Asymmetric Punishment as an Instrument of Corruption Control

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Abstract

The control of bribery is a policy objective in many developing countries. It has been argued that asymmetric punishments could reduce bribery by incentivizing whistle-blowing. This paper investigates the role played by asymmetric punishment in a setting where bribe size is determined by Nash bargaining, detection is costly, and detection rates are set endogenously. First, if whistle-blowing is infeasible, the symmetry properties of punishment are irrelevant to bribery-deterrence but not to bribe size. Bribery disappears if expected penalties are sufficiently high; otherwise, bribe sizes rise as expected penalties rise. Second, when the bribe-giver may whistle-blow, a switch from symmetric to asymmetric punishment eliminates bribery only if whistle-blowing is cheap and the stakes are low. When bribery persists, multiple bribe sizes could survive in equilibrium. The paper derives parameter values under which each of these outcomes occurs, and discusses implications for welfare and the design of policy. (JEL Codes: H83, K14, P48)

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1 Introduction

Corruption is a major concern in several countries. One reason it is difficult to control is that those involved have an incentive to collude to prevent detection. While this is a feature of many criminal activities, the detection of corruption might be made harder by criminal codes that, in most countries, penalize the bribe-giver and the bribe-taker equally.[1] Under such a legal framework, all participants in a bribing scheme, including those who might otherwise be considered victims and could be tempted to act as whistle-blowers, have a vested interest against doing so.

How could collusion be weakened and bribery reduced? A possible solution lies in *asymmetric punishment*. By penalizing some parties less than others, the government can create ex-post incentives for agents to report the crime and thereby stop colluding. In a note for India's Ministry of Finance, one of us (Basu, 2011) proposed the following in the case of *harassment bribes* (bribes paid for services citizens are entitled to receive for free): decriminalize bribe-giving and require the bribe-taker to return the bribe to the bribe-giver if caught. This creates ex-post incentives for citizens to reveal that bribes were paid, and could end up discouraging bureaucrats from demanding bribes in the first place.[2]

The idea of asymmetric punishment is not new. For example, prosecutors in the United States selectively offer immunity to those who reveal financial crimes that they might themselves have been complicit in. In Italy, similar schemes have been used to fight organized crime. The United States and the European Union use conditional leniency as a way to deter cartels (Marvao and Spagnolo, 2014).

But asymmetric punishment is relatively rare in the case of bribery. As Rose-Ackerman (2010) writes, "[B]oth [bribe paying and bribe acceptance] are generally criminal offenses, and most statutes impose parallel punishments." According to India's Prevention of Corruption Act (1988), the giver and the taker of a bribe are considered equally culpable and can be financially penalized and incarcerated for up to five years. The United States too regards both the giving and receiving of bribes as criminal acts. But there are some exceptions that serve as examples of asymmetric punishment. In China and Taiwan, bribe-giving is a crime only if the payer receives illegal benefits (Li, 2012). In Romania, furthermore, the bribe-giver is in some cases entitled to have her payments returned to her (Rose-Ackerman, 2010).

Given the pervasiveness of bribery, there might be significant political and economic returns to tackling the problem with innovative solutions. In this paper, we assess the ro-

[1] See Linklaters (2012) for a survey.

[2] This proposal led to some controversy in the Indian parliament and animated discussion in the media. See The Economist (2011), Dreze (2011), Sainath (2011), Mitra (2011), Seabright (2011), Haider (2012), and Zakaria (2011).

bustness of the basic argument for asymmetric punishment. Our motivating setting involves harassment bribes, where a bribe is demanded though the citizen already meets the requirements to receive the service (say, a passport, a tax refund, or a business license). We build a model that combines two key modeling features–bribe size is determined by Nash Bargaining and whistle-blowing is costly and imperfect. The effects of a switch from symmetric to asymmetric punishment depend on parameter values, and in some subtle ways. Whistle-blowing depends on bribe size, and bribe size depends on anticipated whistle-blowing. As a result, asymmetric punishment does not automatically deter the bureaucrat from demanding a bribe–the bureaucrat and citizen may be able to agree on a modified bribe size that accounts for whistle-blowing. In this framework, we analyze the desirability and optimal design of asymmetric punishment primarily for cases of harassment bribes and extortion, but also discuss how these results could be applied to study other forms of corruption.

Our model necessarily complicates policy prescriptions, but offers a novel framework for the design and analysis of anti-corruption strategies. If whistle-blowing is sufficiently cheap and punishments sufficiently severe, asymmetric punishment can be an effective tool to eliminate bribery. However, in countries where improved detection is hard to achieve, possibly the same countries where harassment bribes are a problem in the first place, bribery will survive under asymmetric punishment. When this is the case, asymmetric punishment may cause the bribe size to rise, creating the impression that corruption has been exacerbated. Our model could therefore partly explain why a country like China, which implemented asymmetric punishments in 1997 but has high costs of whistle-blowing, has not experienced a discernible reduction in corruption (Li, 2012).

This is a timely exercise as advances in technology and media make it increasingly possible to publicize and verify bribes. Cell phone cameras can discreetly document transactions and the internet allows citizens to share information about corrupt encounters.[3]

1.1 Summary of Arguments

Consider a bureaucrat who is required to provide a service that creates a surplus for an entrepreneur, but might demand a bribe in exchange. In a benchmark case where whistle-blowing is not possible, we first show how bribery depends on the properties of punishment. Here, the symmetry properties of punishment are irrelevant to the incidence of bribery–a bribe is exchanged as long as the total expected penalty is small enough. Whether the penalty burden falls disproportionately on the bureaucrat or the entrepreneur, and whether the bureaucrat is required to repay part of the bribe, do not matter: the bribe size will adjust

[3]See, for example, www.ipaidabribe.com.

to keep the expected surplus equally split.

This suggests that bribe size should not be viewed as an indication of the severity of bribery. For example, suppose the probability of detection rises. If penalties are at all asymmetric in favor of the entrepreneur, as enforcement improves the entrepreneur must pay a larger bribe to compensate the bureaucrat for her relatively larger expected penalty. So, an attempt to reduce bribery could appear to have the opposite effect when in fact the change in bribe size simply reflects a re-allocation of surplus.

Next, we introduce the possibility of whistle-blowing–the entrepreneur can incur a cost to raise the probability of detection. Asymmetric punishment creates an incentive for the entrepreneur to whistle-blow. Whistle-blowing reduces the potential surplus to be shared through bargaining, both because is costly and because it raises the expected penalty. However, whether this deters bribery depends on parameter values. Asymmetric punishment eliminates bribery if two conditions are satisfied: whistle-blowing must be cheap (so the citizen can credibly threaten to engage in it) and the value of the service being exchanged must be low (so that whistle-blowing would eliminate any surplus to be bargained over).

These two conditions are not independent of each other. This generates some initially counter-intuitive results. For instance, suppose asymmetric punishment deters bribery under some parameter values. The same will not necessarily be true if, all else equal, whistle-blowing gets cheaper. This is because a drop in whistle-blowing costs raises the potential surplus that can be shared through bargaining. Now, it might be possible for a bribe to be exchanged despite the certainty that it will be followed up by whistle-blowing.

When asymmetric punishment fails to eliminate bribery, there are parameter regions where it has no effect, where bribery persists and the bribe size adjusts to account for the greater probability of detection, and where there are multiple equilibria with two possible outcomes–one where the bribe size is small and the probability of detection is also small, and another where both the bribe size and probability of detection are large. If whistle-blowing occurs but does not deter the corrupt transaction, it merely serves to destroy some surplus.

A switch from symmetric to asymmetric punishment can be recommended if two objectives are satisfied: asymmetric punishment should deter bribery and bribery deterrence should be desirable. The above analysis addresses the first. The second depends on welfare with and without bribery. As Bardhan (1997) writes, " . . . our objective is not merely to reduce corruption in an official agency but, at the same time, not to harm the objective for which the agency was deployed in the first place." While a formal welfare analysis is beyond the scope of the paper, we make a number of observations. First, the parameter region in which bribery is eliminated might not overlap with the region in which the elimination of bribery raises welfare.

Second, implications of asymmetric punishment depend on the type of corruption. For instance, it can be argued that parameter values systematically differ for harassment bribes and extortion. Additionally, in more complex forms of bribery, externalities must be accounted for in any welfare analysis. While our model is motivated by harassment bribes, it will be evident that many of the arguments apply more broadly.

