Strategic Analysis of Bureaucratic Corruption

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THESIS

Submitted to the University of Adelaide
in partial fulfillment of the
requirement for the degree of

Doctor of Philosophy
in
Economics

January 2017

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Abstract

This thesis is a collection of three papers, studying corruption games between private citizens and bureaucrats from the perspective of law enforcement.

The first paper develops a model in which bribe type is endogenous and examines how this choice is affected by asymmetric punishment which is proposed as an instrument of corruption control. It has been argued that this policy can eliminate harassment bribery if both whistle-blowing costs and the stakes are low. 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 mix of the two bribes. 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 relevance of detection of bribery and non-compliance. The result is robust when the legalization of bribe-giving is not feasible to non-harassment bribes.

The second paper takes intermediaries into account and studies the effectiveness of

asymmetric punishment as an anti-corruption strategy. Intermediaries that facilitate corruption between clients and bureaucrats are common in developing economies. Anecdotal evidence shows that intermediary agents are responsible for the greater corruption and welfare loss, and some formal analyses confirm this result in various aspects. By using a game theoretic model, this paper examines the efficacy of asymmetric punishment in combating harassment bribery in the presence of a monopolist intermediary. If asymmetric punishment cannot eliminate direct corruption but ends up with a larger bribe size when whistle-blowing is feasible, this policy leads to a shorter licensing procedure in a bribe only game. However, it strengthens incentives of the bureaucrat to create red tape when the intermediary exists, resulting in a longer procedure.

The third paper studies a petty corruption game with a sequence of entrepreneurs and a set of bureaucrats. In this game, each entrepreneur has a project of which a benefit can be generated only if she acquires approvals from all the bureaucrats simultaneously. The bureaucrats are assumed to take the undominated strategy, demanding a positive bribe based on the take-it-or-leave-it rule. However, their non-approval decisions can be appealed by the entrepreneur by incurring an exogenous legal cost. The work shows that there are multiple equilibria in both one-stage and repeated game. BIME (bribe-income-maximizing-equilibrium), one extreme class of them, is non-monotonic in the reduced legal cost in the long run.

Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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Acknowledgement

First and foremost I wish to thank Mandar Oak, my principal supervisor, for his inspiring guidance, continuous encouragement and support, and patience throughout my Ph.D. study and research. I am also deeply grateful to my co-supervisor Rahph-C Bayer for his insightful academic suggestions and kind assistance on various issues.

I would like to thank the School of Economics for the excellent support provided. I am especially grateful to Nicholas Sim, Jocob Wong, Dmitriy Kvasov, Paul Pezanis-Christou, Tatyana Chesnokova and Firmin Doko Tchatoka for their stimulating teaching, and to Terence Cheng for his arrangement of seminars and talks to the speakers. My appreciation also goes to professional staffs for their heartwarming help. The financial support from the China Scholarship Council is gratefully acknowledged.

I am very grateful to all of my friends for their companionship, caring and support during these four years that I spent working on this thesis.

Finally, I am forever indebted to my family, for their endless love and support.

Chapter 1

Introduction

As an age old problem, corruption persists over time and space. Instances of corruption are documented and the studies are across many social science disciplines, including politics, sociology, law, economics (see Aidt, 2003). The focus of analyzing corruption in contemporary economics dates back to Rose Ackerman (1975). In the past two decades, a large literature on various aspects of corruption have sprung up, including several substantial books and edited volumes (see Elliott, 1997; Rose-Ackerman, 1999, 2007; Abed and Gupta, 2002; Lambsdorff, 2007). This development shows an increased public concern about this problem.

Even though corruption is not limited to developing countries, it is a major concern in these economies. According to Olken and Pande (2012), there is an increasing academic and policy consensus that corruption is high in low-income countries. This can also be verified by the fact that developing countries are high on many rankings of corruption. On the other hand, it is found that corruption hinders economic growth and human development (Transparency International Report 2003)[1]. As a result, policy makers

[1]It can be verified by the empirical researches in corruption. See a related review by Lambsdorff

in developing countries as well as international bodies including the World Bank have been concerned about the impact of corruption on development over past few decades and have laid growing emphasis on combating it.

