The Endogenous Choice of Bribe Type under Asymmetric Punishment

Lin Hu

School of Economics, University of Adelaide

Abstract

As an instrument of corruption control, it has been argued that asymmetric punishment can eliminate harassment bribery if whistle-blowing is cheap and effective. In a more realistic environment where bribery is most likely to survive and another type of bribery—non harassment one—coexists, this paper investigates how asymmetric punishment affects the endogenous choice of bribe type to the bribe-giver. This is analyzed in a setting where bribe size is determined by Nash bargaining, detection of bribery and its type is conducted separately but could be related, and bribery detection rates can be endogenously chosen through whistle-blowing. The feasibility of whistle-blowing has no effect on the fraction of harassment bribery under symmetric punishment. When it is feasible, however, a switch from symmetric to asymmetric punishment leads to either no difference or more non-harassment bribery, which is independent of the relation between detection of bribery and non-compliance. The result is robust when the legalization of bribe-giving is not feasible to non-harassment bribes.

1 Introduction

Bribery, defined as exchanging money between private entrepreneurs and bureaucrats to realize some benefits, can be classified into two forms. One is harassment bribery which happens when the bureaucrat asks a bribe in exchange for offering an service to which the entrepreneur is legally entitled, while the other one is non-harassment bribery which takes place when a bribe is agreed on by both players for a service that should not be provided. It is argued that the former bribery only involves reallocation of surplus from the citizen to the bureaucrat, but the latter can cause much worse social damage. However, harassment bribery could end up with social loss in terms of lower investment if the entrepreneur chose to stay out of the market[1]. Moreover, if two types of bribery coexist and they are endogenously chosen by the entrepreneur, non-harassment bribery might become more attractive if a large investment cost is involved. There is therefore a serious motivation to reduce bribery.

Recently, Basu (2011) has come up with a novel proposal to reduce harassment bribery by applying asymmetric punishment. Specifically, the proposal suggests that bribe-giving should be legalized, and the bribe-taker is required to not only take all the punishments but also return some of the bribe if caught. This asymmetric punishment works by encouraging the bribe-giver to blow the whistle on the bureaucrat and thereby stops their colluding which is one important reason why bribery is hard to control. This proposal has aroused animated discussion about its effectiveness and Basu et al. (2014) has given a further analysis on the conditions under which asymmetric punishment actually works. In that paper, the authors

[1] With paying a bribe, the net gain for the entrepreneur to do a project might be negative such that she will exit the market.

construct a model in which bribery detection probability is endogenously decided by the bribe-giver, and bribe size is determined by Nash bargaining solution. By doing so, they find that asymmetric punishment can eliminate harassment bribery only if whistle-blowing is effective and cheap, but otherwise it could allow the bribery to survive with a larger bribe size. These results refine our understanding of how asymmetric punishment affects the incidence and bribe size of harassment bribery. However, this analysis is limited to the harassment bribes. It is necessary to investigate the effects of asymmetric punishment on fighting bribery in a more complicated and realistic environment where two types of bribes coexist.

In this paper, we extend the analysis to such a complex environment and allow the entrepreneur to choose the bribe type. She is making the choice by deciding whether or not to comply with regulations for doing an economic activity (i.e., a project). The harassment and non-harassment bribes are paid for doing the compliant and non-compliant project respectively. The bribe size is still determined by Nash bargaining as Basu et al. (2014) does. Compared to their work, we introduce a separate inspection of non-compliance in addition to the detection of bribery. The detection of non-compliance could be affected by the detection of bribery. By solving such a model, we try to find out the implication of Basu's proposal on non-harassment bribes. Furthermore, we are interested in studying the impact of a switch from symmetric to asymmetric punishment on the entrepreneur's choice of bribe type.

Starting with a benchmark model where bribery detection probability is exogenous, we show that the size of a non-harassment bribe is smaller than that of a harassment bribe and the entrepreneur's choice of bribe type is independent of symmetry properties of punishment. Next, the benchmark model is modified to the one in which bribery detection probability can be raised by the entrepreneur through whistle-blowing. In this modified model, if harassment bribery cannot be eliminated, it either persists with a larger bribe size or the same size when multiple equilibria exist as the larger one is dominated. On the other hand, the size of a non-harassment bribe could go up if the whistle-blowing is cheap while detection is inefficient, otherwise it is not affected. Moreover, we find that a shift from symmetric to asymmetric punishment either has no effect on the entrepreneur's incentive to comply or makes non-harassment bribes more attractive. This is robust even if legalization of bribe-giving is only conditional on the harassment bribes.

Related work is summarized in the next section. By setting the model and introducing Nash bargaining process, section 3 studies the equilibrium for each type of bribery and how asymmetric punishment affects the entrepreneur's choice of bribe type in a benchmark model. In section 4, we analyze a modified model in which the bribery detection probability can be endogenously chosen by the entrepreneur through whistle-blowing. Section 5 checks the robustness of the previous results when legalization of bribe-giving is only feasible to harassment bribes. The concluding remarks are given in the last section.

2 Related Work

There is a growing amount of literature studying various aspects of corruption. This paper belongs to the strand of theoretical study of approach to fight corruption. An important reason why corruption is hard to detect is that participants involved have the incentive to collude to keep its secrecy because it is illegal. Asymmetric punishment and leniency program can create ex-post incentives for the agents to report the wrongdoing and undermine the collusive relationship between them. Rose-Ackerman (1999) is one of the first papers to put forward the rationale of asymmetry of punishments, saying that successful detection of corruption really relies on the insiders' report combined with the leniency to one of the participants. Buccirossi and Spagnolo (2006) constructs a theoretical model to analyze the application of asymmetric penalties and leniency to both one-off and repeated corrupt transactions. They find that the combination can deter the hold up of occasional illegal transactions which is difficult to self-enforce. Moreover, their results show that the deterrence effect is robust for the long-term illegal relationships if leniency rewards the reports. However, if it is not well designed, the leniency may backfire and facilitate corrupt deals. Lambsdorff and Nell (2007) investigate how to apply asymmetric penalties on different acts of corrupt perpetrators, including bribe-giving and taking, and contract giving and taking, such that the corruption deterrence is more effective. This is analyzed with collusive bribes in a one-shot game. The results show that bribe-giving and reciprocating should be heavily punished while bribe-taking and contract-accepting should be less penalized. In addition, it is argued that leniency to the entrepreneur should be conditional on the whistle-blowing after the contract is obtained.

In a note, Basu (2011) suggests the unconditional leniency to the giving of harassment bribes if detected. By assuming the simultaneous corrupt deal, there is no risk of hold-up and thereby the acts of giving and receiving contract. Dreze (2011) argues that the central argument of Basu's proposal is incorrect and it actually can lead to more bribery. On the one hand, if whistle-blowing is expensive and useless, legalization of bribe-giving makes paying bribe more attractive than standing out of corruption. On the other hand, it makes bribe-giving less immoral such that the applicants become less guilty and more likely to bribe, which is conflicting with the idea of building up values and ethics to reduce bribery. To obtain a deeper understanding of conditions under which Basu's proposal is likely to be effective, Dufwenberg and Spagnolo (2015) develop a formal model that takes into account of the institution quality and moral costs. The analysis shows that the proposal is effective to reduce harassment bribery only if the institution quality is high, which is confirmed later by Basu et al. (2014). Moreover, they agree that immunity to entrepreneurs should be conditional on whistle-blowing because it is useful on solving the problem mentioned by Dreze (2011), and argue that conditional leniency also works for fighting the non-harassment bribery as long as the bribers can be compensated with rewards for losing the illegal favor.

In an environment where bribe type is endogenously chosen by the entrepreneur and the legalization of bribe-giving is not feasible for non-harassment bribes, Oak (2015) investigates the efficacy of Basu's proposal. In such a framework, the author argues that Basu's proposal can lead to different results: in one case it can even fight against the collusive bribery while in the other case it may reduce social welfare by making non-harassment bribes more attractive. The key factor on which this case depends is the magnitude of appealing cost in the event of disapproving compliant projects. Basu et al. (2014) give further investigation of how asymmetric punishment affects the incidence and sizes of harassment bribes. They construct a Nash bargaining model and endogenize the bribery detection through whistle-blowing of bribe giver. Their results show that asymmetric punishment can eliminate harassment bribery only if report is cheap and effective, otherwise it could lead to a larger bribe size.