1.2 Related Literature

Bribery and corruption have been subjects of economic inquiry for some time (see Bardhan, 1997, for a comprehensive survey). In their seminal paper, Shleifer and Vishny (1993) show how institutions affect the prevalence and efficiency implications of corruption. Banerjee (1997) analyzes how bribery and red tape emerge when bureaucrats are required to allocate goods to credit-constrained individuals. More recently, several papers present theoretical and empirical analyses of approaches to reduce corruption (see Besley and MacLaren, 1993; Hindricks, Keen, and Muthoo, 1999; Brunetti and Weder, 2003; Olken, 2007; Andrianova and Melissas, 2008; and Dixit, 2013). The present paper belongs to that tradition and relates closely to the growing academic literature on the possibilities and limitations of asymmetric punishment (see Rose-Ackerman, 1999; Lambsdorff and Nell, 2007; Felli and Hortala-Vallve, 2015; and Oak, 2015). On this topic, Rose-Ackerman (2010) and Dufwenberg and Spagnolo (2014) are most closely related to our analysis.

The first paper, which is a critical survey of the law and economics of bribery and extortion, provides a wide-ranging discussion of how different punishment schemes affect the bargaining between the bribe-giver and bribe-taker. While some of the intuition of our paper can be found there, our contribution lies in the formalization of the analysis and the endogenization of costly actions undertaken by the bribe-giver.

Dufwenberg and Spagnolo (2014) examine a similar problem in an alternative non-cooperative framework, and derive a number of complementary results. They show that, in a one shot game, asymmetric punishment either has no effect or prevents bribery but at the cost of the service offered. Which of these is realized depends on whether, in the absence of a bribe, institutions are effective enough to incentivize the bureaucrat to offer the service. They then consider a repeated version of the game in which the bureaucrat has an incentive to build a reputation of being corrupt. In such a set-up, they show that asymmetric punishment indeed becomes an effective instrument to fight corruption but only if institutions are sufficiently good.[4]

[4] These are insightful results, so it is useful to briefly describe how our approach complements theirs and delivers some different implications. First, we model the interaction as a bargaining game rather than a dynamic game where the official sets the bribe size. This is intended to capture the idea that neither party

Aside from the theoretical research, there is a limited but growing empirical literature on the effectiveness of asymmetric punishment in deterring harassment bribes. On the one hand, Wu and Abbink (2013) and Abbink et al. (2014) provide some experimental evidence supporting the use of asymmetric punishment in certain types of interactions. On the other, Engel et al. (2013) use a lab experiment to show that, when the bureaucrat can bestow favors in response to a bribe, asymmetric punishment raises the incidence of bribery. Additional empirical work, guided by economic theory, can continue to refine our understanding of how alternative forms of punishment may affect incentives to demand and pay bribes.

Finally, there is a literature that emphasizes specific, different, contexts of corruption and shows how anti-corruption measures may themselves alter the type of bribe being exchanged. Our paper is narrower in scope–we focus on those cases where the citizen is already entitled to receive a service from the bureaucrat–but it is useful to consider how our results may translate into other contexts. In particular, much corruption exists in cases with externalities–a bribe is paid to help the citizen bypass regulations, thereby imposing additional costs on those who are not party to this exchange. Khalil, Lawarree, and Yun (2010) and Mishra and Mookherjee (2012) analyze the trade-off between collusion and extortion. The latter shows how penalties could be designed to allow both to occur simultaneously but in such a way that the efficient outcome is achieved. Carson (1985) and Oak (2015) show that the distinction between harassment bribes and other forms of bribery may be fluid and complex. For example, in Oak (2015) the citizen's project is endogenously chosen. Under asymmetric punishment, the official will encourage her to choose a project that does not comply with regulations, as this weakens her incentive to whistle-blow.

Our goal is to bring some carefully constructed game theoretic methods to investigate a subject of great practical significance and vigorous public debate. Not surprisingly, the analysis does not lead to a unique prediction, but to conditional results which try to delineate where a certain kind of law will work and where it will not. Our model provides a stylized description of the mechanics that underlie bribery, and emphasizes the interaction of two fundamental choices–bribe size and detection probability. It is hoped that by bringing dispassionate analysis to bear on this emotive subject, we are able to shed some light on

is in a position to extract all surplus from the other. As a result of this modeling decision, in our paper some bribe would be paid even if the official had a taste for providing the service. Second, we endogenize bribe size, making it a function of the punishment regime as well as the probability of detection. Much of the existing literature on this subject proceeds under the assumption that the size of the bribe is unaffected by whether or not the punishment is symmetric or asymmetric. Dufwenberg and Spagnolo's (2014) analysis is primarily focused on whether a bribe is paid, and actual bribe size is left unspecified except in some cases, such as when reporting costs are introduced. Third, we introduce the realistic assumption of probabilistic detection which is endogenously determined. This delivers the striking result that, even in an environment without moral considerations, asymmetric punishment could raise bribe size.

what is ultimately a practical matter of policy in law and economics.

2 Benchmark Model: Exogenous Detection

In the benchmark model, we analyze the bargaining problem. An official must deliver a license to an entrepreneur, possibly in exchange for a bribe. Penalties for bribery are set by the government and there is no opportunity to whistle-blow. This allows us to illustrate the relationship between penalty design and bribery. The following section builds on this framework by introducing the possibility of whistle-blowing.

2.1 Setup

2.1.1 Entrepreneur and Official

Suppose an entrepreneur (denoted E) is eligible to receive a license from a government official (denoted O). The license gives the entrepreneur a maximum benefit of $L > 0$. The official must choose whether to deliver the license for free or to charge for it; that is, demand a bribe.

First, if a bribe is not demanded, the uncorrupt outcome is realized, in which the official receives a payoff $U_O \in \mathbb{R}$ and the entrepreneur receives a payoff $U_E \in [0, L]$.

Second, the official could demand a bribe. In this case, the two players must bargain over the bribe size, $B \geq 0$. Conditional on successful bribe negotiations, the official receives B and the entrepreneur receives the full license value L.[5] But they may also be punished, as described in Section 2.1.2.

Third, if a bribe is demanded but they are unable to reach an agreement, they receive their disagreement payoffs–the official receives $D_O < U_O$ and the entrepreneur receives $D_E \in [0, L]$.

This setup accommodates a range of scenarios in which a bribe may be exchanged. The parameters described above have multiple interpretations. The official's uncorrupt payoff, U_O, could be positive or negative–it represents the net value of (a) psychic or tangible rewards of being uncorrupt (alternatively, the psychic or penal costs of asking for a bribe in the first place), and (b) reduced effort costs associated with delivering a license of inferior quality.

U_E may be smaller than L–if delivery is costly, the official might have some flexibility to be lax about delivery.

[5] This assumes there is no hold-up problem. If the official is unable to credibly commit to delivering the license after receiving a bribe, we could assume the entrepreneur instead receives some $\hat{L} < L$. The implications of this adjusted assumption will be straightforward and will not alter the mechanics of the model.

Once a bribe is demanded, the official's disagreement payoff (D_O) depends on whether the license can be used to procure a bribe in the future. We make the simplifying assumption that D_O is smaller than U_O to ensure that the official would prefer to be uncorrupt than to make a failed request for a bribe. For the entrepreneur, D_E represents the discounted value of an inferior license, the delay associated with reapplying for the license, or possible retaliation by the bureaucrat.[6]

2.1.2 Penalty Structure

If a bribe is agreed upon and paid, it is detected with a probability $p \in [0, 1]$. If detected, the entrepreneur is penalized $F_E \geq 0$ and the official is penalized $F_O \geq 0$. These penalties could constitute fines or other non-pecuniary costs. We define the total penalty as $F \equiv F_E + F_O$. Furthermore, if a bribe is detected, the official is required to return βB to the entrepreneur, where $\beta \geq 0$.[7] We define *perfectly symmetric* punishment as $F_E = F_O$ and $\beta = 0$.

We shall throughout assume that the fine on the official is at least as large as the fine on the entrepreneur:

A1. $F_O \geq F_E$.

In the case of harassment bribes this is a reasonable assumption and allows us to limit the cases we study without altering the qualitative conclusions of the analysis.