This thesis consists of game-theoretical analyses studying the effectiveness of anti-corruption policies. The introduction is structured as follows. First, I state what corruption is and what type of it is the focus of this thesis. Second, I review some of the literature in this vein, describing several anti-corruption policies and their possibilities and limitations. Particularly, asymmetric punishment proposed in Basu's proposal is represented in detail because that is the main anti-corruption policy this thesis studies. Last, what has been done and the contribution made by this thesis to the literature is presented.

The starting point is to define corruption. There are several versions of its definition, which are differ in detail and emphasis[2]. In this thesis, we adopt the most general one: corruption is the abuse of public power for private gain, which is used by the World Bank, Transparency International and others. Staying away from political corruption, this analysis focuses on bureaucratic corruption of which the context is the transactions between clients (individuals or firms) and government officials. Bureaucratic corruption can be further classified as without theft and with theft described in Shleifer and Vishny (1993). These two kinds of corruption are involved in harassment and non-harassment bribes[3]. Besides, it can also be sorted as grand and petty, depending on the bribe size.

In the existing literature, several policy measures have been put forward to combat corruption. For useful reviews, one can turn to Abbink and Serra (2012) and Rose-Ackerman and Truex (2012). To control the possible corrupt behavior, Becker and

(1999). Abbink and Serra (2012) also argue that it is uncontroversial to state that corruption hinders growth and development.

[2]See Heidenheimer and Johnston (2011) for discussion about various definition of corruption.

[3]In the literature, they are also referred as extortionary and collusive bribes.

Stigler (1974) argue that monetary incentives should be provided to public officials such that behaving honestly can generate a higher expected return. This can be achieved by raising the probability of detection and the corresponding penalty imposed if caught. As one of the most often prescribed remedies for corruption, increasing monitoring and punishment will likely reduce corruption, but it is costly and has risk to cause collusion between corrupt officials and the judiciary (see Kugler, Verdier and Zenou, 2005). In addition, increasing wages paid to the bureaucrats could also create incentives for bureaucrats to be honest as the opportunity costs of corruption go up. However, theoretical analysis finds that wage incentives can only reduce bribery under certain conditions (see Besley and Maclaren, 1993), and empirical researches do not have a consistent result that higher wages deter corruption (see Svensson, 2005).

There are internal controls to corruption in addition to the external monitoring. Staff rotation is widely employed and introducing competition at government bureaucracy is discussed. The former works by preventing bureaucrats from developing long-term corrupt relationships. There is some evidence that staff rotation can reduce the incidence of corruption (see Abbink, 2004; Ryvkin and Serra, 2012). However, it has a negative spillover effect in a fully corrupt bureaucratic hierarchy (Rose-Ackerman, 1999)[4]. The latter was first suggested in Rose-Ackerman (1978) and discussed in Shleifer and Vishny (1993) of which the results show that the level of bribe is the lowest under a competitive regime. Drugov (2010) further explores the effect of competition on corruption and finds that citizens are more likely to comply with the law under this regime relative to a monopoly one. However, competitive bureaucracy still has negative effects. It might raise up the incidence of bribery in the meantime of bringing down the equilibrium bribe size, especially in a environment where harassment and non-harassment bribery

[4]Higher level officials can induce low-level ones to elicit bribes for sharing by using a threat of rotation to a remote area.

coexist (see Shleifer and Vishny, 1993; Rose-Ackerman,1978, 1999).

One reason corruption is hard to control is that players involved have an incentive to collude to prevent detection. Recent theories have suggested that the collusion could be weakened and bribery thus could be reduced by asymmetric punishment and leniency. This works by creating incentives for (at least one of) the parties to report wrong-doing. The effect of whistle-blowing and leniency has been studied in the anti-trust literature, and Rose-Ackerman (1999) is one of the first papers which put forward that this policy instrument can be applied in fighting corruption. In a similar vein, Lambsdorff and Nell (2007) investigate how to apply asymmetric penalties on different acts of corrupt perpetrators such that the corruption deterrence is more effective. They argue that leniency to the entrepreneur should be conditional on the whistle-blowing.

