribery.[10] On one hand, there is a tendency for p^* to be higher with bribery because the dilution in deterrence due to bribery means that a higher p is needed to achieve the same level of deterrence as without bribery. On the other hand, there is a tendency for p^* to be lower with bribery because bribery-induced dilution of deterrence causes p to be less productive in providing deterrence compared to when bribery is absent (for with bribery, raising p raises deterrence by λf, whereas without bribery, raising p raises

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[10] Both possibilities are illustrated in the numerical example at the end of this section.

deterrence by f).

Finally, and perhaps most significantly, observe that bribery lowers social welfare relative to the situation in the absence of bribery. To see this, let p^* be the optimal p when there is bribery, in which case the expected payment, and thus $\hat{g}$, is $p^*\lambda w_o$. In the absence of bribery, set $p' = p^*\lambda$ and $f = w_o$. Then $\hat{g}$ will be unchanged, so the first term in social welfare will be the same, but $e(p)$ will fall because $p' < p^*$; hence, social welfare will be higher.[11] Moreover, it is clear that the reduction in social welfare caused by bribery is the result of the dilution of deterrence, for if the bribe λw_o equaled the optimal fine w_o, social welfare would not decline as a result of bribery.

We may summarize what we have shown as follows.

PROPOSITION 1: If bribery occurs and no attempt is made to control it, then:

(a) the optimal fine for the underlying offense f^* is maximal, equal to the offender's wealth w_o;

(b) the optimal probability of detecting the underlying offense p^* is determined by (5) and leads to some underdeterrence;

(c) this probability could be higher or lower than it would be if bribery were absent; and

(d) bribery lowers social welfare relative to the situation in which bribery is absent, due to its deterrence-diluting effect.

The results of this section can be illustrated with a numerical example. Let the harm h be \$1,000; the gain g that individuals obtain from committing the harmful act be distributed uniformly between \$0 and \$2,000; the enforcement expenditure e required to detect violators with probability p be $\$10{,}000p^2$; the wealth of offenders be \$10,000; and the bargaining power of the enforcer λ be .5. The first-best outcome then is for individuals to commit the harmful act if and only if their gains exceed \$1,000 — that is, for the critical gain $\hat{g}$ to be \$1,000. If bribery did not occur, the optimal fine f^* would be \$10,000 and the optimal probability of

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[11] Note that p' generally is not the optimal p in the absence of bribery, so social welfare will rise by more than $e(p^*) - e(p')$.

detecting offenders p^* would be .07, resulting in $\hat{g}$ equal to \$700 (= .07 x \$10,000) and social welfare equal to \$178.50.[12] Thus, there would be some underdeterrence even in the absence of bribery. If bribery does occur, f^* remains at \$10,000, p^* rises to .08, $\hat{g}$ falls to \$400 (= .08 x .5 x \$10,000), and social welfare declines to \$96.00. Bribery significantly increases the degree of underdeterrence and significantly reduces social welfare. This is due, of course, to the dilution of deterrence from bribery. Instead of paying a fine of \$10,000, offenders who are detected now pay a bribe of \$5,000. The large deterrence-diluting effect of bribery is only slightly offset by the increase in the probability of apprehension, which requires additional expenditures on enforcement. (As noted in part (c) of Proposition 1, the optimal probability could fall as a result of bribery; this would occur in the example if, for instance, λ equals .2.[13])

3. Optimal Control of Bribery

We next consider the problem of law enforcement assuming that bribery is illegal and is penalized if detected. Clearly, it is worthwhile devoting resources to control bribery if the cost is low enough.

Now assume that if an individual is detected by an enforcement agent for the underlying offense and pays a bribe to him to avoid paying the fine f, the bribe might then be detected, resulting in a fine on both the offender and the enforcer.[14] The state chooses the probability of detecting bribery, which involves a cost, and the fines for bribery. These fines are bounded by the applicable party's level of wealth. Let

f_o = fine imposed on an offender who is caught engaging in bribery, $f_o \leq w_o$;

w_e = wealth of the enforcer;

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[12] We used a computer to calculate social welfare for values of p in increments of .01 from .01 to 1. (An analogous procedure is used in Section 3 when both p and q are policy instruments.)

[13] If λ = .2, then p^* = .05. The reason p^* falls is, as noted, that when λ is low, the bribe is low, so raising p does not generate much additional deterrence.