Several experimental analyses test the effects of asymmetric punishment on fighting corruption[2]. Engel, Goery and Yu (2013) find that asymmetric punishment helps

[2]The objects include not only the harassment bribery but also the non-harassment one.

bribers to enforce illegal transactions and therefore leads to more distortive corruptions. The results from the experiment in Abbink et al. (2014) support that Basu's proposal can significantly reduce harassment bribery, but this effect can be mitigated by the retaliation of bribe taker in the long run. A most recent paper by Berlin and Spagnolo (2015) gives the first empirical test of deterrence effect of asymmetric punishment on fighting corruption in China. They find evidence showing that the number of major corruption cases did decrease to a large extent due to the 1997 reform in which asymmetric punishment and one-sided leniency were introduced. As seen from above, more researches need to be done to deepen our knowledge of the possibilities and limitations about asymmetric punishment. Our study attempts to contribute a bit to the literature.

3 Benchmark Model: Exogenous Bribery Detection

We start with a benchmark model in which the detection of bribery and non-compliance is exogenous. After setting up the model, we analyze the bribery game under a compliant project and under a non-compliant project respectively. Once the equilibrium expected payoffs for doing both types of projects are derived, a comparison of them can yield the condition under which the entrepreneur will comply.

3.1 Setup

The model is set up following the framework of Basu et al. (2014) which assesses whether asymmetric punishment can effectively reduce harassment bribery by encouraging the bribe-giver to whistle-blow. In their model, size of the harassment bribe is a function of the punishment scheme as well as the bribery detection probability, and it is determined by standard Nash bargaining process. Same definitions of punishment schemes and Nash bargaining are applied in our model. However, several basic settings as well as the focus are different. Unlike their model in which the entrepreneur naturally does a compliant project, we assume that she can also choose to do a non-compliant one. Besides, to do a compliant project involves an extra investment cost, which could affect entrepreneur's choice of project type. In this paper, we are interested in not only finding out how asymmetric punishment affects the non-harassment bribes, but also in studying how it is likely to affect the entrepreneur's incentive to comply relative to symmetric punishment.

3.1.1 Settings

An entrepreneur (E) has a project which can generate a benefit of $V > 0$. Its value is fixed and known to all the players. This project can be done in either of the following types: compliant and non-compliant. Let $\theta \in \{c, n\}$ denote the corresponding project type status. To do a compliant project, E has to incur an investment cost $x > 0$ to meet all the regulations. In order to get the project approved and then its value realized, E needs a license from a bureaucrat (B). It is intended that only compliant projects should be approved because non-compliant projects cause too much social damage. However, B is corrupt and he delivers the license conditional on a bribe being paid without caring about the project type. The bribe size is determined by standard Nash bargaining model in which E and B have the same power. If a bribe is failed to be agreed, the license will not be delivered and the project value cannot be realized.

To control corruption and non-compliant projects, there are two departments who are in charge of investigating bribery and non-compliance respectively. The bribery is detected with probability $p \in [0,1]$ if a bribe is paid, while the non-compliance is detected with probability $q \in [0,1]$ if bribery is not caught and $q' \in [0,1]$ otherwise. The probability q' is either equal to or greater than q, depending on the relevance of detection of bribery to non-compliance. Particularly, if they are independent, $q' = q$; if they are fully dependent, $q' = 1$. When bribery is detected, E is penalized $F_E \geq 0$ and B is penalized $F_B \geq 0$. The total penalty is defined as $F = F_B + F_E$. Moreover, E can get back a fraction $\beta \in [0,1]$ of the paid bribe. If non-compliance is detected, both E and B are penalized $\varphi > 0$[3].

As asymmetric punishment here refers to the legalization of bribe giving and repay a fraction of the bribe if caught, it is straight forward to define a perfectly asymmetric punishment as $F_B > F_E = 0$ and $\beta = 1$, and correspondingly define perfectly symmetric punishment as $F_E = F_B$ and $\beta = 0$.

3.1.2 Nash bargaining

The equilibrium bribe size is determined by standard Nash bargaining. Let $b_\theta \in (b_c, b_n)$ denote the bribe paid for doing a project with type status θ. For any b_c to a compliant project, the expected payoffs of an entrepreneur and a bureaucrat are denoted as $u^E(b_c)$ and $u^B(b_c)$. Similarly, for any b_n to a non-compliant project, the expected payoffs of them are denoted as $u^E(b_n)$ and $u^B(b_n)$ respectively.

If a bribe is failed to be exchanged, both players receive their outside options, 0. It is important to notice that, for a compliant project, the investment cost x cannot

[3]If we denote penalties for non-compliance to bureaucrats and entrepreneurs as φ_B and φ_E, whether they are disproportionately allocated does not affect the main result as long as $\varphi_B + \varphi_E$ keeps fixed. Therefore, we just simplify the setting by assuming that $\varphi_B = \varphi_E = \varphi$.

be taken from the surplus when E is bargaining with B because it by then has already become the sunk cost. As a result, we add x back to the expected payoff of E in the bargaining process[4].

So, the equilibrium bribe paid for a compliant project, if exists, is determined by the following bargaining model:

$$b_c^* = \underset{b_c}{argmax}[u^E(b_c) + x - 0][u^B(b_c) - 0]. \tag{1}$$

Slightly different from the above bargaining process, E with a non-compliant project doesn't need to pay the investment cost x and then the corresponding equilibrium bribe size is given by:

$$b_n^* = \underset{b_n}{argmax}[u^E(b_n) - 0][u^B(b_n) - 0], \tag{2}$$

No matter which type the project is, B is demanding a bribe if there exists a solution for the corresponding bargaining model.

3.2 Benchmark Analysis

As we mentioned above, detection of bribery and non-compliance could be related. However, the enforcement of punishment strategies for each crime is independent. Therefore, under asymmetric punishment, the legalization of bribe-giving is irrelevant to the project type. In other words, any E is free of penalty and can get bribe recovery as long as bribery is caught. Given that legalization of bribe giving is only for harassment bribes in Basu's proposal, one would concern that it is unrealistic to make it applicable to non-harassment bribes because this might result in a lower

[4]See equation (3) for the expected payoff of E with a compliant project. The investment cost x is incurred before the bargaining process such that it is the sunk cost of E.

cost for breaking the regulations. However, non-compliance can also be detected in our model. Once it is caught, the project cannot proceed and a separate fine φ is imposed. As a result, doing a non-compliant project involves greater risk if the detection of non-compliance is effective.

Recall that non-compliance can only be detected on a non-compliant project. A compliant project will not be wrongly caught as the other type. Therefore, the detection of non-compliance and how it is affected by the bribery detection have no effects on doing a compliant project at all. We first study the bribery game with a compliant project and then the one with a non-compliant project. After having the equilibrium profits of doing each type of project, we just compare them to find out the cut-off values of the investment cost below which E will comply under symmetric and asymmetric punishment. The further comparison of these cut-off values will show how a switch from symmetric to asymmetric punishment affects the entrepreneur's incentive to comply.

3.2.1 Bribery under a compliant project

The expected payoff of each player is the function of the bribe they agree on. Particularly, for any b_c to a compliant project, the expected payoffs of E and B in the benchmark model can be expressed respectively as:

$$u^E(b_c) = V - x - b_c - pF_E + p\beta b_c, \tag{3}$$

$$u^B(b_c) = b_c - pF_B - p\beta b_c. \tag{4}$$

Assuming a bribe is exchanged, the equilibrium bribe b_c^* is determined by equation (1), and the solution is:

$$b_c^* = \frac{V + p(F_B - F_E)}{2(1 - p\beta)}. \tag{5}$$

Substituting b_c^* back into expected payoff functions (3) and (4) gives us more specific expressions of expected payoffs:

$$u^E(b_c^*) = \frac{V - pF}{2} - x, \tag{6}$$

$$u^B(b_c^*) = \frac{V - pF}{2}. \tag{7}$$

Due to the investment cost x which has to be subtracted from the half-split surplus, the expected payoff of E is smaller than that of B. Similar as what has been shown in Basu et al. (2014), the expected payoffs are independent of β, and the elimination of harassment bribery has nothing to do with symmetric properties of punishment. Instead, it is related to pF and x. The harassment bribery cannot survive as long as $u^E(b_c^*) \leq 0$, i.e., $pF \geq V - 2x$.