2.1.3 Bargaining

We use the standard Nash bargaining solution to determine the bribe size. For any bribe, the entrepreneur's utility is:[8]

$$V_E(B) = L - B - p(F_E - \beta B). \tag{1}$$

Similarly, the official's utility is:

$$V_O(B) = B - p(F_O + \beta B). \tag{2}$$

[6] The magnitudes of the disagreement utilities can reflect a number of institutional characteristics: the official's ability to delay delivery (Bose, 2004), competition between officials (Bardhan, 1997), and the ratio of honest and opportunistic officials (Ahlin and Bose, 2007).

[7] Observe that the penalty is not a function of B or L. The above setup should be viewed as describing a particular class of license (a passport, for example), so that any corrupt exchange is punished in the same way regardless of individual valuations. This setup does not preclude the government from setting different penalties for different classes of licenses (see Allingham and Sandmo, 1972).

[8] Risk-aversion could introduce a potentially interesting dimension–how outcomes vary by risk-tolerance, which in turn might be correlated with other socioeconomic variables. However, risk-neutrality is a convenient simplifying assumption for the points this model makes.

If the players fail to agree on a bribe size, they both receive their outside options.

If a solution exists,[9] it is given by the following:

$$B^* \equiv \arg\max_B \left[V_E(B) - D_E\right]\left[V_O(B) - D_O\right]. \tag{3}$$

We assume that the official decides to demand a bribe if, and only if, a Nash bargaining solution exists and leaves him weakly better off than not asking for a bribe, so that $V_O(B) \geq U_O$.

Indeed, the exchange of a bribe comes closest to the kind of two-person negotiating situation that Nash (1950) had envisaged. Because of its illegal nature, there is seldom a third party or competitor involved during a transaction. It is a face-off between two individuals–a classic bargaining situation.[10]

2.2 Benchmark Analysis

Assuming a bribe is paid, the equilibrium bribe size is determined by equation (3). This yields the following bribe size:

$$B^* = \frac{(L - D_E + D_O) + p(F_O - F_E)}{2(1 - p\beta)}. \tag{4}$$

The corresponding utilities are:

$$V_E(B^*) = \frac{(L + D_E - D_O) - pF}{2}, \tag{5}$$

$$V_O(B^*) = \frac{(L - D_E + D_O) - pF}{2}. \tag{6}$$

The Nash bargaining solution leaves the players with identical utility net of the outside options–they essentially agree to split the gains generated by delivery of the license. Any rise in penalties results in a smaller surplus to be shared, so utility drops. Observe that utility is unaffected by β or the relative sizes of F_E and F_O (holding F fixed), since these do not alter the total surplus to be shared.

A Nash bargaining solution exists if, and only if, there is some surplus to be split ($L - D_E - D_O \geq pF$). Bribery will be selected by the official if a bargaining solution exists and

[9] Since $\{(V_E(B) - D_E, V_O(B) - D_O) : B \geq 0\}$ is a compact and convex set, a Nash bargaining solution exists as long as the penalties are sufficiently small (or, the entrepreneur's outside option is sufficiently bad); that is, there exists some $\tilde{B}$ such that $\left(V_E\left(\tilde{B}\right), V_O\left(\tilde{B}\right)\right) \geq (D_E, D_O)$.

[10] While there are competing bargaining models, such as the one by Kalai and Smorodinsky (1975), which have the advantage of a slightly wider domain of application (see Anant, Mukherji, and Basu, 1990), in this simple framework they are unlikely to make any substantial difference.

leaves him weakly better off than not asking for a bribe ($V_O(B^*) \geq U_O$). Since the second condition embeds the first, we can see that a bribe will be demanded if and only if

$$\frac{(L - D_E + D_O) - pF}{2} \geq U_O \Longleftrightarrow L \geq \hat{L} \tag{7}$$

For a bribe to be exchanged, there must remain adequate surplus beyond the total expected punishment so that the outcome is acceptable to the official.

Suppose bribery exists. Equation (4) lends itself to some natural comparative statics analysis. In particular, we might be interested in how the punishments and especially their symmetry properties affect equilibrium outcomes. It can easily be verified that $\frac{\partial B^*}{\partial F_0} > 0$ and $\frac{\partial B^*}{\partial F_E} < 0$. Intuitively, the one who expects to get penalized more heavily needs to be given more up-front. Similarly, $\frac{\partial B^*}{\partial \beta} > 0$ – any redistribution that emerges from punishment must be accounted for in the bribe size.

Finally, $\frac{\partial B^*}{\partial p} = \frac{(F_O - F_E) + \beta(L - D_E - D_O)}{2(1-\beta p)^2}$ is weakly positive if, and only if:

$$F_O - F_E \geq -\beta (L - D_E - D_O). \tag{8}$$

In such cases, the bribe size rises in p if the rise in p hurts the official sufficiently more than it hurts the entrepreneur. This condition is satisfied by Assumption 1.

The results above are summarized in Proposition 1.

Proposition 1 *Given a penalty structure (F_O, F_E, β, and p):*

(1) If $L \geq \hat{L}$, a bribe is exchanged and the bribe size is strictly rising in F_O, strictly dropping in F_E, strictly rising in β, and weakly rising in p.

(2) If $L < \hat{L}$, bribes are eliminated.

Two simple lessons emerge from this benchmark setting. The first is that the symmetry properties of punishment are irrelevant to the persistence of bribery. Bribery is eliminated as long as the total expected penalty is large enough with respect to the value of the licence. Whether the penalty burden is on the official or the entrepreneur, and whether the official is required to repay part of the bribe, do not matter, since the bribe size can adjust to account for them.

The second lesson is that bribe sizes can rise when anti-corruption enforcement is strengthened. In particular, if the penalty is low to begin with, a rise in the official's fine or, under some conditions, a rise in the detection probability, will result in a larger bribe.[11] Similarly, keeping total expected penalties constant, a switch from symmetric to asymmetric punishment will raise the bribe size.

[11] Mookherjee and Png (1995) make a similar observation in a setting with pollution enforcement.

This provides an alternative explanation for Bardhan's (1997) observation that larger bribes should not be interpreted as more severe corruption.[12] In the current model, variation in bribe size is simply a reflection of the reallocation of surplus between entrepreneur and official. Larger bribes seem to suggest a more acute problem, but policies designed to detect bribery might themselves raise the size of the bribe.

2.2.1 Bribe Size as a Function of Detection Probability

It will be useful for the next section to discuss how the relationship between bribe size and p is affected by the symmetry properties of punishment. As shown above, B^* is rising in p. Figure 1 depicts $B^*(p)$ for some classes of parameter values. As noted before, the incidence of bribery is unaffected by whether punishment is symmetric or asymmetric. However, bribe size, and the effect of p on bribe size, depend on how symmetric the punishment is. Under perfectly symmetric punishment, bribe size stays constant at $\frac{(L-D_E+D_O)}{2}$ as long as total punishment is sufficiently small. If $\beta = 0$ but fines are asymmetric, bribe size rises linearly in p. If fines are asymmetric and some of the bribe must be returned upon detection, bribe size is rising and convex in p. Intuitively, for high p, the official gets a large bribe which he gets to keep with low probability, while the citizen pays a large bribe which is most likely returned to him.

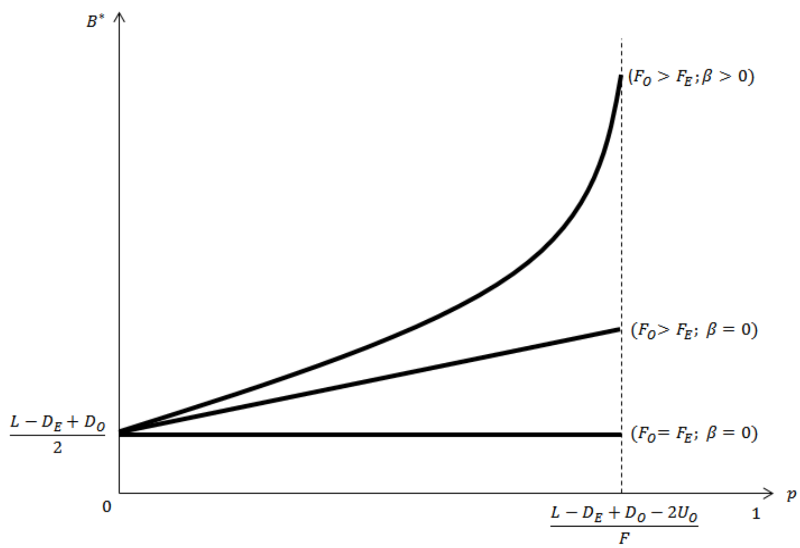

Figure 1: Equilibrium bribe size as a function of detection probability.