[14] We do not consider the possibility of a second round of bribery — to buy off the agent who is supposed to detect bribery. On this subject, see Basu, et al. (1992).

f_e = fine imposed on an enforcer who is caught engaging in bribery, $f_e \leq w_e$;

q = probability of detecting bribes;

$c(q)$ = enforcement cost to detect bribery, $c'(q) > 0$.

We assume that an offender who pays a bribe and thereafter is caught does not also pay the fine f for the underlying offense (there is no loss of generality in making this assumption because f_o can equal or exceed f). Note, too, that in assuming that f_o and f_e are at most w_o and w_e, we are implicitly assuming that if bribery is detected, the bribe transaction is undone before fines for bribery are imposed.[15]

Again consider the willingness of an offender who has been detected to offer a bribe. If he does not do so, he pays f, whereas if he offers a bribe, he pays b and faces the probability q that the bribe will be detected, in which case the bribe transaction will be undone and he will have to pay a fine f_o. Thus, a detected offender will prefer to pay a bribe if and only if $b + q(-b + f_o) < f$, or equivalently, if and only if:

$$(1 - q)b + qf_o < f. \tag{6}$$

Similarly, if the enforcer accepts a bribe, he obtains b and faces the probability q of having the bribe transaction undone and paying a fine f_e. Hence, he will accept a bribe if and only if:

$$(1 - q)b - qf_e > 0. \tag{7}$$

Therefore, for a bribe to be feasible, (6) and (7) imply that:

$$qf_e/(1 - q) < b < (f - qf_o)/(1 - q). \tag{8}$$

As before, we assume that if a mutually satisfactory bribe exists, it will be made. It follows from (8) that a bribe will be made if and only if $qf_e < f - qf_o$, or equivalently, if and only if:

$$q(f_o + f_e) < f. \tag{9}$$

The interpretation of (9) is that the expected sum of fines for bribery is less than the fine if there is no bribery, so that the parties together can avoid some fine payment.

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[15] If the bribe transaction were not undone, the offender would have $w_o - b$ available to pay the fine f_o rather than w_o. Likewise, the enforcer would be able to pay up to $w_e + b$ rather than w_e. Then we would have to deal with the distracting complication that the bribe payment would itself affect the magnitude of the fines that could be paid for bribery.

Also as above, we assume that when a bribe is paid, the enforcer obtains a fraction λ of the parties' surplus from entering into a bribe agreement. From (8), this surplus is $[(f - qf_o)/(1 - q)] - [qf_e/(1 - q)] = [f - q(f_o + f_e)]/(1 - q)$.[16] Thus, the bribe is:

$$b = \{qf_e + \lambda[f - q(f_o + f_e)]\}/(1 - q). \tag{10}$$

The interpretation of (10) is that the offender must compensate the enforcer for bearing an expected fine of qf_e, as well as give him λ of the surplus from bribery. Note that the bribe is independent of p, for the surplus from bribery obviously does not depend on the probability that the offender might have been caught.

Next consider the critical value of the gain $\hat{g}$ below which an individual will not commit the harmful act and above which he will; as noted, $\hat{g}$ is the expected value of the payment the individual makes if he commits the harmful act. If he would pay the fine if caught, his expected payment is pf. But if he would pay a bribe if caught, and then also face the risk that his bribery will be detected and sanctioned, his expected payment is $p[b + q(-b + f_o)] = p[(1 - q)b + qf_o)]$, which, using (10), can be written as

$$p[\lambda f + (1 - \lambda)q(f_o + f_e)]. \tag{11}$$

Because the offender will take the lesser-cost option,

$$\hat{g} = \min\{pf, p[\lambda f + (1 - \lambda)q(f_o + f_e)]\}. \tag{12}$$

Accordingly, social welfare now is:

$$\int_{\hat{g}}^{\infty}(g - h)r(g)dg - e(p) - c(q), \tag{13}$$

where $\hat{g}$ is given by (12).

Let us determine the optimal policy regarding the fines f, f_o, and f_e, and the probabilities p and q. We can again show that the fine for the underlying offense, f, must equal the maximum fine, w_o. If f is less than w_o, raise f to w_o and lower p to a level p' such that $\hat{g}$ is unchanged.[17] It is clear from (13) that the only effect on social welfare is that $e(p)$

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[16] In the previous section, in which q was in effect zero, the surplus from bribery was f.