According to equation (5), the equilibrium bribe b_c^* is increasing in F_B and β, but decreasing in F_E, which is the nothing new compared to the corresponding result in Basu et al. (2014). This is because the formula of b_c^* is exactly the same in these two papers. In addition, the first and second derivatives of b_c^* with respect to p are:

$$\frac{\partial b_c^*}{\partial p} = \frac{\beta V + (F_B - F_E)}{2(1 - p\beta)^2}, \tag{8}$$

$$\frac{\partial^2 b_c^*}{\partial p^2} = \frac{\beta[\beta V + (F_B - F_E)]}{(1 - p\beta)^3}. \tag{9}$$

They are positive if $F_B > F_E$ and $\beta = 1$, and zeros if $F_B = F_E$ and $\beta = 0$. It indicates that the bribe size to a compliant project is rising in p with an increasing speed under asymmetric punishment, and constant in p under symmetric punishment.

3.2.2 Bribery under a non-compliant project

When it comes to a non-compliant project, we need to take into account not only bribery detection but also non-compliance investigation. Notice that only projects which have been approved will be detected. If a project is detected as non-compliant, it will be blocked immediately and its value cannot be realized. The relation between the non-compliance detection probability q and q' depends on the relevance of the detection of those two crimes. For any $\lambda \in [0, 1]$, define

$$q' = (1 - \lambda)q + \lambda. \tag{10}$$

The larger λ is, the more likely the non-compliance is caught when bribery is detected. Particularly, as we mentioned above, $q' \mid_{\lambda=0} = q$ when the detection of bribery and non-compliance is independent, and $q' \mid_{\lambda=1} = 1$ when the detection of non-compliance is fully dependent on the detection of bribery.

Now we can solve the model to a non-compliant project. There are four possible detection outcomes: neither bribery nor non-compliance is detected, only bribery is detected, only non-compliance is detected and both crimes are detected. Therefore, for any b_n to a non-compliant project, the expected payoff of E is:

$$\begin{aligned} u^E(b_n) &= p[q'(0 - b_n - F_E + \beta b_n - \varphi) + (1 - q')(V - b_n - F_E + \beta b_n)] + \\ &\quad (1 - p)[q(0 - b_n - \varphi) + (1 - q)(V - b_n)] \\ &= (1 - \lambda p)(1 - q)V - (1 - p\beta)b_n - pF_E - [q + (1 - q)\lambda p]\varphi, \end{aligned} \tag{11}$$

Similarly, the expected payoff of B who accepts a non-compliant project is:

$$
\begin{aligned}
u^B(b_n) &= p[q'(b_n - F_B - \beta b_n - \varphi) + (1-q')(b_n - F_B - \beta b_n)] + \\
&\quad (1-p)[q(b_n - \varphi) + (1-q)b_n] \\
&= (1-p\beta)b_n - pF_B - [q + (1-q)\lambda p]\varphi. \qquad (12)
\end{aligned}
$$

Substituting (11) and (12) into bargaining model (2) yields the equilibrium bribe to a non-compliant project:

$$
b_n^* = \frac{(1-\lambda p)(1-q)V + p(F_B - F_E)}{2(1-p\beta)}. \qquad (13)
$$

Given that a non-compliant project is done without incurring the investment cost, E and B having the same bargaining power split the gains equally:

$$
u^E(b_n^*) = u^B(b_n^*) = \frac{(1-\lambda p)(1-q)V - pF}{2} - [\lambda p + (1-\lambda p)q]\varphi. \qquad (14)
$$

Doing a non-compliant project involves the the risk of losing its value and paying extra fine φ when the type is detected. Therefore, the gains generated by the license to this type of project is smaller than that to a compliant project. As a result, the Nash bargaining solution which splits the surplus in the same ratio generates a smaller equilibrium bribe to a non-compliant project, i.e., $b_n^* < b_c^*$. Correspondingly, the expected payoff of a bureaucrat to accept a non-compliant project is smaller. However, for an entrepreneur, which type of project brings more benefits is still depending on the magnitude of x. In addition, equation (14) shows that expected payoff of each player for doing a non-compliant project is still unaffected by β but related to pF. Therefore, the elimination of both types of bribery is independent of symmetry properties of punishment.

Based on equation (13), it is easily to verify that b_n^* changes in response to F_B , β

and F_E in the same way as b_c^* does. Besides, it is decreasing in q and λ. This is because the surplus to be shared decreases if non-compliance is more likely to be detected. Finally, with respect to p, the first and second derivatives of b_n^* are:

$$\frac{\partial b_n^*}{\partial p} = \frac{(1-q)(\beta-\lambda)V+(F_B-F_E)}{2(1-p\beta)^2}, \tag{15}$$

$$\frac{\partial^2 b_n^*}{\partial p^2} = \frac{\beta[(1-q)(\beta-\lambda)V+(F_B-F_E)]}{(1-p\beta)^3}. \tag{16}$$

They are still positive when $F_B > F_E$ and $\beta = 1$, which means that b_n^* changes in p in a similar way as b_c^* does under asymmetric punishment. Notice further that these derivatives of b_n^* are smaller than those of b_c^*, indicating that b_n^* increases in p in a smaller rate and the curve of $b_n^*(p)$ is thus flatter than that of $b_c^*(p)$ (Figures 2-4, 6-7).

The results of the above two games can be summarized in the following proposition.

Proposition 1. *Assume the following are given: the investment cost (x), the penalties for bribery and non-compliance (F_E, F_B, φ), the fraction of bribe to be returned (β), the probability for detecting each crime (p, q), and the relevance of detection of bribery and non-compliance (λ).*

(1) Bribery is eliminated if $pF \geq max\,\{V-2x,\,(1-q)V-2q\varphi\}$[5].

(2) If $pF < min\,\{V-2x,\,(1-p)(1-q)V-2(p+q-pq)\varphi\}$[6]*, both types of bribery survive even when $\lambda = 1$. The bribe size to a non-compliant project is lower than that to a compliant project, i.e., $b_n^* < b_c^*$. Both types of bribes are increasing in F_E and β, but decreasing in F_B. Besides, b_n^* is dropping in q and λ. Moreover,*

[5] *Harassment bribery is eliminated if $p(F_B+F_E) \geq V-2x$ and non-harassment bribery is eliminated if $p(F_B+F_E) \geq (1-q)V-2q\varphi$. The latter condition comes from setting $u^E(b_n)\mid_{\lambda=0} \leq 0$ because $u^E(b_n)\mid_{\lambda=0} > u^E(b_n)\mid_{\lambda=1}$.*

[6] *The condition $pF < (1-p)(1-q)V-2(p+q-pq)\varphi$ is derived by solving $u^E(b_n)\mid_{\lambda=1} > 0$.*

these bribe sizes are rising in p under asymmetric punishment, but the slopes are different: $\frac{\partial b_c^*}{\partial p} > \frac{\partial b_n^*}{\partial p}$.

The proposition shows that, when bribery detection is exogenous, the elimination of bribery is related to the total amount of the penalties rather than the allocation between them. Furthermore, whether a fraction of the bribe is returned the entrepreneur does not matter. Therefore, the symmetry properties of punishment are irrelevant to bribery in the benchmark model. If both types of bribes are exchanged, the bribe size to a compliant project is bigger than that to a non-compliant project because of the greater surplus. The bribe sizes are rising in the bribery detection probability p because bureaucrats need more compensation for a higher chance to be caught. Moreover, the bribe to a compliant project increases faster in p than that to a non-compliant project as it is unaffected by the detection of non-compliance, which decides the shape of $b_\theta^*(p)$.

3.2.3 The endogenous choice of project type

Now that we have already solved the equilibrium bribe and corresponding expected payoffs of players to do each type of project, it is time to study $E's$ choice of project type under different punishment regimes. In order to analyze this question, it is necessary to make sure that doing either type of project is profitable such that E has to make a choice of whether or not to comply. We firstly show the condition under which the exogenous bribery detection probability p can support bribery, and then solve the cut-off value of investment cost x below which E will choose to comply under each punishment scheme.