More recently, Basu (2011) comes up with a proposal, suggesting the unconditional leniency to the giving, not the taking, of harassment bribes if detected and that the bribe should be returned by the bureaucrat. This is the main anti-corruption strategy being studied in this thesis. It could work by creating ex-post incentives for bribe-giver to whistle-blow, and thereby could discourage bureaucrats from demanding bribes in the first place. Basu's proposal has aroused animated discussion about its effectiveness in the ways of public comments and academic researches (see Engel et al., 2013; Abbink et al., 2014; Basu et al., 2014; Berlin and Spagnolo, 2015; Dufwenberg and Spagnolo, 2015; Oak, 2015). Particularly, Basu et al. (2014) find that asymmetric punishment can eliminate corruption only if whistle-blowing is cheap and effective. Except for investigating the conditions under which asymmetric punishment is effective in reducing harassment bribery, researchers also put efforts to examine its applicability in the case of non-harassment bribery. Engel et al. (2013) find that asymmetric punishment helps to enforce illegal transactions and therefore leads to more distortive corruptions, while

Dufwenberg and Spagnolo (2015) argue that it can even reduce non-harassment bribery as long as the the bribers can be compensated with rewards for losing the illegal favor.

It is therefore a natural extension to study the efficacy of asymmetric punishment in fighting corruption in a more complicated and realistic environment where two types of bribes coexist. Oak (2015) develops such a model in which the bribe type is endogenously chosen by entrepreneurs based on the selection of project type (compliant or non-compliant)[5]. He assumes that the bribe type is uncovered once bribery is caught and that the giving of non-harassment bribes cannot be legalized. The results show that Basu's proposal can either be even effective in combating collusive bribery or backfire by making non-harassment bribes more attractive. Which case will show up is depending on the magnitude of appealing cost in the event of non-approval of compliant projects.

Motivated by the idea of endogenous bribe type and the fact that having the bribery detected does not necessarily reveal the project type, I further investigate the choice of bribe type under asymmetric punishment when detection of bribery and non-compliance is conducted separately. Moreover, the detection of non-compliance can depend on the bribery detection to some extent. Different from the assumption that the bureaucrat is the monopolist to decide the bribe size in Oak (2015), I assume that bureaucrats and entrepreneurs have the same bargaining power as Basu et al. (2014) does. The results show that, regardless of the feasibility of legalization of bribe-giving to non-harassment bribes, asymmetric punishment does not make a difference or makes non-harassment bribes more attractive relative to symmetric punishment if whistle-blowing is possible. This study provides additional evidence that there are reasons to be cautious about the implementation of asymmetric punishment. Chapter 2 presents this analysis.

To deepen the knowledge of possibilities and limitations of asymmetric punishment in

[5]A harassment bribe is paid for doing a compliant project and a non-harassment bribe is paid for doing a non-compliant project.

fighting corruption, the presence of intermediaries between potential bribers and public officials has to be taken into account. On the one hand, it is common in developing countries that corrupt transactions are organized and channeled through professional intermediaries. Anecdotal evidence shows that intermediary agents are responsible for the greater corruption and welfare loss. However, the fact is overlooked in the economic researches. Bose (2010) says "... we did not pay much attention to the process of corruption; it was implicitly assumed that bribes are handed directly to the bureaucrat by members of the public." On the other hand, some studies have already found that traditional anti-corruption policies are less effective or even counter-effective in the presence of intermediaries (see Bayar, 2005; Hasker and Okten, 2008; Dusha, 2015).

In Chapter 3, I address the problem of intermediaries in corruption market under asymmetric punishment. This work is closely related to Fredriksson (2014) which studies the incentives of bureaucrats to create red tape in the presence of intermediaries. Following his framework, I introduce asymmetric punishment as an anti-corruption policy into the model and investigate its efficacy when a monopolist intermediary exists. Different from those works looking at non-harassment bribery (see Bayar, 2005; Hasker and Okten, 2008), the focus of the this analysis is harassment bribery.