[17] This can be done because $\hat{g}$ is equal to $p\min\{f, \lambda f + (1 - \lambda)q(f_o + f_e)\}$. The min expression is strictly increasing in f (because it is the minimum of two functions each of which is strictly increasing in f). Thus, when f

declines, which raises social welfare. Hence, $f^* = w_o$. Similarly, the optimal fines for bribery must be maximal. If f_o is not maximal, raise f_o to w_o, and lower q to a level q' such that $\hat{g}$ is unchanged.[18] The only effect on social welfare is to lower $c(q)$, so that $f_o^* = w_o$. Likewise, $f_e^* = w_e$.

We claim that q^*, the optimal probability of detecting bribery, is less than or equal to q_m, where

$$q_m = w_o/(w_o + w_e) < 1. \tag{14}$$

This follows from the observation that, because f_o^* and f_e^* equal w_o and w_e, respectively, (9) becomes $q(w_o + w_e) < w_o$. Thus, any q equal to or greater than q_m will deter bribery entirely, and if bribery is completely deterred, social welfare does not depend on q. Hence, if q exceeds q_m, social welfare can be increased by lowering q to q_m and thus reducing $c(q)$.

Because, as seen in Section 2, bribery lowers social welfare when bribery is not controlled, it must be desirable to control bribery at least to some extent — that is, to set q above zero — if the cost of doing so is low enough. Indeed, if the cost is sufficiently low, it will be optimal to set q equal to q_m and deter bribery completely. Conversely, if the cost of controlling bribery is high enough, bribery will not be worth controlling at all ($q^* = 0$).

If q^* is less than q_m, then bribery occurs and q^* is determined by maximizing

$$\int_{p[\lambda w_o + (1 - \lambda)q(w_o + w_e)]}^{\infty} (g - h)r(g)dg - e(p) - c(q) \tag{15}$$

over q, where the lower bound of integration is an offender's expected payment when bribery occurs. If q^* is positive, the resulting first-order condition can be written as:

$$r(p[\lambda w_o + (1 - \lambda)q(w_o + w_e)])p(1 - \lambda)(w_o + w_e)(h - p[\lambda w_o + (1 - \lambda)q(w_o + w_e)]) = c'(q), \tag{16}$$

which is interpreted similarly to (5). It is clear from (16) that the optimal choice of q results in some underdeterrence — the offender's expected payment, $p[\lambda w_o + (1 - \lambda)q(w_o + w_e)]$, is

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is raised to w_o, the min expression rises, so that a reduction in p can be found to maintain $\hat{g}$ at its initial level.

[18] This can be done because f_o and q appear in (12) only in the expression $q(f_o + f_e)$, and this expression obviously can be kept constant by lowering q appropriately to q'.

less than h. The reason is essentially that discussed in Section 2 to explain why the optimal choice of p results in some underdeterrence.

Note that even though bribery occurs when q^* is less than q_m, sanctioning bribery still discourages commission of the underlying offense. For when bribery occurs, an individual's expected payment if he commits the offense is equal to the sum of his expected bribe payment and his expected sanction for bribery. This sum, which can be written as $p[\lambda f + (1 - \lambda)q(f_o + f_e)]$ (see (11)), is increasing in q, f_o, and f_e. The explanation is, in essence, that raising q and f_o raises the expected fine on the offender for bribery, and raising f_e raises the bribe payment (the enforcer demands a higher payment because he bears a higher sanction if he is caught engaging in bribery).[19]

Now consider the choice of the probability of detecting offenders, p. Two cases need to be examined. If $q^* = q_m$, then bribery is deterred completely, so offenders who are caught pay the fine $f^* = w_o$. In this case, the optimal p is determined by maximizing

$$\int_{pw_o}^{\infty}(g - h)r(g)dg - e(p) - c(q_m) \tag{17}$$

over p. The first-order condition determining p^* is thus

$$r(pw_o)w_o(h - pw_o) = e'(p), \tag{18}$$

which has an interpretation similar to that with respect to (5).

If $q^* < q_m$, then bribery is not deterred, so individuals who commit the harmful act face expected payments given by (11). In this case, p^* is determined by maximizing (15) with respect to p, yielding the first-order condition

$$r(p[\lambda w_o + (1 - \lambda)q(w_o + w_e)])[\lambda w_o + (1 - \lambda)q(w_o + w_e)](h - p[\lambda w_o + (1 - \lambda)q(w_o + w_e)]) = e'(p), \tag{19}$$

which also has an interpretation similar to (5). It is clear from (18) and (19) that the optimal choice of the probability of apprehension results in some underdeterrence.