Doing either type of project is profitable requires:

$$Min\{u^E(b_c),\, u^E(b_n)\} > 0. \tag{17}$$

It yields a constraint for the probability of detecting bribery:

$$p < p_b = Min\{\frac{V-2x}{F}, \frac{(1-q)V-2q\varphi}{\lambda(1-q)(V+2\varphi)+F}\}, \tag{18}$$

where p_b is the cut-off value of bribery detection probability below which a bribe is exchanged in the benchmark model.

When this condition is satisfied, E is making choice about which type of project should be done. Obviously, she will comply only if doing so gives her the higher expected payoff, i.e., $u^E(b_c^*) > u^E(b_n^*)$, that is, only if

$$x < \overline{x}_b = \frac{[q+(1-q)\lambda p]V}{2} + [q+(1-q)\lambda p]\varphi, \tag{19}$$

where $\overline{x}_b$ is the cut-off value of investment cost below which E will choose to comply in the benchmark model. Based on the formula of $\overline{x}_b$, we get $\overline{x}_b \mid_{\lambda=0}= \frac{qV}{2} + q\varphi$ and $\overline{x}_b \mid_{\lambda=1}= \frac{(p+q-pq)V}{2} + (p+q-pq)\varphi$. They are both constants because p is exogenous in the benchmark analysis and other variables are also given. Clearly, $\overline{x}_b \mid_{\lambda=1} > \overline{x}_b \mid_{\lambda=0}$, and more generally we have $\frac{\partial \overline{x}_b}{\partial \lambda} > 0$. It means that E is more likely to comply when detection of non-compliance is more dependent on bribery detection. Moreover, $\overline{x}_b$ is independent of F_B, F_E and β, showing that symmetry properties of the punishment are irrelevant to the choice of project type for E when p is exogenous. These results are summarized in the following proposition.

Proposition 2. *In the benchmark model where the bribery detection probability p is exogenous, the critical investment cost $\overline{x}_b$ below which E will comply is not affected by the symmetry properties of punishment. It instead is a function of λ, the* *relevance of detection of bribery and non-compliance. The more related they are, the larger $\overline{x}_b$ is and the more chance for the entrepreneur to comply.*

The critical value $\overline{x}_b$ is actually the difference between the profits of doing compliant and non-compliant projects. Recall that the profits are not affected by β, the fraction of bribe to be returned. Besides, the effects of total penalty can be canceled out. As a result, $\overline{x}_b$ is irrelevant to the symmetry properties of the punishment. Furthermore, $\overline{x}_b$ is increasing in λ. Intuitively, doing a compliant project is a better choice when non-compliance will be easily caught.

4 Endogenous Bribery Detection Probability

In this section, the model is modified by assuming that E can raise the bribery detection probability p through whistle-blowing. Report the bribery will incur a cost in terms of money and time to the entrepreneur. The cost is a function of p and can be denoted as $c(p)$. This whistle-blowing cost should be incorporated into $E's$ expected payoff function to each type of project. By comparing the corresponding expected payoffs of staying quiet and reporting bribery, E will make her choice of raising p or not.

In the benchmark model, the notion of equilibrium is just the bribe size as p is fixed, but now it becomes a pair (p^*_θ, b^*_θ) where θ is still the project type status. The bribe size and the bribery detection probability are the best response to each other such that $p^*_\theta = p^*_\theta(b^*_\theta)$ and $b^*_\theta = b^*_\theta(p^*_\theta)$.

4.1 Whistle-blowing Cost Function

No matter which type of project E is doing, she can choose to raise p. Let $\underline{p} \in [0,1)$ denote the exogenous benchmark bribery detection probability, and it can be raised to some $\overline{p} \in (\underline{p}, 1]$ by E through whistle-blowing at a cost $k > 0$. Therefore the cost function can be written as:

$$c(p) = \begin{cases} 0, & if\, p = \underline{p}; \\ k, & if\, p = \overline{p}. \end{cases} \tag{20}$$

If $\underline{p}$ is already high enough so that there is no bribery, it will be meaningless to study $E's$ decision of whether to whistle-blow. So consistent with before, we assume $\underline{p}$ satisfies the inequity constraint (18) to guarantee that a bribe is exchanged.

When p is endogenously chosen, there might exist multiple equilibria. Nash bargaining process still determines $b^*_\theta(p_\theta)$, and the comparison of $u^E(\overline{p}, b_\theta)$ and $u^E(\underline{p}, b_\theta)$ decides $p^*_\theta(b_\theta)$. After having the equilibrium pair (p^*_θ, b^*_θ) and corresponding expected payoffs, we are able to analyze how would E make her choice of project type in this modified model.

4.2 Equilibrium

Given that $\theta \in \{c, n\}$, p_c and p_n automatically denote the bribery detection probability to compliant and non-compliant project respectively. Furthermore, taking the whistle-blowing cost into account, the expected payoffs of E with different type of project then become:

$$u^E(p_c, b_c) = V - x - (1 - p_c\beta)b_c - p_c F_E - c(p_c), \tag{21}$$

$$u^E(p_n, b_n) = (1 - \lambda p_n)(1 - q)V - (1 - p_n\beta)b_n - p_n F_E - [\lambda p_n + (1 - \lambda p_n)q]\varphi - c(p_n). \tag{22}$$

The expected payoffs of B are not affected by the whistle-blowing cost, but now they are related to the endogenous bribery detection probability p_θ. Therefore, approving a compliant or a non-compliant project gives B the following expected payoff:

$$u^B(p_c, b_c) = (1 - p_c\beta)b_c - p_c F_B, \tag{23}$$

$$u^B(p_n, b_n) = (1 - p_n\beta)b_n - p_n F_B - [q + (1 - q)\lambda p_n]\varphi. \tag{24}$$

If the Nash bargaining solutions exist, for either $p_\theta^* \in \{\underline{p}, \overline{p}\}$, they are:

$$b_c^*(p_c^*) = \frac{V + p_c^*(F_B - F_E) - c(p_c^*)}{2(1 - p_c^*\beta)}, \tag{25}$$

$$b_n^*(p_n^*) = \frac{(1 - \lambda p_n^*)(1 - q)V + p_n^*(F_B - F_E) - c(p_n^*)}{2(1 - p_n^*\beta)}. \tag{26}$$

Denote $\overline{x}_m$ as the cut-off investment cost below which E will comply in the modified model. It can be given by solving $u^E(p_c^*, b_c^*) = u^E(p_n^*, b_n^*)$. Therefore, E will choose to do a compliant project only if

$$x < \overline{x}_m = [\lambda p_n^* + (1 - \lambda p_n^*)q]V + (1 - p_n^*\beta)b_n^* - (1 - p_c^*\beta)b_c^* + (p_n^* - p_c^*)F_E + [q + (1 - q)\lambda p_n^*]\varphi + c(p_n^*) - c(p_c^*). \tag{27}$$

Substituting b_c^* and b_n^* from (25) and (26) into the above equation gives a more specific expression of $\overline{x}_m$, which is:

$$\overline{x}_m = \frac{[q + (1-q)\lambda p_n^*]V + (p_n^* - p_c^*)F + c(p_n^*) - c(p_c^*)}{2} + [q + (1-q)\lambda p_n^*]\varphi. \quad (28)$$

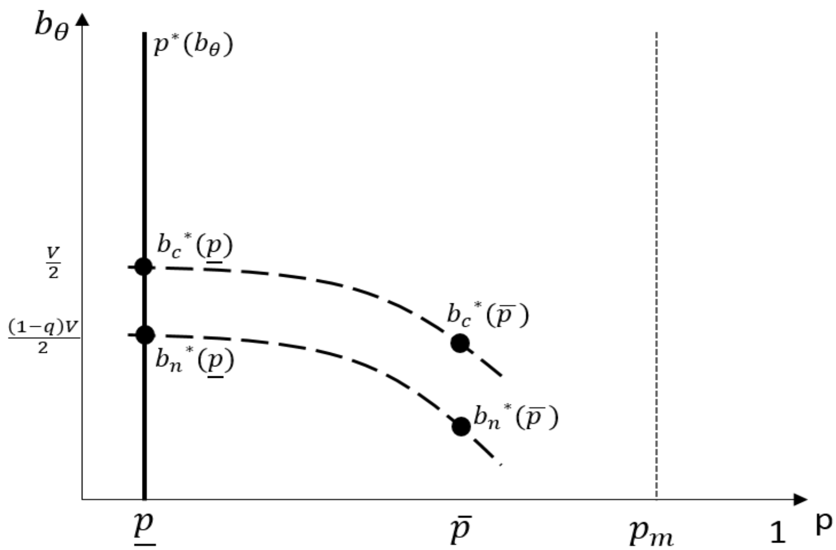
Recall that $p_\theta \in \{\underline{p}, \overline{p}\}$, taking λ as given, the magnitude of $\overline{x}_m$ thereby depends on the equivalence between p_c^* and p_n^*. If they are the same, $\overline{x}_m = \overline{x}_b$; if not, $\overline{x}_m \neq \overline{x}_b$ and the incentive for an entrepreneur to comply changes. The next step is to solve the equilibrium bribery detection probability p_θ^* under each punishment scheme, and find out how a switch from symmetric to asymmetric punishment affects $E's$ attempt to comply. Particularly, we are interested in the situation where $\bar{p}$ is not high enough to eliminate bribery, and denote p_m as the critical value below which the bribery can survive when whistle-blowing is possible[7].