[12] Bardhan (1997) writes: "A particular African country may be in some sense more corrupt than a particular East Asian country, even though the actual amount of bribe money exchanging hands may be much larger in the latter; this may be simply because rampant corruption may have choked off large parts of economic transactions in the former."

3 Endogenous Detection Probability

We continue with the assumptions above, but with a modification. If a bribe has been paid, the entrepreneur can choose to incur a cost to raise the detection probability. This is a reasonable and important assumption. In addition to the state, the entrepreneur paying a bribe presumably has some control over, and interest in setting, p. How he chooses to exercise this control depends on his incentives–he must weigh the benefits of raising p against the costs. This anticipated whistle-blowing, in turn, might affect the incidence of bribery and the bribe size. In this setting, the symmetry properties of punishment play a more significant role, affecting not just bribe size but also the incidence of bribery.

There are two reasons the state might prefer to encourage revelation by citizens rather than relying on its own detection. The first is that detection by the state could be particularly costly. To detect bribery, it has to be vigilant across all transactions, even those where no bribes are exchanged. On the other hand, it might be cheaper for individuals to reveal that bribery has occurred, since they know exactly who was involved and how much was exchanged.

The second is that bribe-monitors might have less of an incentive to eliminate bribery than bribe-givers do. Since the state cannot distinguish between $p = 0$ (under which no bribes will be detected) and $p = 1$ (under which bribery will actually be eliminated), the monitor has no incentive to exert any effort to raise p. Alternatively, suppose the monitor is rewarded by the number of bribes detected This actually incentivizes higher detection probabilities, but it is never in the monitor's interest to raise detection so high that bribery is eliminated.[13]

3.1 Setup

3.1.1 Costly Whistle-blowing

We first define a cost function, $c(p)$. Suppose the base detection probability is $\underline{p} < 1$, but the entrepreneur can raise the probability to some $\bar{p} \in (\underline{p}, 1]$ at a cost $k > 0$.[14] We refer to this as whistle-blowing. So,

$$c(p) = \begin{cases} 0, \text{ if } p = \underline{p}; \\ k, \text{ if } p = \bar{p}. \end{cases} \tag{9}$$

These anticipated costs of whistle-blowing must be incorporated in the entrepreneur's

[13] See Khalil and Lawarree (2006) for additional arguments. Ortner and Chassang (2014) analyze the problem of potential collusion between the monitor and the bureaucrat.

[14] $\bar{p}$ is the combined probability that the transaction will be both detected and penalized, both of which depend on specific institutional features. For ease of exposition, we assume there are only two possible values of p. It is straightforward to extend the analysis to a continuum of possible values.

utility, so that:[15]

$$V_E(B) \equiv L - B - p(F_E - \beta B) - c(p). \tag{10}$$

$V_O(B)$ continues to be defined as in Equation 2.

3.1.2 Equilibrium

As before, the official has two choices when faced with an entrepreneur's request for a license–deliver it for free or demand a bribe. However, in the event that a bribe is paid, the entrepreneur has the option of engaging in costly whistle-blowing.

It will be necessary to modify our notion of the Nash bargaining solution to accommodate an endogenous choice of p. We will assume that the selection of B and p satisfies rational expectations.

The optimal bribe size B^* is determined taking p as given (according to a function $B^*(p)$ which satisfies equation (3)). The entrepreneur chooses p according to some function $p^*(B)$. In the spirit of rational expectations, the p assumed during bribe size negotiations must be the same as the actual p the entrepreneur selects.[16] For (B^*, p^*) to constitute a solution to the bargaining problem, it must satisfy $B^* = B^*(p^*)$ and $p^* = p^*(B^*)$. The bribe size must be a best response to the detection probability, and vice versa. If a bribe is demanded but no such solution exists, each player gets his disagreement utility.

For the remainder of the analysis, we limit our attention to the cases of interest–those where, at the base detection probability, bribery actually exists:

A2. $\frac{(L-D_E+D_O)-\underline{p}F}{2} \geq U_O \Leftrightarrow L \geq \underline{L}$.

We define $\underline{L}$ as the minimum license value necessary for bribery to occur in the absence of whistle-blowing.

3.2 Nash Bargaining Solution

Suppose a bribe is demanded. The Nash Bargaining solution, if it exists, for either $p \in \{\underline{p}, \bar{p}\}$ is given by:

$$B^*(p) = \frac{(L - D_E + D_O) + p(F_O - F_E) - c(p)}{2(1 - \beta p)}. \tag{11}$$

[15] This continues to satisfy the convexity requirements of the Nash Bargaining problem.

[16] This is a non-standard concept of equilibrium as it combines cooperative and non-cooperative choices. Intuitively, a way to think of this within the standard framework of a non-cooperative game is the following: consider simultaneous moves made by two "players," where one player is the entrepreneur who must choose p and the other player is the entrepreneur-official pair who must choose B according to their own objective function which, in this case, is provided by Nash bargaining.

The corresponding utilities are:

$$V_E(B^*) = \frac{(L + D_E - D_O) - pF - c(p)}{2}, \tag{12}$$

$$V_O(B^*) = \frac{(L - D_E + D_O) - pF - c(p)}{2}. \tag{13}$$

Now, even if Condition 8 is satisfied, $B^*(p)$ may no longer rise in p; indeed, if k is sufficiently large, $B^*(\bar{p}) < B^*(\underline{p})$. This is because there are now two forces at play as p rises: first, as before, a higher p reduces the surplus to be split, with a weakly greater burden imposed on the official, causing the bribe size to rise; second, a higher p imposes a whistle-blowing cost on the entrepreneur, causing the bribe size to drop.

3.3 Possible Outcomes

Suppose the government sets $\underline{p}$, F_O, F_E, and β . There are three possible outcomes: $B^*(\underline{p})$ is paid, $B^*(\bar{p})$ is paid, or no bribe is demanded.

The entrepreneur must trade off the cost of whistle-blowing against the potential benefit in the form of greater expected bribe recovery.[17] He will choose $p = \bar{p}$ if the potential recovery is sufficiently large, so:[18]

$$p^*(B) = \begin{cases} \bar{p}, \text{ if } (\bar{p} - \underline{p})(\beta B - F_E) > k \\ \underline{p}, \text{ if } (\bar{p} - \underline{p})(\beta B - F_E) \leq k \end{cases} \tag{14}$$

For an outcome in which a bribe is demanded and $B^*(\underline{p})$ is paid, two conditions must satisfied. First, expected penalties should be low enough so that bribery leaves the players with enough net surplus. This is satisfied by A1.

Second, at $B^*(\underline{p})$, the entrepreneur should prefer to not whistle-blow ($p^*(B^*(\underline{p})) = \underline{p}$). Using (11) and (14), this condition becomes:

$$k \geq (\bar{p} - \underline{p})(\beta B^*(\underline{p}) - F_E) \tag{15}$$

$$\iff k \geq k_l. \tag{16}$$

Similarly, for an outcome in which a bribe is demanded and $B^*(\bar{p})$ is paid, the following conditions must be satisfied. First, the entrepreneur must prefer to whistle-blow at this bribe

[17] We assume that, when indifferent, the entrepreneur chooses the lower detection probability.

[18] In some cases, governments offer conditional leniency rather than de-criminalization (see Spagnolo, 2005 and Bigoni, Fridolfsson, Le Coq, and Spagnolo, 2014). This could be incorporated in this model as an increased benefit to whistle-blowing, since not doing so would subject the entrepreneur to greater penalties.

size:

$$\begin{aligned} & k < \left(\bar{p} - \underline{p}\right)\left(\beta B^*\left(\bar{p}\right) - F_E\right) \\ \iff & k < k_h. \end{aligned} \tag{17}$$

Additionally, at the high detection probabilities, expected penalties and the cost of whistle-blowing should be low enough so that bribery leaves the players with enough net surplus:

$$\frac{(L - D_E + D_O) - \bar{p}F - k}{2} \geq U_O \tag{18}$$

$$\iff \quad L \geq \bar{L} \tag{19}$$

k_l and k_h are derived explicitly in the appendix. It can easily be verified that $k_l < k_h$. This establishes the following proposition.