In addition to create ex-post incentives for bribe-givers to whistle-blow, legal recourse should be introduced such that clients can refuse to pay the bribe and report the non-approval decisions of bureaucrats. To strengthen the legal institutions and improve its efficiency, one can think to decrease the legal cost to report. Chapter 4 analyzes the effects of this policy in a setting where entrepreneurs need several approvals from multiple bureaucrats to get a license. This is motivated by the multiple approval system at government bureaucracy in developing countries. In this context, entrepreneurs are usually interacting with low-level bureaucrats and small bribes are involved. Using a game-theoretical model, Lambert-Mogiliansky et al. (2007, 2008) study the equilibrium outcomes of such a petty corruption game in which the bureaucrats are set in a specified order. In a different setting where the bureaucrats are in the same level of position and clients apply to them simultaneously, I examine the effects of reducing the legal cost on the equilibrium bribe size.

A short synopsis for the rest of this thesis is as follows:

Chapter 2 develops a model in which bribe type is endogenously chosen by the entrepreneur and examines how this choice is affected by a switch from symmetric to asymmetric punishment. Following Basu et al. (2014), the bribe size is determined by standard Nash bargaining. In addition to the detection of bribery, we also introduce a separate inspection of non-compliance which however can be affected by the bribery detection. In the benchmark model where the bribery detection probability is given, we find 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, in a modified model where bribery detection probability can be raised by the entrepreneur through whistle-blowing, the results show that a switch from symmetric to asymmetric punishment leads to either no difference or more non-harassment bribery, which is independent of the relevance of detection of two crimes. The result is robust when the legalization of bribe-giving is not feasible to non-harassment bribes.

Chapter 3 further examines the efficacy of asymmetric punishment in combating harassment bribery when a monopolist intermediary exists. We present a model in which clients can benefit from a government license of which the value is fixed and known to everyone. In addition to the regular licensing procedure, clients can receive the license through bribing or through the intermediary. Under asymmetric punishment, we characterize the equilibrium outcomes in both “bribe only” and “bribe and intermediary” game. If direct corruption persists with whistle-blowing under this punishment regime, the incidence of total corrupt activities drops while the use of the intermediary increases. Besides, we study the incentives for bureaucrats to create red tape under same circumstance. The results show that asymmetric punishment leads to a shorter licensing procedure for direct corruption. However, it backfires by leading to a longer procedure when the intermediary exists.

Chapter 4 presents a petty corruption game with a sequence of entrepreneurs and multiple bureaucrats. In such a game, each entrepreneur has a project of which a benefit can be generated only if she acquires approvals from all the bureaucrats simultaneously. The bureaucrats demand a positive bribe based on the take-it-or-leave-it rule in exchange for awarding approvals. However, their non-approval decisions can be appealed by the entrepreneur by incurring an exogenous legal cost. The work shows that there are multiple equilibria in both one-stage and repeated game. BIME (bribe-income-maximizing equilibrium), one extreme class of them, is non-monotonic in the reduced legal cost in the long run.

Chapter 2

The Endogenous Choice of Bribe Type under Asymmetric Punishment

2.1 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

[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.

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 punishment 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 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 2.3 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 2.4, we analyze a modified model in which the bribery detection probability can be endogenously chosen by the entrepreneur through whistle-blowing. Section 2.5 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.

2.2 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) construct 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 two types of bribery coexist and bribe type is endogenously chosen by the entrepreneur, Oak (2015) investigates the efficacy of Basu's proposal. By solving a model in which the bureaucrat has full bargaining power and the benefit is private information, the author finds out that the 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. Inspired by the animated discussion, Basu et al. (2014) further explore the conditions under which asymmetric punishment is able to reduce harassment bribery. 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. Following their framework, we introduce non-harassment bribery and corresponding non-compliance detection into the model, examining the effects of asymmetric punishment on the entrepreneur's choice of bribe type. The similar framework facilitates the comparison with Basu et al. (2014), and our analysis derive a number of complementary results. Specifically, we show the implication of Basu's proposal on non-harassment bribes, and provide extra evidence to the argument that the proposal may backfire by making non-harassment bribes more attractive.

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

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

asymmetric punishment. Our study attempts to contribute a bit to the literature.

2.3 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.

2.3.1 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.