4.2.1 Symmetric punishment

Under perfectly symmetric punishment, no matter which type of project E chose to do, she has no incentive to whistle-blow because it is not only implying an extra cost but also a higher probability to pay the penalty F_E for bribing. Therefore, $p_c^*(b_c) = p_n^*(b_n) = \underline{p}$ under this scheme. The equilibrium outcomes for both types of projects under symmetric punishment are shown in Figure 1. The upper dash curve is for the compliant project and the lower one is for the non-compliant project because $b_c^*(p) > b_n^*(p)$. In addition, $b_\theta^*(p_\theta)$ is defined at two points as there are only two choices for p_θ. As $b_\theta^*(\underline{p}) > b_\theta^*(\overline{p})$ under this punishment scheme, these curves are shaped downwards. The intersection point of $\underline{p}$ and the dash line is the equilibrium for corresponding type of project.

[7]When whistle-blowing is possible, the critical value $p_m = Min\{\frac{V-2x-c(p)}{F}, \frac{(1-q)V-2q\varphi-c(p)}{\lambda(1-q)(V+2\varphi)+F}\}$

Figure 1: Equilibrium under symmetric punishment



As p_θ^* is now constant at $\underline{p}$, $\overline{x}_m$ under symmetric punishment is thus the same as $\overline{x}_b$. Use the superscript s to denote symmetric punishment, so,

$$\overline{x}_m^s = \overline{x}_b = \frac{[q + (1-q)\lambda \underline{p}]V}{2} + [q + (1-q)\lambda \underline{p}]\varphi. \tag{29}$$

4.2.2 Asymmetric punishment

Under perfectly asymmetric punishment, E has to compare the costs and benefits of whistle-blowing in terms of greater bribe return. Only if the expected payoff from whistle-blowing is larger than that from keeping silent, will E choose $p_\theta^* = \overline{p}$. Based on equation (21), solving $u^E(\overline{p}, b_c) > u^E(\underline{p}, b_c)$ yields the best response function $p_c^*(b_c)$. Therefore, for any b_c to a compliant project:

$$p_c^*(b_c) = \begin{cases} \overline{p}, & if\, b_c > \frac{k}{\overline{p}-\underline{p}}, \\ \underline{p}, & otherwise. \end{cases} \tag{30}$$

Similarly, the best response function $p_n^*(b_n)$ can be given by solving $u^E(\overline{p}, b_n) > u^E(\underline{p}, b_n)$, and it is:

$$p_n^*(b_n) = \begin{cases} \overline{p}, & if\, b_n > \lambda(1-q)(V+\varphi) + \frac{k}{\overline{p}-\underline{p}}, \\ \underline{p}, & otherwise. \end{cases} \tag{31}$$

Combining (25) and (30), the following result for a compliant project can be concluded: if a bribe is exchanged, an equilibrium pair $(\overline{p},\, b_c^*(\overline{p}))$ exists if $k < k_L$ while $(\underline{p},\, b_c^*(\underline{p}))$ exists if $k \geq k_H$, and for $k \in [k_L,\, k_H)$, there will be two equilibria[8].

Let $k_L^{'}$ and $k_H^{'}$ denote the corresponding critical value to a non-compliant project. Using (26) and (31), we can get:

$$k_L^{'} = \frac{[(1-q)((1+\lambda\underline{p}-2\lambda)V - 2\lambda(1-\underline{p})\varphi) + \underline{p}F_B](\overline{p}-\underline{p})}{2(1-\underline{p})}, \tag{32}$$

$$k_H^{'} = \frac{[(1-q)((1+\lambda\overline{p}-2\lambda)V - 2\lambda(1-\overline{p})\varphi) + \overline{p}F_B](\overline{p}-\underline{p})}{2-(\overline{p}+\underline{p})}. \tag{33}$$

It is easy to verify that $k_L^{'} < k_H^{'}$. We can therefore have a similar result for a non-compliant project: if a bribe is exchanged, an equilibrium pair $(\overline{p},\, b_n^*(\overline{p}))$ exists if $k < k_L^{'}$ while $(\underline{p},\, b_n^*(\underline{p}))$ exists if $k \geq k_H^{'}$, and for $k \in [k_L^{'},\, k_H^{'})$, there will be two equilibria. Recall that the investment cost in our model is positive. To make $k_L^{'} > 0$,

[8] Here $k_L = \frac{(V+\underline{p}F_B)(\overline{p}-\underline{p})}{2(1-\underline{p})}$ and $k_H = \frac{(V+\overline{p}F_B)(\overline{p}-\underline{p})}{2-(\overline{p}+\underline{p})}$, which are the same as those in Basu et al. (2014) because of the same euqilibrium bribe and optimal report decision.

we need $\lambda < \tilde{\lambda}$[9]. It means that, if $\lambda > \tilde{\lambda}$, the entrepreneur with a non-compliant project reports bribery only if whistle-blowing is awarded.

Therefore, the equilibrium outcomes are parameter-specific, depending on the value of k, λ and q. They are depicted in Figures 2-8. We particularly analyze two extreme cases in which $\lambda = 0$ and $\lambda = 1$.

First, in the independent case where $\lambda = 0$, both types of entrepreneurs have the same optimal report choice function and it is:

$$p_\theta^*(b_\theta) = \begin{cases} \overline{p}, & if\, b_\theta > \frac{k}{\overline{p}-\underline{p}}, \\ \underline{p}, & otherwise. \end{cases}, \; if\, \lambda = 0.$$

We can first see that in Figure 2 and 3, if k is small, the whistle-blowing is cheap such that there is a unique equilibrium ($\overline{p}$, $b_c^*(\overline{p})$) to a compliant project, while the outcomes to a non-compliant project depend on the value of q. For a small q, $k_L^{'}$ is quite close to k_L such that there is also a unique equilibrium ($\overline{p}$, $b_n^*(\overline{p})$); for a large q, two bribe sizes survive but ($\underline{p}$, $b_n^*(\underline{p})$) dominates the other one. The dominant equilibrium is depicted as a solid cross point. Next, if k goes up to some intermediate value (Figure 4), multiple equilibria (low bribe and high bribe) exist to a compliant project and the high bribe is dominated[10]. In the meantime, E with a non-compliant project will keep quiet no matter q is small or large. Lastly, if k is high, $b_\theta^*(p_\theta)$ is decreasing in p, resulting in low bribe persists to both types of projects (Figure 5).

[9] Solving $k_L^{'} > 0$ derives $\tilde{\lambda} = \frac{(1-q)V+\underline{p}F_B}{(1-q)[(2-\underline{p})V+2(1-\underline{p})\varphi]}$.