Proposition 2 *Given a penalty structure (F_O, F_E, β, and $\underline{p}$), under endogenous whistle-blowing:*

(1) For $k < k_l$: (a) if $L < \bar{L}$, bribery is eliminated; (b) if $L \geq \bar{L}$, there is a unique bargaining equilibrium $(B^*(\bar{p}), \bar{p})$.

(2) For $k \in [k_l, k_h)$: (a) if $L < \bar{L}$, there is a unique bargaining solution $\left(B^*\left(\underline{p}\right), \underline{p}\right)$; (b) if $L \geq \bar{L}$, there are two possible bargaining solutions, $\left(B^*\left(\underline{p}\right), \underline{p}\right)$ and $(B^*(\bar{p}), \bar{p})$.

(3) For $k \geq k_h$, there is a unique bargaining solution $\left(B^*\left(\underline{p}\right), \underline{p}\right)$.

We now discuss the proposition intuitively. For bribery to exist, there must be an equilibrium bribe size (B^*) and detection probability (p^*) such that p^* is a best response to the bribe size and B^* is a "best response" to the detection probability (additionally, there must be enough surplus left to share). $p^*(B)$ is (step-wise) rising in B–under perfectly asymmetric punishment, a higher bribe means the entrepreneur stands to gain more from whistle-blowing. And B^* is the value that, given p, maximizes the Nash product or, in this case, divides the net surplus equally across both parties. Some distinct possible outcomes are depicted in Figures 2-5. A bribery equilibrium exists if the best response functions intersect.

First, observe that under perfectly symmetric punishment, whistle-blowing cannot exist. At any bribe size, the gains to whistle-blowing are negative, so $p^*(B) = \underline{p}$ regardless of bribe size. More generally, if k is large relative to the benefits of whistle-blowing, the entrepreneur does not have the necessary incentive to raise p and the only possible outcome involves bribery without whistle-blowing (Figure 2).

We next consider asymmetric punishment. The basic logic of asymmetric punishment (Basu, 2011) survives under certain conditions. If k is low, whistle-blowing is cheap relative to the potential gains of improved detection. So, for a given bribe size, the entrepreneur is more willing to set a high p, as this raises the possibility of recovering his bribe relatively cheaply. The best response to a high p is an adjusted bribe size that accounts for the greater likelihood that the official will be left with nothing. But if $\bar{p}$ is high enough (or, L is small enough), it is impossible to find a bribe size that leaves both players with net surplus. In such a case there will be no intersection of the best response functions (Figure 3). The official will provide the license without asking for a bribe.

But, if whistle-blowing is expensive or there are limits to how high detection probability could go, bribes might survive whistle-blowing under asymmetric punishment. If k remains low enough to encourage whistle-blowing while $\bar{p}$ is low enough to sustain bribery, asymmetric punishment could simply lead to a rise in the bribe size, which must occur to account for the higher likelihood of detection (Figure 4). Finally, for intermediate values of k, two equilibria can coexist (Figure 5).

4 Interpretation, Welfare and Optimal Design

The previous section describes the range of outcomes that can emerge under asymmetric punishment. Depending on parameter values, asymmetric punishment might function just like perfectly symmetric punishment (i.e. bribery without whistle-blowing), or allow bribery to survive with whistle-blowing, or eliminate bribery. To interpret these results for policy, it is necessary to discuss the contexts in which bribery might occur, and how these affect both equilibrium outcomes and welfare determinations. For asymmetric punishment to be an effective instrument of corruption control, it must actually control corruption, and the control of corruption must be desirable. Our model allows us to address each of these.

We first summarize the impact of asymmetric punishment across parameter regions. We then show how different interpretations of the environment result in changes in parameters and consequently in the implications of asymmetric punishment. Next, we discuss welfare. A formal exercise is beyond the scope of our model, but we examine how different environments affect welfare calculations, both at the level of the individual interaction and in aggregation. Finally, we conclude the section with a discussion of optimal punishment design.

4.1 Comparative Statics

Consider a switch from perfectly symmetric punishment to asymmetric punishment. For the purposes of comparison, we assume the total penalty (F) remains constant across the two regimes. The impact of this switch from symmetric is critically contingent on parameter

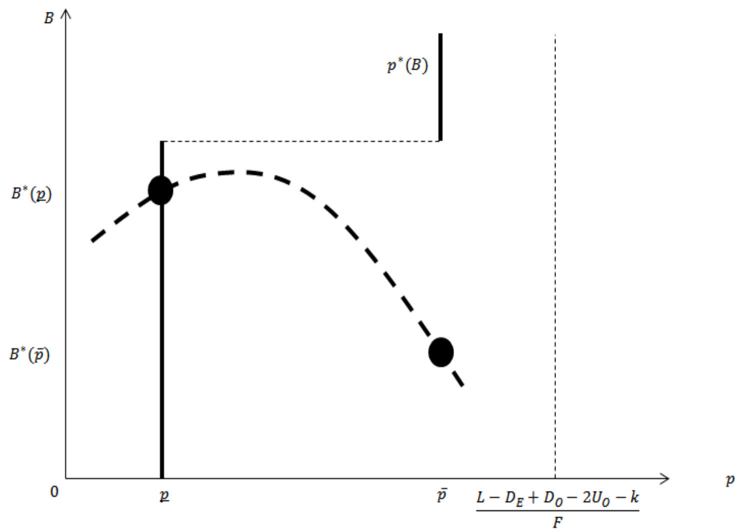

Figure 2: If k is high, the low bribe equilibrium survives. Also note that, because of the high cost of whistle-blowing, $B^*\left(\underline{p}\right)$ might be greater than $B^*\left(\bar{p}\right)$.

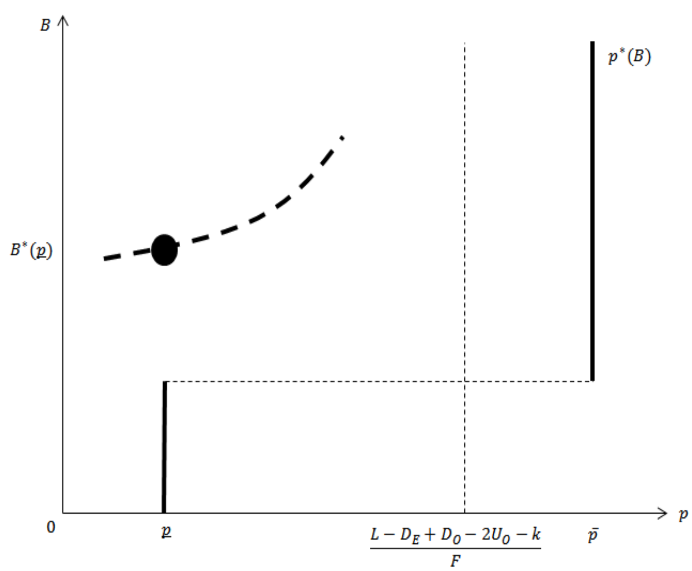

Figure 3: If k is low enough and $\bar{p}$ high enough, asymmetric punishment eliminates bribery.

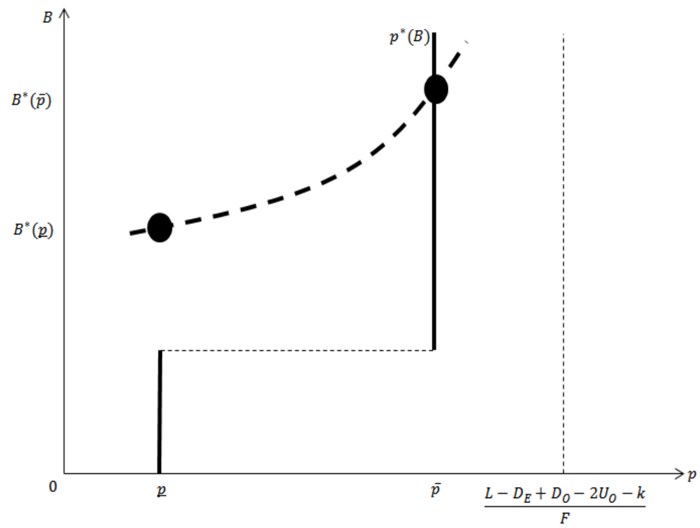

Figure 4: If both k and $\bar{p}$ are low, whistle-blowing occurs but bribery survives.