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[19] However, raising f_o lowers the bribe payment and raising q has an ambiguous effect on the bribe payment. Nonetheless, the net effect of raising f_o or q is to raise the sum of the injurer's bribe payment and his expected fine for bribery.

The probabilities p and q could be either complements or substitutes, in the following sense. If q is high and equals q_m, then bribery is discouraged, an offender's payment if detected is $f^* = w_o$, and raising p increases deterrence to the greatest extent possible (that is, the derivative of pf with respect to p is w_o, which is the highest this derivative can be). This suggests that a high q may lead to a high p. But the fact that when q is high p is more effective in creating deterrence implies that to achieve any given level of deterrence requires a lower p than otherwise. This means that a high q may lead to a low p.

We may summarize the results of this section as follows.

PROPOSITION 2: If bribery occurs and effort is made to control it, then:

(a) all fines should be maximal: the optimal fine for the underlying offense f^* and the optimal fine on the offender for bribery f_o^* equal the offender's wealth w_o, and the optimal fine on the enforcer for bribery f_e^* equals the enforcer's wealth w_e;

(b) the optimal probability of detecting bribery q^* must be less than or equal to $q_m = w_o/(w_o + w_e)$, where q_m is the lowest probability of detecting bribery that deters bribery;

(c) depending on the cost of detecting bribery, q^* may equal q_m, may be positive but less than q_m, in which case it is determined by (16), or may be zero;

(d) if $q^* = q_m$, then bribery is completely deterred, whereas if $q^* < q_m$, bribery is not deterred;

(e) the optimal probability of detecting the underlying offense p^* is determined by (18) or (19), depending on whether bribery is deterred; and

(f) when p and q are chosen optimally, some underdeterrence results.

The numerical example in Section 2 also can be used to illustrate the results in the present section. Recall that when bribery occurs but no attempt is made to control it, the optimal fine for the underlying offense f^* is \$10,000, the optimal probability of detecting offenders p^* is .08, the critical gain $\hat{g}$ is \$400, and social welfare is \$96.00. Now let the cost c required to detect bribery with probability q be $\$1{,}000q^2$ and the wealth of enforcers be \$10,000. Then the optimal fine for the underlying offense f^* remains, of course, at \$10,000, and the optimal fines on the offender and the enforcer for bribery, f_o^* and f_e^*, are also \$10,000. The optimal probability of detecting offenders p^* remains .08, and the optimal probability of detecting bribery q^* is .10. Because q^* is less than the minimum probability q_m that would deter bribery, which is .5 in the example, bribery occurs when offenders are detected by enforcers. The bribe payment is $5,556, far less than the $10,000 fine for the underlying offense. This bribe payment, together with the risk of paying a $10,000 fine if bribery is detected, leads to a critical gain $\hat{g}$ of $480. And social welfare rises to $108.40. Thus, while it is not optimal to expend enough resources to deter bribery, it is desirable to control bribery by sanctioning it with a positive probability. Doing so raises the critical gain from $400 to $480, reducing the degree of underdeterrence.

4. Extensions

In this section we present two extensions of our analysis. In part A we discuss corruption when enforcement is "general" (that is, when the same probability of apprehension applies to a continuum of harmful acts), and in part B we discuss the use of jail sanctions to control corruption.[20]

A. General Enforcement

Consider the model of general enforcement, in which expenditures to catch offenders apply to a range of harmful acts, rather than to just one act; this model is relevant when the state does not individually choose enforcement effort for each specific act.[21] For example, a police officer directing traffic at an intersection may observe a driver who is speeding, an individual who litters, and a pedestrian who jaywalks; or an IRS agent inspecting tax returns may detect many different kinds of violations.

Thus, suppose now that the same probability p applies to a range of acts causing different levels of harm h. The harms h are assumed to be distributed on $[0, \infty)$. For simplicity, we also assume that the same probability q of detecting bribery applies to all harmful acts and that the wealth of offenders w_o is the same for those who commit different

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[20] In our analysis of these extensions, we do not formally prove many of our claims because it will be clear that they follow largely from arguments that we made above.