[10] If multiple equilibria exist, the low bribe one dominates the other one because $u^E(\underline{p}, b_\theta^*(\underline{p})) > u^E(\bar{p}, b_\theta^*(\bar{p}))$

Figure 2: Equilibrium under asymmetric punishment with small k and q when $\lambda = 0$

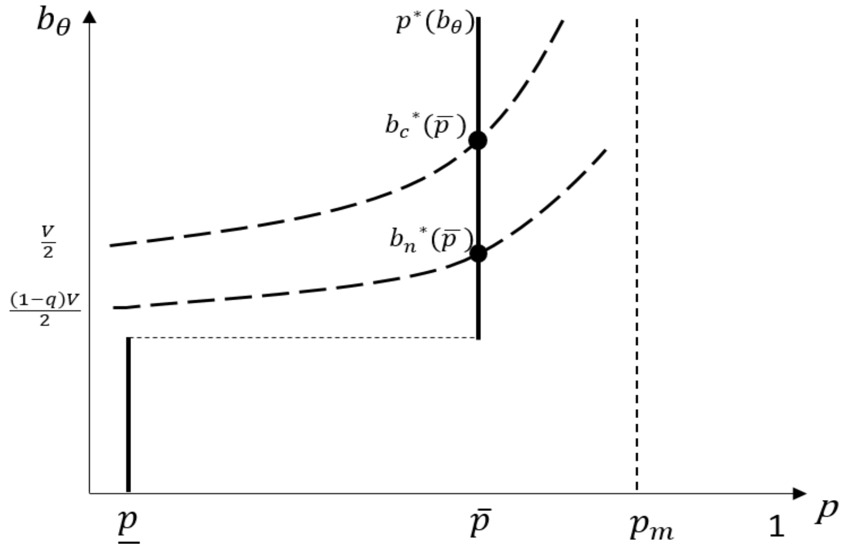


Figure 3: Equilibrium under asymmetric punishment with small k and large q when $\lambda = 0$

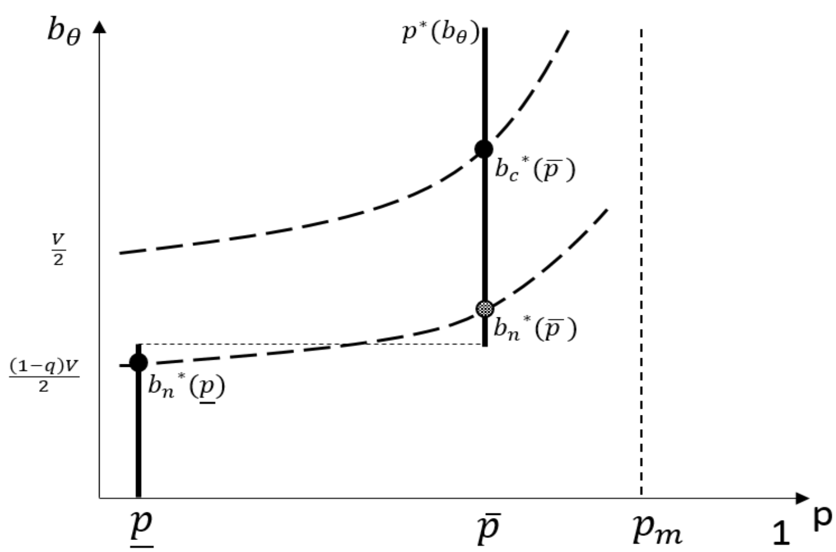


Figure 4: Equilibrium under asymmetric punishment with intermediate k when $\lambda = 0$

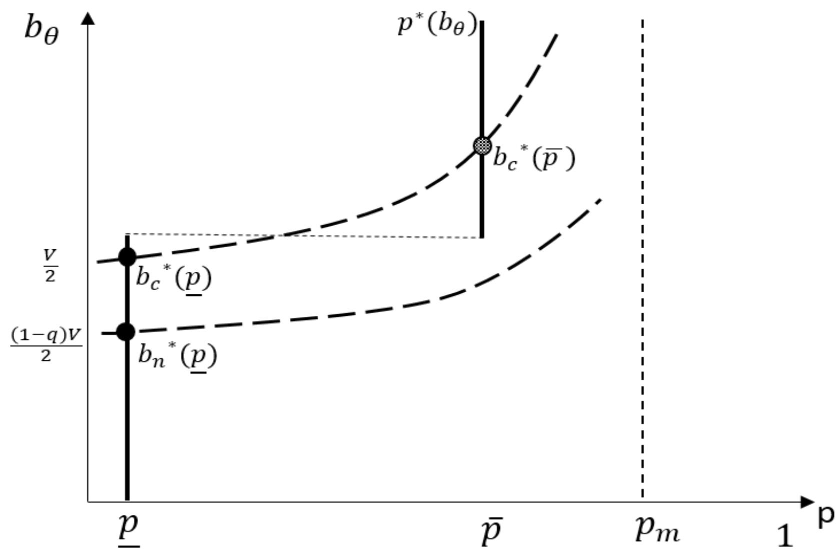
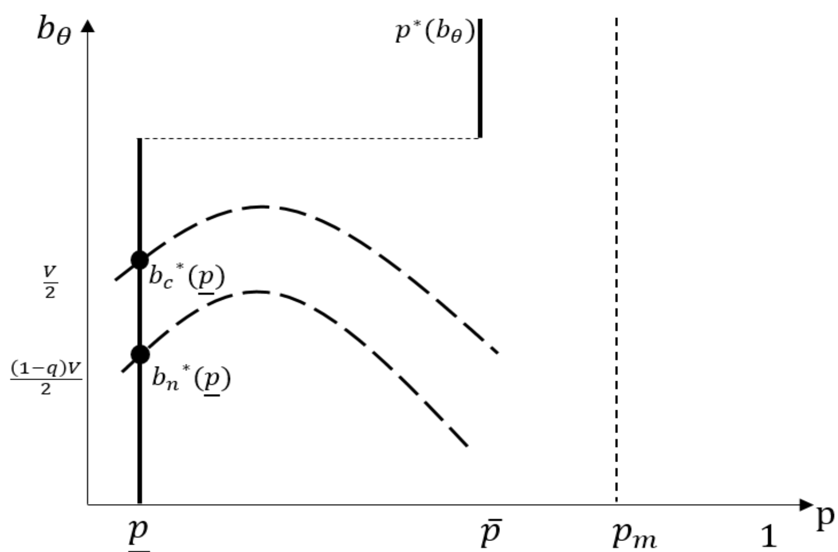


Figure 5: Equilibrium under asymmetric punishment with large k when $\lambda = 0$



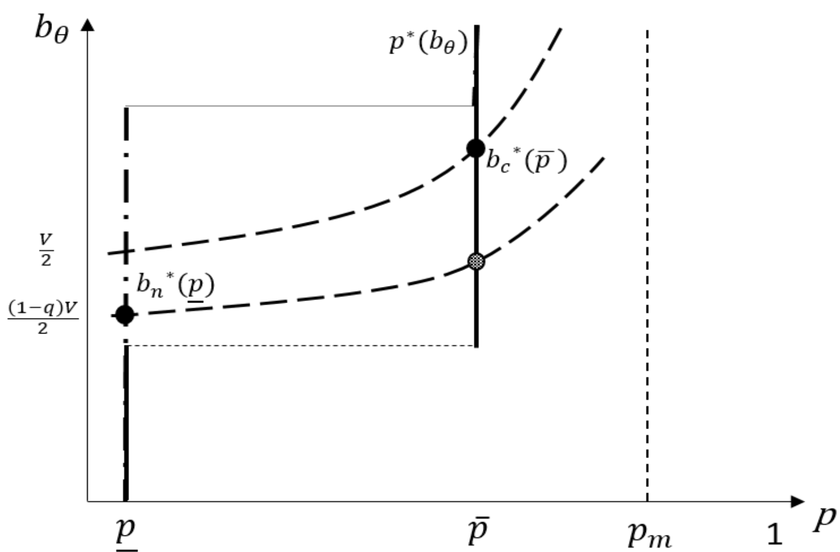
Therefore, if $\bar{p} < p_m$ such that bribery cannot be eliminated and $\lambda = 0$, there are three possible equilibrium outcomes under asymmetric punishment[11]: one is that

[11]In this case, if $\bar{p} > p_m$, harassment bribery can be eliminated if k is small, while the non-

neither type of entrepreneurs reports, one is that they both report, and the last one is one of them reports. Moreover, it can only be $p_c^* = \overline{p}$, $p_n^* = \underline{p}$ for the last probability. To sum up, p_c^* and p_n^* can be either same or different, which leads to different value of $\overline{x}_m$ under asymmetric punishment.