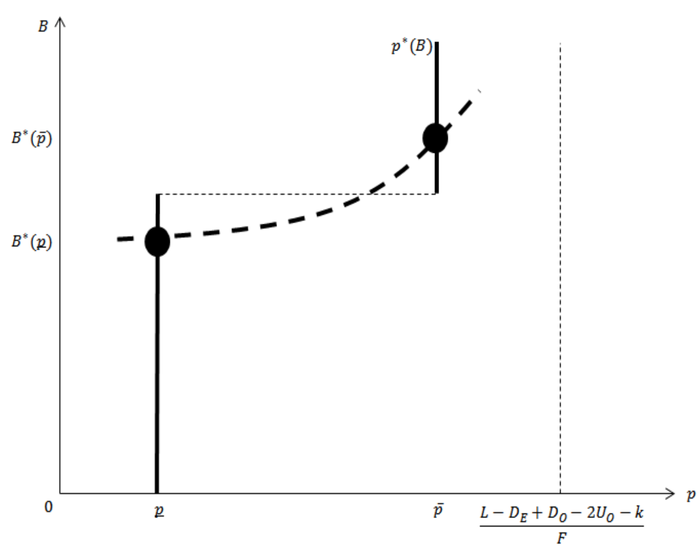

Figure 5: With a low $\bar{p}$ and at intermediate values of k, both low bribe and high bribe equilibria are feasible.

values.

4.1.1 Types

A natural source of heterogeneity is entrepreneur type. Figure 6 maps our results for entrepreneurs who vary along two dimensions: L and k. The first–valuation of the license–is a measure of willingness to pay which, depending on the context, could signal productivity or wealth. The second–cost of whistle-blowing–possibly depends on political connectedness.

First, in some regions, the only possible outcome involves bribery without whistle-blowing. This happens either when whistle-blowing is very costly ($k \geq k_h$) or when it is moderately costly but, since the licence is not attractive enough, it would eliminate surplus if implemented ($k \in [k_l, k_h)$ and $L < \bar{L}$).

Second, when whistle-blowing is intermediately costly so that both $\underline{p}$ and $\bar{p}$ are feasible best-responses, and the license is attractive enough to leave surplus even after accounting for costly whistle-blowing (($k \in [k_l, k_h)$ and $L \geq \bar{L}$), the outcome is indeterminate. The official will ask for a bribe, and negotiations could lead to either outcome. However, in such cases, since the whistle-blowing equilibrium is Pareto dominated, we assume below that it is not selected when two equilibria exist.

Third, when $k < k_l$, whistle-blowing is so cheap that the entrepreneur will certainly engage in it after paying a bribe. Now, if whistle-blowing eliminates surplus ($L < \bar{L}$), the official will choose to deliver the license without asking for a bribe. But if the license is attractive enough ($L \geq \bar{L}$), a bribe will be paid and the entrepreneur will engage in whistle-blowing.

This is summarized in Figure 6, which plots cutoff values of k and L for a punishment regime that satisfies $F_E = 0$ and $\beta = 1$.[19] In the light grey regions asymmetric punishment has no effect, in the dark grey regions bribery persists but with whistle-blowing, and in the unshaded region bribery is eliminated.

So, we can see that the intended effect of asymmetric punishment–the elimination of bribery–is achieved only when the official faces entrepreneurs for whom whistle-blowing is cheap enough to ensure that it happens and the license is sufficiently unattractive that there is nothing to bargain over. In those cases where asymmetric punishment results in the persistence of bribery with added whistle-blowing, both the official and the entrepreneur are left strictly worse off. Whistle-blowing, if it doesn't discourage bribery, merely introduces surplus-burning costs.

An observation: suppose the parameter values are such that asymmetric punishment eliminates bribery. It does not follow that this outcome will persist with further reduced

[19] We set the disagreement utility to be a fraction of the license value, so $D_E = \lambda L$, where $\lambda \in [0, 1)$.

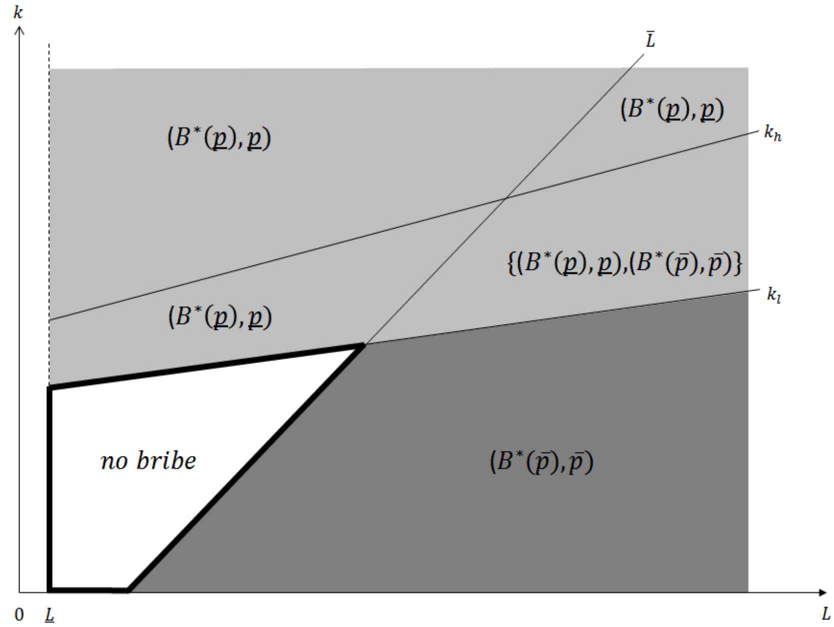

Figure 6: Outcomes under asymmetric punishment for heterogeneous entrepreneurs.

whistle-blowing costs or license values. For example, in Figure 6, we see that if k is already low, a further lowering reduces the range of license valuations for which bribery is eliminated. This happens because there are two effects of lowering k: whistle-blowing gets more attractive, but because the entrepreneur can raise p more cheaply, the potential post-whistle-blowing surplus *rises*. This serves to perpetuate bribery despite the higher probability of detection. A similar analysis can be conducted for cases where L drops further.

4.1.2 Institutional Variables

We can now examine how the cutoff values above depend on the context in which a potentially corrupt exchange occurs. The key values are $\underline{L}$ (below which any punishment regime eliminates bribery), k_l (below which whistle-blowing must occur) and $\bar{L}$ (above which bribery can survive whistle-blowing). We can continue a comparative statics exercise to examine how these cutoff values vary across outside options, which comprise the uncorrupt outcome (U_E, E_O) and the disagreement outcome (D_E, D_O). First, observe that U_E is irrelevant to this exercise. Indeed, it affects welfare (to be discussed next), but since the official decides whether to demand a bribe and he does not care about U_E, its value does not affect these comparative statics.

The effects of the other three variables are straightforward. The appendix contains explicit derivations.

$$\frac{d\underline{L}}{dU_O} \geq 0; \frac{d\underline{L}}{dD_E} > 0; \frac{d\underline{L}}{dD_O} > 0 \quad (20)$$

$$\frac{dk_l}{dU_O} = 0; \frac{dk_l}{dD_E} < 0; \frac{dk_l}{dD_O} > 0 \quad (21)$$

$$\frac{d\bar{L}}{dU_O} \geq 0; \frac{d\bar{L}}{dD_E} > 0; \frac{d\bar{L}}{dD_O} > 0 \quad (22)$$

We can now see how changes in institutional features or contexts can affect the effectiveness of asymmetric punishment. Consider a comparison of harassment bribes and extortion. Under extortion, the official threatens to punish the entrepreneur in the amount L if a bribe is not paid. A natural implication is that D_O will be lower under extortion than under harassment (since the official will have the implement punishment if they disagree).