[21] On the model of general enforcement, see Shavell (1991).

acts. The solution of the general enforcement model involves choosing fine schedules that depend on h, that is, functions $f(h)$, $f_o(h)$, and $f_e(h)$, along with the probabilities of detecting offenders and detecting bribery, p and q.

Consider initially the case in which corruption is not controlled, as in Section 2. Given a harm h and a fine for the underlying offense of $f(h)$, a bribe will be made for the amount $\lambda f(h)$. Let p^* be the optimal probability that applies to all harmful acts. Then it is clear that if $f(h)$ is chosen such that $p^*\lambda f(h) = h$, first-best behavior will result. Hence, $f^*(h) = h/(p^*\lambda)$, provided that $h/(p^*\lambda)$ is less than or equal to w_o, that is, provided that $h \leq p^*\lambda w_o$. For h greater than $p^*\lambda w_o$, $f^*(h) = w_o$, in which case there is some underdeterrence.

It is apparent that the existence of bribery lowers social welfare in the general enforcement model. As just noted, although individuals can be induced to behave in a first-best manner for harms up to $p^*\lambda w_o$, they are inadequately deterred for harms above this threshold level. If bribery did not occur, they would pay the fine $f(h)$ instead of the bribe $\lambda f(h)$, so deterrence could be increased. In particular, for harms between $p^*\lambda w_o$ and p^*w_o, $f(h)$ could be set so that first-best behavior is achievable — by setting $f(h) = h/p^*$ in this range. For harms in excess of p^*w_o, while there will be underdeterrence even without bribery, the extent of underdeterrence will be less if bribery is absent: the expected fine payment would be $p^*w_o < h$, whereas the expected bribe payment is $p^*\lambda w_o < p^*w_o$.[22]

Next consider the case in which bribery is controlled, as in Section 3. First, we claim that the optimal fines for bribery may be taken to be maximal for all levels of harm — that is, $f_o^*(h) = w_o$ and $f_e^*(h) = w_e$. This can be demonstrated by showing that if either $f_o(h)$ or $f_e(h)$ were less than maximal, it is possible to raise them to their maximal values and possibly lower the corresponding fine for the underlying offense $f(h)$ such that social welfare is the same, implying that we can assume that fines for bribery are maximal at the optimum.[23] Given such

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[22] In this discussion we used the probability of apprehension that is optimal when bribery is present to evaluate the outcome if bribery is absent. Obviously, if the latter probability were chosen optimally, eliminating bribery would raise social welfare further.

[23] To explain, observe that, by (12), the expected payment facing a person who commits an act causing harm h is $\min\{pf(h), p[\lambda f(h) + (1 - \lambda)q(f_o(h) + f_e(h))]\}$. It is readily shown that if $f_o(h)$ is less than w_o, we can

fines, it is clear that the optimal probability of detecting bribery q^* must be less than or equal to $q_m = w_o/(w_o + w_e)$ for the reason given in Section 3 — because bribery is deterred at $q = q_m$, any higher q would involve wasteful expenditures.

Suppose that q^* is less than q_m and consider the fine schedule $f(h)$ for the underlying offense. It can be shown that $f(h)$ then has the following character. (a) For harms sufficiently low, bribery is deterred, $f^*(h) = h/p^*$, and behavior is first-best. In essence, this result occurs for the following reason. Because the harm is low, the fine on the underlying offense that, if paid, would induce first-best behavior is low. Avoiding such a low fine through bribery is not worthwhile for the parties given the risk of the high fines for bribery. Hence, bribery is deterred and the fine that induces first-best behavior is paid. (b) For harms in a higher range, bribery is not deterred, but the fine $f(h)$ for the underlying offense can be set high enough to cause the resulting bribe amount to induce first-best behavior. (c) For even higher harms, bribery is not deterred, $f(h)$ should be set maximally at w_o, and some underdeterrence results.[24]

This discussion of general enforcement leads to a more realistic depiction of the behavior of the parties and of optimal enforcement policy. Although fines for bribery are high, the fines for the underlying offense are low for low harms, rise with the level of harm, and are maximal only for sufficiently high harms. Moreover, bribery is only a problem for harms above a threshold. When bribery occurs, the deterrence-diluting effects of bribery can be offset for relatively low harms by raising the fine on the underlying offense and thereby causing the bribe to rise. But if the harm is sufficiently high, this can no longer be done and

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raise it to w_o and lower $f(h)$ if necessary so that the expected payment is held constant. Likewise, if $f(h)$ is less than w_e, we can raise it to w_e and possibly lower $f(h)$ so that the expected payment is held constant. Thus, given any schedule of fines for the underlying offense and fines for bribery that are not maximal, we can raise fines for bribery to their maximal levels and find another schedule of fines for the underlying offense such that social welfare is the same, implying that we can assume that fines for bribery are maximal at the optimum.