2.3.1.1 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

[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 $\varphi_B = \varphi_E = \varphi$.

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 $\beta = 0$.

2.3.1.2 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 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:

$$b_c^* = \underset{b_c}{argmax}[u^E(b_c) + x - 0][u^B(b_c) - 0]. \tag{2.1}$$

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:

[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.

$$b_n^* = \underset{b_n}{argmax}[u^E(b_n) - 0][u^B(b_n) - 0], \tag{2.2}$$

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

2.3.2 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 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.

2.3.2.1 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:

$$u^E(b_c) = V - x - b_c - pF_E + p\beta b_c, \tag{2.3}$$

$$u^B(b_c) = b_c - pF_B - p\beta b_c. \tag{2.4}$$

Assuming a bribe is exchanged, the equilibrium bribe b_c^* is determined by equation (2.1), and the solution is:

$$b_c^* = \frac{V + p(F_B - F_E)}{2(1 - p\beta)}. \tag{2.5}$$

Substituting b_c^* back into expected payoff functions (2.3) and (2.4) gives us more specific expressions of expected payoffs:

$$u^E(b_c^*) = \frac{V - pF}{2} - x, \tag{2.6}$$

$$u^B(b_c^*) = \frac{V - pF}{2}. \tag{2.7}$$

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 (2.5), 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:

$$\frac{\partial b_c^*}{\partial p} = \frac{\beta V + (F_B - F_E)}{2(1 - p\beta)^2}, \tag{2.8}$$

$$\frac{\partial^2 b_c^*}{\partial p^2} = \frac{\beta[\beta V + (F_B - F_E)]}{(1 - p\beta)^3}. \tag{2.9}$$

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.

2.3.2.2 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

$$q' = (1 - \lambda)q + \lambda. \tag{2.10}$$

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:

$$\begin{aligned} u^E(b_n) &= p[q'(0 - b_n - F_E + \beta b_n - \varphi) + (1-q')(V - b_n - F_E + \beta b_n)] + \\ &\quad (1-p)[q(0 - b_n - \varphi) + (1-q)(V - b_n)] \\ &= (1-\lambda p)(1-q)V - (1-p\beta)b_n - pF_E - [q + (1-q)\lambda p]\varphi, \end{aligned} \tag{2.11}$$

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

$$\begin{aligned} u^B(b_n) &= p[q'(b_n - F_B - \beta b_n - \varphi) + (1-q')(b_n - F_B - \beta b_n)] + \\ &\quad (1-p)[q(b_n - \varphi) + (1-q)b_n] \\ &= (1-p\beta)b_n - pF_B - [q + (1-q)\lambda p]\varphi. \end{aligned} \tag{2.12}$$

Substituting (2.11) and (2.12) into bargaining model (2.2) yields the equilibrium bribe to a non-compliant project:

$$b_n^* = \frac{(1-\lambda p)(1-q)V + p(F_B - F_E)}{2(1-p\beta)}. \tag{2.13}$$

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:

$$u^E(b_n^*) = u^B(b_n^*) = \frac{(1-\lambda p)(1-q)V - pF}{2} - [\lambda p + (1-\lambda p)q]\varphi. \tag{2.14}$$

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 (2.14) 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 (2.13), 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:

$$\frac{\partial b_n^*}{\partial p} = \frac{(1-q)(\beta-\lambda)V+(F_B-F_E)}{2(1-p\beta)^2}, \tag{2.15}$$

$$\frac{\partial^2 b_n^*}{\partial p^2} = \frac{\beta[(1-q)(\beta-\lambda)V+(F_B-F_E)]}{(1-p\beta)^3}. \tag{2.16}$$

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 2.2-2.4, 2.6-2.7).

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

Proposition 2.1. *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, 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 $b_\theta^*(p)$.

2.3.2.3 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

[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* $u^E(b_n)\mid_{\lambda=1} > 0$*.*

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:

$$Min\{u^E(b_c),\, u^E(b_n)\} > 0. \tag{2.17}$$

It yields a constraint for the probability of detecting bribery:

$$p < p_b = Min\{\frac{V-2x}{F}, \frac{(1-q)V-2q\varphi}{\lambda(1-q)(V+2\varphi)+F}\}, \tag{2.18}$$

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

$$x < \overline{x}_b = \frac{[q+(1-q)\lambda p]V}{2} + [q+(1-q)\lambda p]\varphi, \tag{2.19}$$

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 2.2. *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.