Second, in the fully dependent case where $\lambda = 1$, it is obvious that $E's$ best response function $p_n^*(b_n)$ is different with $p_c^*(b_c)$. In Figure 6-8, the first step curve of $b_n^*(p_n)$ is so high that there will no intersection point on the second step curve, meaning that E with a non-compliant project will never whistle blow and thus the unique equilibrium is $(\underline{p},\, b_n^*(\underline{p}))$ in this case. For a compliant project, the equilibrium outcomes are the same as before because it is unaffected by λ.

Figure 6: Equilibrium under asymmetric punishment with small k when $\lambda = 1$



harassment bribery can only be eliminated if both k and q are small.

Figure 7: Equilibrium under asymmetric punishment with intermediate k when $\lambda = 1$

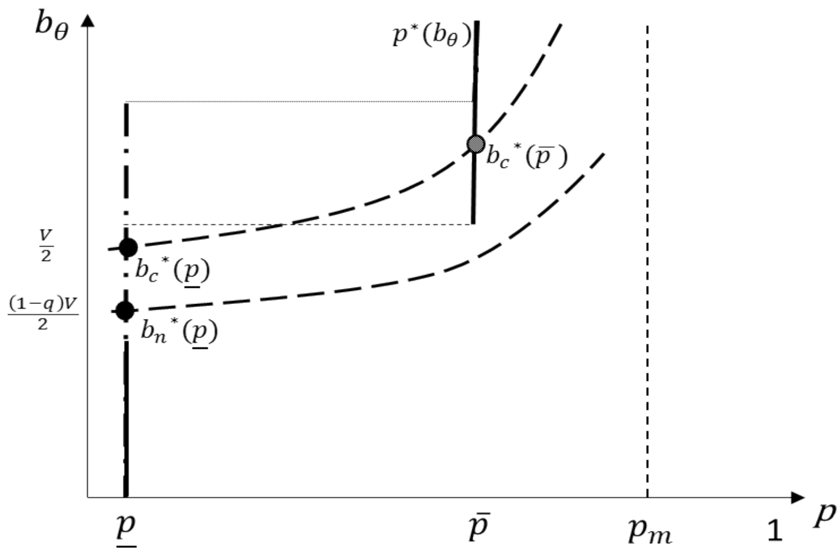
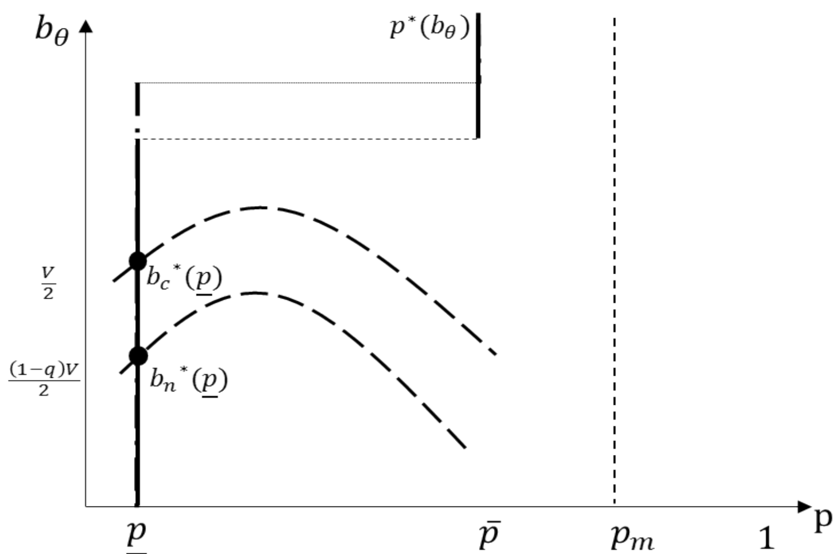


Figure 8: Equilibrium under asymmetric punishment with large k when $\lambda = 1$



Therefore, if $\bar{p} < p_m$ and $\lambda = 1$, there are only two possibilities for p^*_θ under asymmetric punishment[12]. One is that neither type of entrepreneur reports, i.e.,

[12]In this case, if $\bar{p} > p_m$, harassment bribery can be eliminated if k is small, while the non-

$p_c^* = p_n^* = \underline{p}$, and the other one is that only E who does imply reports, i.e., $p_c^* = \overline{p}$, $p_n^* = \underline{p}$.

Denote the cut-off value of investment cost under asymmetric punishment as $\overline{x}_m^a$. Substituting the corresponding λ and p_θ^* into (28) yields the following results:

Table 1: The cut-off investment cost under asymmetric punishment

p_θ^*	$p_c^* = p_n^*$	$p_c^* = \overline{p}, p_n^* = \underline{p}$
$\overline{x}_m^a$	$\frac{[q+(1-q)\lambda p]V}{2}+[q+(1-q)\lambda p]\varphi$	$\frac{[q+(1-q)\lambda\underline{p}]V-(\overline{p}-\underline{p})F_B-k}{2} + [q+(1-q)\lambda\underline{p}]\varphi$

Based on the formula of $\overline{x}_m^s$ in (29) and this table, we can find that $\overline{x}_m^a = \overline{x}_m^s$ when $p_c^* = p_n^*$. This indicates that a switch from symmetric to asymmetric punishment doesn't affect the choice of project type if it causes same equilibrium report decision for both types of entrepreneurs. Besides, it can be easily verified that $\overline{x}_m^a < \overline{x}_m^s$ when $p_c = \overline{p}$ and $p_n = \underline{p}$, meaning that E is less likely to comply under asymmetric punishment if it brings different equilibrium report decision when whistle-blowing is possible. These results can be summarized in Proposition 3.

Proposition 3. *Suppose an entrepreneur can raise bribery detection probability from the base level $\underline{p}$ to a certain level $\overline{p}$ through whistle-blowing such that $p \in \{\underline{p}, \overline{p}\}$. If $\bar{p}$ is not high enough to eliminate bribery,*

(1) under symmetric punishment, the entrepreneur has no incentive to whistle-blow regardless of project type, i.e., $p_c^* = p_n^* = \underline{p}$;

(2) under asymmetric punishment, (a) if whistle-blowing is cheap and it is hard to detect non-compliance, both types of entrepreneurs report bribery, i.e., $p_c^* = p_n^* = \overline{p}$;

harassment bribery can not be eliminated.

(b) if whistle-blowing is not cheap, neither of them reports, i.e., $p_c^* = p_n^* = \underline{p}$*;*

(c) otherwise compliant entrepreneurs report while the other type ones do not, i.e., $p_c^* = \overline{p}$, $p_n^* = \underline{p}$*;*

(3) no matter whether or not detection of non-compliance is affected by detection of bribery, a switch from symmetric to asymmetric punishment either makes no difference or makes an entrepreneur less likely to do a compliant project.

Only when whistle-blowing is cheap and non-compliance is hard to be detected, allowing whistle-blowing under asymmetric punishment creates incentives for both types of entrepreneurs to report bribery. In this case, the entrepreneur who does not comply with regulations could pretend to be a compliant one and get bribe recovery. In all the other cases, non-compliant entrepreneurs do not report while the compliant ones do if whistle-blowing is cheap. The whistle-blowing cost incurred is a surplus loss for the entrepreneur. As a result, compared to symmetric punishment under which no one reports bribery, complying with regulations is less attractive under asymmetric punishment if this policy only encourages compliant entrepreneurs to report.

5 Legalize Bribe-giving Only to a Compliant Project

In previous sections, we assume that the giving of non-harassment bribes can also be legalized. To check the robustness of the results above, we now modify this assumption to that the unconditional leniency is only feasible to the giving of harassment bribes.