[24] The specific formulas for $f^*(h)$ are as follows: for $h \leq p^*q^*(w_o + w_e)$, $f^*(h) = h/p^*$; for h such that $p^*q^*(w_o + w_e) < h \leq p^*[\lambda w_o + (1 - \lambda)q^*(w_o + w_e)]$, $f^*(h) = (h/(p^*\lambda)) - [(1 - \lambda)/\lambda]q^*(w_o + w_e)$; and for higher h, $f^*(h) = w_o$. Also, as we stated, this paragraph describes $f^*(h)$ when $q^* < q_m$. If $q^* = q_m$, the description of $f^*(h)$ is similar, except that bribery is deterred at all levels of h and first-best behavior therefore can be achieved over a greater range of h.

bribery lowers social welfare.

B. Imprisonment

We have been assuming that sanctions are fines, but now consider the use as well of jail sentences. The social cost of imprisonment includes the disutility borne by the prisoner and the costs borne by the public to operate jails. We assume for simplicity that there is a maximum jail term that can be imposed on the offender and on the enforcer. Let:

t_m = maximum jail term that can be imposed;

t = jail term imposed on an offender if the offense is reported, $t \leq t_m$;

t_o = jail term imposed on an offender who is caught engaging in bribery, $t_o \leq t_m$;

t_e = jail term imposed on an enforcer who is caught engaging in bribery, $t_e \leq t_m$.

The disutility to the prisoner of a jail sentence of length t is assumed to be t.

First suppose that bribery is not controlled. The surplus from a bribe is now $f + t$, so the bribe will be $\lambda(f + t)$ if this does not exceed the offender's wealth w_o; if $\lambda(f + t)$ does exceed w_o, the offender will pay his entire wealth in a bribe. Thus, the bribe will be $\min[\lambda(f + t), w_o]$. Note that the prospect of having to go to jail makes it more valuable to an offender to pay a bribe, and clearly raises the bribe payment.

Optimal sanctions are again maximal: $f^* = w_o$ and $t^* = t_m$. For if f and t are not maximal and $\lambda(f + t) < w_o$, sanctions could be raised to the maximal levels and p lowered, so as to leave the offender's expected bribe payment $p\min[\lambda(f + t), w_o]$ unchanged, but save enforcement costs. (If $\lambda(f + t) \geq w_o$, raising the sanctions will be of no consequence because the offender will have been paying the maximum bribe already, so the sanctions can be presumed to be maximal in that case.) It is optimal to have maximal jail sentences, even though jail is a socially costly sanction, because jail sentences are not actually imposed — instead they are implicitly used to make bribe payments larger, and thus to enhance deterrence.

Bribery generally lowers social welfare, but the explanation is slightly more complicated when jail sentences can be used together with fines. Suppose that in the absence of bribery it is optimal to use the maximal fine w_o and a positive jail sentence. If bribery occurs, deterrence certainly will be diluted, because the highest possible bribe is w_o. Social welfare also must fall as a result of bribery in this case because, if a positive jail sentence is optimal, social welfare with just a fine equal to w_o must be lower, and social welfare if bribery occurs cannot exceed this level and generally will be less than it. Only if optimal policy in the absence of bribery is not to use a jail term might the outcome under bribery be equivalent, and only then if the bribe payment is maximal.

Now assume that bribery is controlled, so that the offender and the enforcer are subject to both fines and jail terms if they are caught engaging in bribery. It is straightforward to show that a necessary condition for a bribe to be paid is that:

$$q(f_o + t_o + f_e + t_e) < f + t. \tag{20}$$

This condition is a natural generalization of (9) and has an analogous interpretation: if the expected sum of sanctions for bribery is less than the sum of the sanctions that the offender would bear for sure if his offense is reported, so that the parties together can obtain a surplus from engaging in bribery, a bribe will be attractive to the parties.[25]

Not surprisingly, optimal fines are all maximal, that is, $f^* = f_o^* = w_o$ and $f_e^* = w_e$. The argument for this result is the usual one: if any fine is less than maximal, it can be raised and p or q lowered, so as to maintain deterrence while saving enforcement resources.