2.4 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 $b^*_\theta = b^*_\theta(p^*_\theta)$.

2.4.1 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:

$$c(p) = \begin{cases} 0, & if\, p = \underline{p}; \\ k, & if\, p = \overline{p}. \end{cases} \tag{2.20}$$

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 (2.18) 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 $(p^*_\theta,\, b^*_\theta)$ and corresponding expected payoffs, we are able to analyze how would E make her choice of project type in this modified model.

2.4.2 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:

$$u^E(p_c, b_c) = V - x - (1 - p_c\beta)b_c - p_c F_E - c(p_c), \tag{2.21}$$

$$\begin{aligned} u^E(p_n, b_n) &= (1 - \lambda p_n)(1 - q)V - (1 - p_n\beta)b_n - p_n F_E \\ &\quad -[\lambda p_n + (1 - \lambda p_n)q]\varphi - c(p_n). \end{aligned} \tag{2.22}$$

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:

$$u^B(p_c, b_c) = (1 - p_c\beta)b_c - p_c F_B, \tag{2.23}$$

$$u^B(p_n, b_n) = (1 - p_n\beta)b_n - p_n F_B - [q + (1 - q)\lambda p_n]\varphi. \tag{2.24}$$

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

$$b^*_c(p^*_c) = \frac{V + p^*_c(F_B - F_E) - c(p^*_c)}{2(1 - p^*_c\beta)}, \tag{2.25}$$

$$b^*_n(p^*_n) = \frac{(1 - \lambda p^*_n)(1 - q)V + p^*_n(F_B - F_E) - c(p^*_n)}{2(1 - p^*_n\beta)}. \tag{2.26}$$

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

$$\begin{aligned} x < \overline{x}_m &= [\lambda p^*_n + (1 - \lambda p^*_n)q]V + (1 - p^*_n\beta)b^*_n - (1 - p^*_c\beta)b^*_c + (p^*_n - p^*_c)F_E + \\ &\quad [q + (1 - q)\lambda p^*_n]\varphi + c(p^*_n) - c(p^*_c). \end{aligned} \tag{2.27}$$

Substituting b^*_c and b^*_n from (2.25) and (2.26) into the above equation gives a more specific expression of $\overline{x}_m$, which is:

$$\overline{x}_m = \frac{[q+(1-q)\lambda p_n^*]V + (p_n^* - p_c^*)F + c(p_n^*) - c(p_c^*)}{2} + [q+(1-q)\lambda p_n^*]\varphi. \tag{2.28}$$

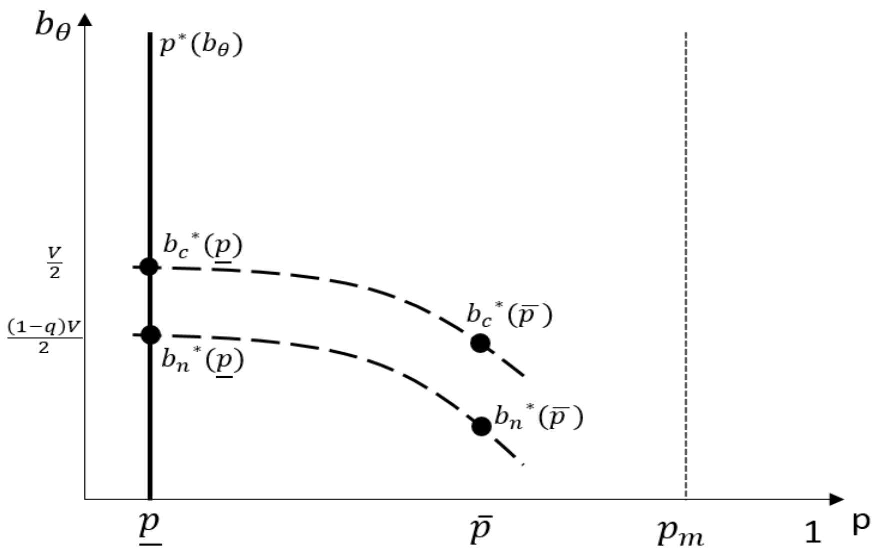
Recall that $p_\theta \in \{\underline{p}, \overline{p}\}$, taking λ as given, the magnitude of $\overline{x}_m$ thereby depends on the equivalence between p_c^* and p_n^*. If they are the same, $\overline{x}_m = \overline{x}_b$; if not, $\overline{x}_m \neq \overline{x}_b$ and the incentive for an entrepreneur 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].