The expected payoffs of E and B who does and accepts a compliant project are the same as before, and so does the equilibrium bribe size. For those who deal with a non-compliant project, they would be slightly different. Specifically, the expected payoff of E becomes:

$$\begin{aligned}\hat{u}^E(b_n) &= p_n[q'(0-b_n-F_E-\varphi)+(1-q')(V-b_n-F_E+\beta b_n)+\\&\quad(1-p_n)[q(0-b_n-\varphi)+(1-q)(V-b_n)]-c(p_n)\\&= (1-\lambda p_n)(1-q)V-[1-p_n(1-\lambda)(1-q)\beta)]b_n-\\&\quad p_nF_E-[q+(1-q)\lambda p_n]\varphi-c(p_n),\end{aligned} \tag{34}$$

and of B it is:

$$\begin{aligned}\hat{u}^B(b_n) &= p[q'(b_n-F_B-\varphi)+(1-q')(b_n-F_B-\beta b_n)]+\\&\quad(1-p)[q(b_n-\varphi)+(1-q)b_n]\\&= [1-p_n(1-\lambda)(1-q)\beta)]b_n-p_nF_B-[q+(1-q)\lambda p_n]\varphi.\end{aligned} \tag{35}$$

The Nash bargaining solution yields the following bribe size to a non-compliant project:

$$\hat{b}_n^* = \frac{(1-\lambda p_n^*)(1-q)V+p_n^*(F_B-F_E)-c(p_n^*)}{2[1-p_n^*(1-q)\beta)]}, \tag{36}$$

By plugging b_c^* and $\hat{b}_n^*$ into the corresponding expected payoff functions and solving $\hat{u}^E(b_c)=\hat{u}^B(b_n)$, we get the following $\overline{x}_m'$ below which E will do a compliant project:

$$\begin{aligned}\overline{x}_m' &= \frac{[q+(1-q)\lambda p_n^*]V+(p_n^*-p_c^*)F+c(p_n^*)-c(p_c^*)}{2}\\&\quad+[q+(1-q)\lambda p_n^*]\varphi.\end{aligned} \tag{37}$$

It's clear that the value of $\overline{x}_m'$ still depends on the value of λ as well as the equivalence of p_c^* and p_n^*. Moreover, the results are exactly the same as what are shown in table 1.

To sum up, independent of the feasibility of legalization of bribe-giving to a non-compliant project, the shift from symmetric to asymmetric punishment is leading to the same or less fraction of compliant projects.

6 Concluding Remarks

In this paper, we study the effects of asymmetric punishment on corruption control in a model where the project type—compliant and non-compliant—is endogenously chosen by the entrepreneur. Aside from solving the equilibrium bribe size, we are interested in studying how asymmetric punishment is likely to affect the entrepreneur's incentive to comply relative to symmetric punishment. This is analyzed in such a setting: doing a compliant project is costly because of the investment, a bribe is exchanged as long as a Nash bargaining solution exists, and detection of bribery and non-compliance are conducted separately.

First, we analyze a benchmark model in which the detection of bribery is exogenous. To make analysis interesting, we assume that bribery cannot be eliminated at the base level of bribery detection probability. Our results show that the entrepreneur's incentive to comply is not affected by symmetry properties of punishment in the benchmark model. It instead depends on the relevance of detection of bribery and non-compliance. The more relevant they are, the more likely a com-pliant project is to be done. Intuitively, doing a non-compliant project in a dependent case is more risky and generates a lower expected payoff for the entrepreneur, which results in a bigger value of critical investment cost below which she prefers to comply.

We then find the results are different in a modified model where the entrepreneur can choose to raise the bribery detection probability (p) through whistle-blowing. This is mainly because report decisions for different type of entrepreneur might be different under asymmetric punishment in an environment where p cannot be raised to a very high level such that bribery can be eliminated. Allowing whistle-blowing does not make any difference under symmetric punishment because neither type of entrepreneur has the incentive to report, which is just like what happens in the benchmark model. However, under asymmetric punishment, the report decision to entrepreneurs with different type of project could be either same or different. Both types of entrepreneurs report bribery only when whistle-blowing is cheap and non-compliance is hard to detect. Neither type of them reports if there is a intermediate and large whistle-blowing cost. Therefore, we have $p_c^* = p_n^*$ in these two cases. This leads to a same critical investment cost as that under symmetric punishment and the same chance for the entrepreneur to comply. In all the other cases, the compliant entrepreneur reports while the other type does not, i.e., $\bar{p} = p_c^* \neq p_n^* = \underline{p}$. Due to the surplus loss caused by whistle-blowing, the critical investment cost under asymmetric punishment becomes lower and thus the entrepreneur is less likely to comply.

Our analysis therefore suggests that the equality of p_c^* and p_n^* decides the cut-off value of investment cost and then the effects of a switch from symmetric to asymmetric punishment on the entrepreneur's incentive to comply when whistle-blowing is possible. If the switch causes the same optimal report choice for both types of entrepreneurs, it makes no difference; if it yields the different report decisions, the entrepreneur is less likely to do a compliant project, which decreases the social welfare. Moreover, this result is robust even if we only legalize the giving of harassment bribes. In conclusion, when whistle-blowing is feasible, we need to be cautious about the application of asymmetric punishment when the bribe type is endogenously chosen by the entrepreneur.

References

Klaus Abbink, Utteeyo Dasgupta, Lata Gangadharan, and Tarun Jain. Letting the briber go free: an experiment on mitigating harassment bribes. *Journal of Public Economics*, 111:17–28, 2014.

Daron Acemoglu and Thierry Verdier. Property rights, corruption and the allocation of talent: a general equilibrium approach. *The economic journal*, 108(450):1381–1403, 1998.

Daron Acemoglu and Thierry Verdier. The choice between market failures and corruption. *The American Economic Review*, 90(1):194–211, 2000.

Toke S Aidt. Economic analysis of corruption: a survey. *The Economic Journal*, 113(491):F632–F652, 2003.

Abhijit V Banerjee. A theory of misgovernance. *The Quarterly journal of economics*, 112(4):1289–1332, 1997.

Pranab Bardhan. Corruption and development: a review of issues. *Journal of economic literature*, 35(3):1320–1346, 1997.

Karna Basu, Kaushik Basu, and Tito Cordella. Asymmetric punishment as an instrument of corruption control. *World Bank Policy Research Working Paper*, (6933), 2014.

Kaushik Basu. Why, for a class of bribes, the act of giving a bribe should be treated as legal. *DEA, Ministry of Finance, Government of India*, 2011.

Gary S Becker. Crime and punishment: An economic approach. *Journal of Political Economy*, 76(2):169–217, 1968.

Maria Perrotta Berlin and Giancarlo Spagnolo. Leniency, asymmetric punishment and corruption evidence from china. *Stockholm Institute of Transition Economics Working Paper (34)*, 2015.

Paolo Buccirossi and Giancarlo Spagnolo. Leniency policies and illegal transactions. *Journal of Public Economics*, 90(6):1281–1297, 2006.

Jean Dreze. The bribing game. *Indian Express*, April 23, 2011.

Martin Dufwenberg and Giancarlo Spagnolo. Legalizing bribe giving. *Economic Inquiry*, 53(2):836–853, 2015.

Christoph Engel, Sebastian J Goerg, and Gaoneng Yu. Symmetric vs. asymmetric punishment regimes for bribery. *Max Planck Institute for Research on Collective Goods, Working Paper*, 2013.

Leonardo Felli and Rafael Hortala-Vallve. Collusion, blackmail and whistle-blowing. *CESifo Working Paper*, 2015.

Fahad Khalil, Jacques Lawarrée, and Sungho Yun. Bribery versus extortion: allowing the lesser of two evils. *The Rand Journal of Economics*, 41(1):179–198, 2010.

Maurice Kugler, Thierry Verdier, and Yves Zenou. Organized crime, corruption and punishment. *Journal of Public Economics*, 89(9):1639–1663, 2005.

Johann Lambsdorff, Mathias Nell, et al. Fighting corruption with asymmetric penalties and leniency. Technical report, CeGE Discussion paper 59. University of Goettingen, 2007.

Ajit Mishra et al. *The Economics of Corruption*. Oxford University Press, 2005.

Mandar Oak. Legalization of bribe giving when bribe type is endogenous. *Journal of Public Economic Theory*, 17(4):580–604, 2015.

Benjamin A Olken and Rohini Pande. Corruption in developing countries. *Annual Review of Economics*, 4(1):479–509, 2012.

A Mitchell Polinsky and Steven Shavell. Corruption and optimal law enforcement. *Journal of public economics*, 81(1):1–24, 2001.

Susan Rose-Ackerman. The economics of corruption. *Journal of public economics*, 4(2):187–203, 1975.

Susan Rose-Ackerman. *Corruption and government: Causes, consequences and reform*. Cambridge University Press, 1999.

Andrei Shleifer and Robert W Vishny. Corruption. *The Quarterly Journal of Economics*, 108:599–617, 1993.

Jakob Svensson. Eight questions about corruption. *The Journal of Economic Perspectives*, 19(3):19–42, 2005.