With regard to the use of imprisonment, the main point we want to make is that it may be optimal to employ jail sentences for bribery but not for the underlying offense. The reason is essentially that jail sentences for bribery may not result in sanctioning costs being incurred, because jail sentences may deter bribery and therefore never have to be imposed. However, it may not be desirable to employ jail sentences for the underlying offense, because such sentences would actually be imposed and sanctioning costs would be incurred. Thus, it may be socially optimal to use fines alone for the underlying offense, but fines and jail terms for bribery.

Although the use of jail sentences makes bribery easier to deter, the optimal choices of

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[25] However, unlike (9), (20) is not also a sufficient condition for bribery to occur. In other words, bribery may result in positive surplus but this does not imply that a bribe will be paid. For instance, bribery may create substantial surplus because it allows the offender to escape a large jail sentence t, but he may not have sufficient wealth to compensate the enforcer for the enforcer's expected sanction $q(f_e + t_e)$, so a bribe will not occur.

the sanctions and the probabilities may result in bribery occurring. If so, then jail sentences for bribery would cause sanctioning costs to be incurred, and may make jail not worthwhile imposing for bribery.

5. Concluding Comments

In this section we discuss informally a number of additional factors related to corruption and law enforcement.

(a) *Impediments to the making of bribes.* Although we assumed that bribery would occur whenever a mutually beneficial bribe amount existed, there are several reasons why this might not happen.[26] The first concerns the possibility that, after receiving a bribe payment, the enforcer still can threaten to report the violator and demand another payment. For instance, after discovering a health violation at a restaurant and being paid to keep quiet, an inspector might nonetheless threaten to disclose the violation. If the restaurateur anticipates this threat, he would not pay the bribe in the first place (even though both he and the inspector would like to consummate a bribe agreement). However, this impediment to bribery can be overcome if either party can take an action that makes it difficult for the enforcer to provide a verifiable report of a violation (for instance, the inspector might agree not to gather evidence of the restaurant's violation[27]). Additionally, to encourage the payment of bribes in the future, the enforcer may have a reputational interest in not threatening to report offenders who have paid bribes.[28]

A second impediment to bribery is the converse of the first: after making a bribe payment, the offender might be able to threaten to expose the enforcer for having taken a bribe

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[26] For an analogous discussion of why blackmail agreements might not be reached, see Shavell (1993, pp. 1880-87).

[27] Similarly, a police officer who stops someone for speeding might, in return for a bribe, agree to forego obtaining the driver's signature on a citation and might rip up the printout generated by the officer's radar gun.

[28] Another way for the parties to facilitate a bribe agreement is for the offender to make his payments over time. Then, if the enforcer were to turn him in, the enforcer would lose the remaining payments.

unless the enforcer returns some or all of it. If the enforcer expects this to happen, he might not accept the bribe initially. This obstacle to reaching a bribe agreement can be circumvented if the parties can ensure that there is no record of the bribe payment.

A third reason bribe agreements might not be reached is that asymmetry of information might lead the enforcer to misgauge the offender's willingness to pay a bribe or the offender to misjudge the enforcer's willingness to accept a bribe. For example, suppose the enforcer believes that the offender's level of wealth is much higher than it is. The offender might not be willing to offer a large bribe because he doesn't expect to pay much if he is turned in, but the enforcer might hold out for a substantial bribe, believing that the offender will otherwise bear a large fine. Similarly, asymmetry of information about the likelihood of a bribe being detected could lead to the failure of a bribe agreement being reached.

(b) *Risk aversion.* We assumed in our analysis that the parties are risk neutral. If offenders are risk averse, however, optimal fines for offenses may be much lower than their wealth in order to reduce the imposition of risk — for example, the optimal fine for speeding could be $100 even though a fine of $1,000, or even $10,000, might be feasible.[29] But does risk aversion also imply that fines for bribery not be too high? It does not suggest this if high fines can deter bribery completely, for then the fines for bribery will not actually be imposed, so risk will not actually be borne. Note, too, that if the parties are risk averse, they can be discouraged from bribery more easily than if they are risk neutral. But if bribery is not deterred completely, then consideration of risk bearing would be relevant to setting the fines for bribery.