As a result, relative to harassment, k_l drops and $\underline{L}$ and $\bar{L}$ shift left. The drop in $\underline{L}$ means that, regardless of the symmetry of punishment, bribery survives over a larger parameter region. The drop in $\bar{L}$ means that the region in which asymmetric punishment allows whistle-blowing to occur expands. These happen because the lower disagreement make it easier to agree on a bribe. The drop in k_l means that the region in which asymmetric punishment is ineffective expands–this is because there is a drop in bribe size, resulting in weaker incentives to whistle-blow. On net, extortion supports a relatively smaller parameter region in which bribery is eliminated.

In general, any institutional changes that improve disagreement outcomes for entrepreneurs while worsening them for officials (such as a higher proportion of honest officials) will result in reduced incentives to whistle-blow. This is because the bribe size will be smaller. Therefore, somewhat counter-intuitively, improvements in outside options can make officials and entrepreneurs more likely to collude.

4.2 Welfare

4.2.1 Across Types

A welfare-based determination of whether to switch to asymmetric punishment depends on a well-defined notion of welfare and the distribution of entrepreneur types. On the first, there is the question of how outcomes are evaluated for each official-entrepreneur interaction and how these are aggregated. Clearly this depends on the context in which bribery occurs. For instance, the social objective might be to simply maximize total surplus in each interaction, or to minimize bribes because of possible externalities generated by a culture of bribery. In these cases, we could attempt a comparison of symmetric and asymmetric punishment, but this would be of second-order interest since optimal outcomes could be achieved by decriminalizing bribery in these contexts instead of attempting to combat it.

But there are other reasons a government might prefer not to leave transactions to the market. For example, bureaucrats might be needed to monitor externality-generating firms (Acemoglu and Verdier, 2000) or enforce property rights for citizens (Acemoglu and Verdier, 1998), and in each of these cases the bureaucrats' private interest could be at odds with efficiency considerations.

In this paper, we take as given that bureaucrats are needed to deliver licenses, and that it is preferable to not charge a price for these. This is not hard to justify in the case of harassment bribes. The government might simply be interested in appearing fair and non-extortionary in certain domains. Or, if entrepreneurs are required to incur a sunk cost before meeting the bureaucrat, the anticipation of a bribe could deter them from making the initial investment in the first place, resulting in an inefficient outcome.

Let us consider a natural welfare objective: maximizing the utility of the entrepreneur. If bribery without whistle-blowing persists, asymmetric punishment has no welfare effect. If there is a switch to bribery with whistle-blowing, asymmetric punishment must reduce welfare since the total surplus is lowered by the whistle-blowing effort and greater expected punishment.

So, asymmetric punishment is potentially welfare-improving only when it eliminates bribery. However, whether the elimination of bribery actually raises welfare depends on utility in the absence of bribery (which, in turn, depends on how motivated the official is to deliver the full value of the license). Under bribery without whistle-blowing, the entrepreneur's utility is $\frac{(L+D_E-D_O)-\underline{p}F}{2}$. Without bribery, utility is U_E. Let us suppose $U_E = \psi L$, where $\psi \in [0,1]$. ψ is a measure of the degree to which the official is motivated to provide the full value of the license in an uncorrupt exchange. This gives us the next proposition.

Proposition 3 *Suppose welfare is defined as the entrepreneur's utility. Asymmetric punishment is welfare-improving relative to symmetric punishment if and only if:*

(1) Bribery is eliminated ($k < k_l$ and $L < \bar{L}$); and

(2) $\psi > \bar{\psi} \equiv \frac{(L+D_E-D_O)-\underline{p}F}{2L}$

The interpretation of this proposition is straightforward. Condition (1) ensures that a no-bribery outcome exists and condition (2) ensures that no-bribery is preferable to bribery without whistle-blowing. If ψ is sufficiently close to one, then condition (1) satisfies condition (2). This is the case where bureaucrats have the necessary motivation to supply the license without a bribe. Then, whenever bribery can be eliminated, it raises welfare.

If ψ is small, asymmetric punishment could have opposing welfare implications within the region where bribery is eliminated. For sufficiently small license values, the elimination of bribery raises welfare. But for larger license values, no-bribery is worse than bribery.[20] Intuitively, this is because, as license value rises, under no-bribery a smaller fraction of utility survives than under bribery.

Clearly, this is an artifact of our assumptions and the details of the proposition might change if punishment too were linked to license size. But the point to be noted here is that parameter values matter *differently* for how asymmetric punishment changes behavior and how a change in behavior can be interpreted from a welfare-perspective.

4.2.2 Distributions of Types

Aggregation across interactions might take a purely utilitarian approach or, depending on the nature of the license, place relatively greater weight on the utility of entrepreneurs who value the license more (greater productivity) or less (possibly poorer). Now, the distribution of types matters. Distributions presumably vary substantially across countries, as do the degrees of correlation between L and k.

Consider populations where the costs of whistle-blowing (k) are generally high. In such cases, regardless of the distribution of L, asymmetric punishment will not raise welfare. In fact, to the extent that it encourages whistle-blowing without eliminating bribery for high-valuation types, there will be a welfare loss.

For populations where the costs of whistle-blowing are generally low, welfare depends on a trade-off: surplus in low-valuation interactions rises while the opposite happens in high-valuation interactions. So, while asymmetric punishment will be an effective tool against petty bribery, it will persist with greater surplus loss in high-stakes interactions.

Finally, one might plausibly imagine a distribution of types where k and L are negatively correlated–those who can easily whistle-blow are the ones who value the license the most (the rich or politically connected). Under such distributions, asymmetric punishment fails to achieve its intended effect. The rich pay bribes and whistle-blow, while the poor pay bribes without whistle-blowing.

4.3 Optimal Design

Suppose bribery elimination is desirable. How should a government optimally design penalties: $\underline{p}, F_E, F_O, \beta$? First, holding $\underline{p}$ and F constant, consider rising asymmetry. As punishment gets more asymmetric, k_l rises while $\underline{L}$ and $\bar{L}$ remain unchanged. This expands the

[20] Pilling (2014) describes some such outcomes.

region that supports whistle-blowing. But optimal asymmetry of punishment depends on the tradeoff between wasteful whistle-blowing and bribery elimination, which again depends on the distribution of types.

Second, consider $\underline{p}$, which may or may not be within the control of the government. If a rise in the baseline probability results in a corresponding rise in $\bar{p}$, the parameter region in which asymmetric punishment eliminates bribery will expand. Alternatively, and plausibly, suppose changes in $\underline{p}$ do not raise $\bar{p}$. Then, as the baseline probability rises, $\underline{L}$ moves right and k_l falls (the entrepreneur has less to gain from whistle-blowing), reducing the area in which asymmetric punishment is effective. Therefore, a switch to asymmetric punishment may be most effective if accompanied a by a reduction in the government's baseline detection efforts.

5 Extensions

5.1 Private Types

One concern related to bribery is that it could lead to misallocation (see Banerjee, Hanna, and Mullainathan, 2012 and Niehaus et al., 2013). While our model allows for the license to not be delivered (if bribe negotiations fail), this is never realized as an outcome. This is due to two assumptions: there is no constraint on the number of licenses, and the official knows the entrepreneur's type before he requests a bribe. While this allows us to focus on the key mechanics of bargaining and whistle-blowing, it is worth discussing how private information about types could affect outcomes.

Suppose the official learns the entrepreneur's type only after a bribe is demanded. Then, his decision to demand a bribe depends on his beliefs about the distribution of types. If he does not demand a bribe, he gets the uncorrupt payoff, U_O.

If, on the other hand, he demands a bribe, he receives either the agreed upon bribe amount or, if negotiations fail, D_O. If a sufficient proportion of entrepreneurs have low k and low L, the official will deliver all licenses without bribes under asymmetric punishment. Otherwise, he will demand bribes from all entrepreneurs, and as a consequence those with low k and low L will end up without the license. So a slight change in the distribution of types can result in a dramatic change in the welfare implications of asymmetric punishment, with under-allocation of licenses to those entrepreneurs who can easily whistle-blow and have relatively low valuations of the license.

5.2 Externalities

By emphasizing harassment bribes and extortion, we ignore the problem of externalities. Since this too is an area prone to corruption, it is worth discussing how our results might translate. Suppose the entrepreneur is eligible for a bribe conditional on costly compliance. The official must choose between verifying compliance, and demanding a bribe in exchange for allowing non-compliance. Then, relative to harassment, U_O will be low since the official presumably incurs a cost of verifying compliance. This does not affect bribe size, so k_l remains intact. However, $\underline{L}$ and $\bar{L}$ will drop, resulting in an expansion of the region in which whistle-blowing occurs while bribery survives.

But a complete analysis of asymmetric punishment in this setting must also take into account additional consequences of whistle-blowing. Since whistle-blowing amounts to an admission that the entrepreneur failed to comply with regulations, the benefits of getting one's bribe back must be weighed against the cost of being penalized for this separate offense. If the latter is sufficiently large, the entrepreneur will not whistle-blow. So, to encourage whistle-blowing the government might have to offer simultaneous immunity for both bribe-giving *and* regulation non-compliance, which one can reasonably assume will be politically infeasible.

5.3 Non-Verifiable Bribe Size

While digital technologies can increasingly allow verification not just of a transaction but the size of a bribe, it is possible that bribe size will be hard to verify. Asymmetric punishment could also be designed to be independent of bribe size, so that regardless of the amount paid to the official, the official must pay the entrepreneur a fixed sum R if the bribe is detected.

Now, the entrepreneur's incentive to whistle-blow becomes independent of his valuation of the license. Having paid the bribe and acquired the license, he is willing to whistle-blow if $\left(\bar{p} - \underline{p}\right)(R - F_E) > k$. In figure 6, this would be reflected in a horizontal k_l. The higher R is, the greater the parameter region that supports whistle-blowing.

6 Conclusion

In the preceding sections, we built a simple model of harassment bribes and whistle-blowing. If a government official demands a bribe in exchange for his service, he and the entrepreneur must bargain over the bribe size. In the absence of whistle-blowing, the incidence of bribery does not depend on the symmetry properties of punishment. A bribe is paid as long as the total expected fines are less than the surplus generated by the license. To eliminate bribery, the state must raise expected punishment to a sufficiently high level. If punishment is raised but inadequately, bribery will persist and bribe sizes will rise. Importantly, these bribe size effects exist solely to reallocate surplus. They should not be viewed as indicators of the severity of corruption.

Next, by endogenizing detection probability, this model suggests some new ways to structure our thinking about anti-corruption policy, which has been the subject of many studies. Clearly, one way to eliminate bribery is to make punishments severe and probability of detection high (Becker, 1968). However, severe fines are often politically infeasible and detection, if carried out by government enforcers, can be expensive (where should we look?) and hard to incentivize (how do we distinguish between eliminating bribery and failing to detect it?). In this context, it makes sense to transfer the task to signaling bribery to those who know it best–the parties involved. This can be incentivized through asymmetric punishment.

But for asymmetric punishment to work, a number of conditions must be satisfied. First, the elimination of bribery must be desirable. This depends on the bureaucrat's motivation in the absence of a bribe.

Second, asymmetric punishment must actually eliminate bribery. Whistle-blowing depends on bribe size and bribe size depends on whistle-blowing. To eliminate bribery, whistle-blowing needs to be sufficiently cheap and sufficiently effective relative to the valuation of the license.

Our results here are quite parameter-specific, and importantly so. Consider variation in k and $\bar{p}$. These two variables describe the ease with which a citizen can reveal bribery to the government, and they depend on the ability to verify a bribe payment, the responsiveness of government departments to such claims, the extent to which the whistle-blower is protected after the act, the effectiveness of the judicial system, etc. If k is low and $\bar{p}$ high, so the country has the infrastructure to allow reporting at low cost, asymmetric punishment is an effective solution for eliminating bribery. The change in the entrepreneur's incentives drives detection probabilities so high that it is impossible to arrive at a bribe size that is large enough to make bribery worthwhile for the official. As $\bar{p}$ drops (i.e., there is reduced scope for whistle-blowing), we move from zero bribery to a surplus-destroying outcome–bribery with whistle-blowing. Once k gets high enough, asymmetric punishment has no effect. The possibility of multiple equilibria adds additional complexity, as identical underlying conditions could lead to substantially different bribe sizes.

Policy design requires careful attention to several aspects of bureaucratic and legal institutions. If the state is unable to make whistle-blowing sufficiently effective to eliminate bribery, then it may be best to make whistle-blowing expensive so it happens less. This is because the effort expended in revealing a bribe creates a pure surplus loss unless bribery is actually eliminated. So, if countries with bribery problems are also countries with weak institutions for reporting, it is possible that asymmetric punishment would make matters worse.

Furthermore, asymmetric punishment is expected to be most effective in eliminating bribery where the stakes are low, so that there would be little surplus left after whistle-blowing. This suggests that both asymmetric and symmetric punishment could coexist, with the former being more effective for petty bribery and the latter for larger-stakes transactions.

The model above is stylized to isolate some key effects. We discuss some natural extensions that could help build a richer understanding of the design and implications of anti-corruption policy. The analytical framework could be extended further to analyze additional relevant questions. First, what if officials too were allowed to whistle-blow as well? Penalties could be designed to reward the first whistle-blower, creating greater incentives to whistle-blow and possibly strengthening the bribery-deterrence properties of asymmetric punishment. Second, it would be worth considering the possibility of excessive motivation to whistle-blow, which could result in fabricated evidence. This is a particular concern when stakes are high, such as under political corruption.

Finally, recall that one prediction of our model is that even if fines are small, bribe sizes can get indefinitely large as the probability of detection approaches one. This raises a concern about the depths of entrepreneurs' pockets. The model could be re-analyzed with an additional "liquidity constraint." This will serve to discourage bribery. Also, tight liquidity constraints could raise the effectiveness of asymmetric punishment by making it more likely that the intersection of the best response functions lies outside the acceptable range of bribe sizes. When populations are poor, this constraint can be expected to be tight. As countries grow and pockets get deeper, the liquidity constraint will loosen and corruption will rise. Simultaneously with growth, we might expect an improvement in institutions and the costs of whistle-blowing, which could deter corruption. How these countervailing effects affect outcomes is a potentially interesting question for continuing empirical and theoretical analysis.

Appendix: Comparative Statics

First, we explicitly derive cutoff values.

$$\begin{aligned} & k_l = \left(\bar{p} - \underline{p}\right)\left(\beta B^*\left(\underline{p}\right) - F_E\right) \\ \Rightarrow \quad & k_l = \left(\bar{p} - \underline{p}\right)\beta\left(\frac{(L - D_E + D_O) + \underline{p}\,(F_O - F_E) - 2\left(1 - \beta\underline{p}\right)F_E}{2\left(1 - \beta\underline{p}\right)}\right) \end{aligned} \tag{23}$$

$$k_h = \left(\bar{p} - \underline{p}\right)\left(\beta B^*\left(\bar{p}\right) - F_E\right)$$
$$\Rightarrow \quad k_h = \left(\bar{p} - \underline{p}\right)\left[\beta\left(\frac{(L - D_E + D_O) + \bar{p}\left(F_O - F_E\right) - k_h}{2\left(1 - \beta\bar{p}\right)}\right) - F_E\right]$$
$$\Rightarrow \quad k_h = \left(\bar{p} - \underline{p}\right)\left[\beta\left(\frac{(L - D_E + D_O) + \bar{p}\left(F_O - F_E\right) - 2\left(1 - \beta\bar{p}\right)F_E}{2 - \beta\left(\bar{p} + \underline{p}\right)}\right)\right] \tag{24}$$

$$\underline{L} = D_E - D_O + \underline{p}F + 2U_O \tag{25}$$

$$\bar{L} = D_E - D_O + \underline{p}F + k + 2U_O \tag{26}$$

Comparing Equations 23 and 24, we can see that Assumption 1 ensures $k_l < k_h$. Next, we show how the cutoff values depend on institutional variables.

$$\frac{dk_l}{dU_O} = 0; \frac{dk_l}{dD_E} = \frac{-\left(\bar{p} - \underline{p}\right)\beta}{2\left(1 - \beta\underline{p}\right)} < 0; \frac{dk_l}{dD_O} = \frac{\left(\bar{p} - \underline{p}\right)\beta}{2\left(1 - \beta\underline{p}\right)} > 0$$
$$\frac{d\underline{L}}{dU_O} = \frac{d\bar{L}}{dU_O} = 2; \frac{d\underline{L}}{dD_E} = \frac{d\bar{L}}{dD_E} = 1; \frac{d\underline{L}}{dD_O} = \frac{d\bar{L}}{dD_O} = -1$$

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