(c) *State's ability to offset deterrence-diluting effects of bribery.* In practice, the optimal fine for the underlying offense usually will not be maximal for a variety of reasons not incorporated into the standard model of enforcement. We considered two such reasons: that enforcement may be general (part A of Section 4) and that individuals may be risk averse (the preceding comment). Whenever the fine that would be optimal in the absence of bribery is less than maximal, it is possible for the state to raise the fine to attempt to offset the

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[29] See Polinsky and Shavell (1979), and also Kaplow (1992).

deterrence-diluting effect of bribery. Sometimes the state will be able to fully counter this effect, but sometimes it will be able only to partially offset the effect. For example, suppose, because of considerations of risk bearing, that the optimal fine for speeding is $100, but that bribery results in speeders paying only $50 when they are detected by an enforcer; the state could then raise the fine for speeding to $200 so that the bribe payment rises to $100, in which case bribery would not lower social welfare. But in our discussion of general enforcement, we saw that, for harms above some threshold, the fine cannot be raised to fully offset the deterrence-diluting effects of bribery and social welfare consequently falls.

(d) *Variation in whether bribes are paid.* We implicitly assumed that offenders acted in the same way if detected, either all offering a bribe if a mutually beneficial bribe payment exists, or none offering a bribe. More realistically, however, many individuals will not consider offering a bribe (perhaps for ethical reasons or because they perceive the expected sanction to be very high), so that only a fraction of offenders can be expected to engage in bribery. This variation in whether bribes are paid creates a new problem for the state in responding to bribery. On one hand, if bribery cannot be deterred completely and the expected sanction for the underlying offense is raised to counter the deterrence-diluting effect of bribery, then individuals who would not consider paying a bribe may be overdeterred. On the other hand, if the expected sanction for the underlying offense is not raised, then individuals who do engage in bribery will be underdeterred for the reason we have emphasized. The optimal response therefore will have to balance these considerations and may result both in some overdeterrence of individuals who would not consider bribery and underdeterrence of those who do engage in bribery.[30]

(e) *Compensation of enforcers.* We assumed that the maximum monetary penalty that could be imposed on an enforcer for accepting a bribe was fixed and equal to the enforcer's wealth. But the state could increase the maximum penalty by paying enforcers higher wages — then they would have more to lose if caught for bribery and denied future work. Thus, the

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[30] The point of this paragraph also would apply if there are variations in the circumstances of enforcers (rather than offenders) that lead some to accept bribes and others not to do so.

wage payment can be used as a policy instrument to discourage bribery. It may be worthwhile for the state to raise the enforcer's wage for this reason, especially if it is costly to raise the probability of detecting bribery.[31]

Another way to discourage bribery is to pay enforcers on the basis of the number of people they report for infractions — say a fixed reward per person reported and sanctioned. This method of payment obviously would reduce the problem of bribery. Indeed, if the reward equals the fine (and there is no jail sentence), such a policy would eliminate bribery because the enforcer would not accept anything less than the fine. However, compensating enforcers in this manner might lead to inappropriate incentives to catch offenders.[32]

(f) *Plea bargaining versus bribery.* Finally, let us comment on the relationship between plea bargaining and corruption. On reflection, one can see that there are similarities between the two practices: in each, a person representing the state (the prosecutor or enforcement agent) makes an agreement with the offender under which the offender bears a lower burden (resulting from the plea bargain or the bribe) than the legally mandated sanction. What then is the difference between the two practices that should result in one being illegal and the other legal? The major difference, we suggest, is the lack of state control over bribes relative to plea bargains. A plea bargain can be tailored to the harmfulness of the offense, whereas a bribe is influenced by factors that are unrelated to the offense (the probability of being caught engaging in bribery, the wealth of the enforcement agent, and the like). Moreover, an enforcer who accepts a bribe can only extract money from the offender, whereas the state, in accepting a plea bargain, can put the offender in jail as well. This latter consideration is significant given the limited income of many offenders and the frequent need for jail terms to achieve reasonable deterrence. For these reasons, bribery appears to be much inferior to plea bargaining.

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[31] There is, however, a social cost to the state of paying enforcers more than the wage necessary to attract them — the distortions caused by the additional taxes needed to make such payments.

[32] See generally Becker and Stigler (1974), Landes and Posner (1975), Polinsky (1980), and Mookherjee and Png (1997).

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