2.4.2.1 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 2.1. 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 2.1: 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,

$$\overline{x}^s_m = \overline{x}_b = \frac{[q + (1-q)\lambda\underline{p}]V}{2} + [q + (1-q)\lambda\underline{p}]\varphi. \tag{2.29}$$

2.4.2.2 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 (2.21), 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:

$$
p_c^*(b_c) = \begin{cases} \overline{p}, & if\, b_c > \frac{k}{\overline{p}-\underline{p}}, \\ \underline{p}, & otherwise. \end{cases} \tag{2.30}
$$

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:

$$
p_n^*(b_n) = \begin{cases} \overline{p}, & if\, b_n > \lambda(1-q)(V+\varphi) + \frac{k}{\overline{p}-\underline{p}}, \\ \underline{p}, & otherwise. \end{cases} \tag{2.31}
$$

Combining (2.25) and (2.30), 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 (2.26) and (2.31), we can get:

$$
k_L^{'} = \frac{[(1-q)((1+\lambda\underline{p}-2\lambda)V - 2\lambda(1-\underline{p})\varphi) + \underline{p}F_B](\overline{p}-\underline{p})}{2(1-\underline{p})}, \tag{2.32}
$$

$$
k_H^{'} = \frac{[(1-q)((1+\lambda\overline{p}-2\lambda)V - 2\lambda(1-\overline{p})\varphi) + \overline{p}F_B](\overline{p}-\underline{p})}{2-(\overline{p}+\underline{p})}. \tag{2.33}
$$

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

[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 equilibrium bribe and optimal report decision.

that the investment cost in our model is positive. To make $k_L^{'} > 0$, 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 2.2-2.8. 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 2.2 and 2.3, 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 2.4), 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 2.5).

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

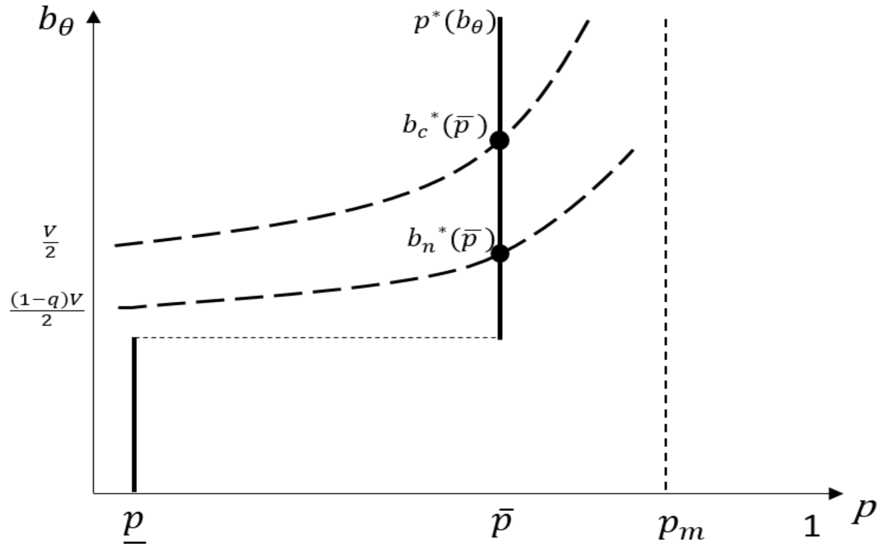


Figure 2.3: Equilibrium under asymmetric punishment with small k and large q when $\lambda = 0$

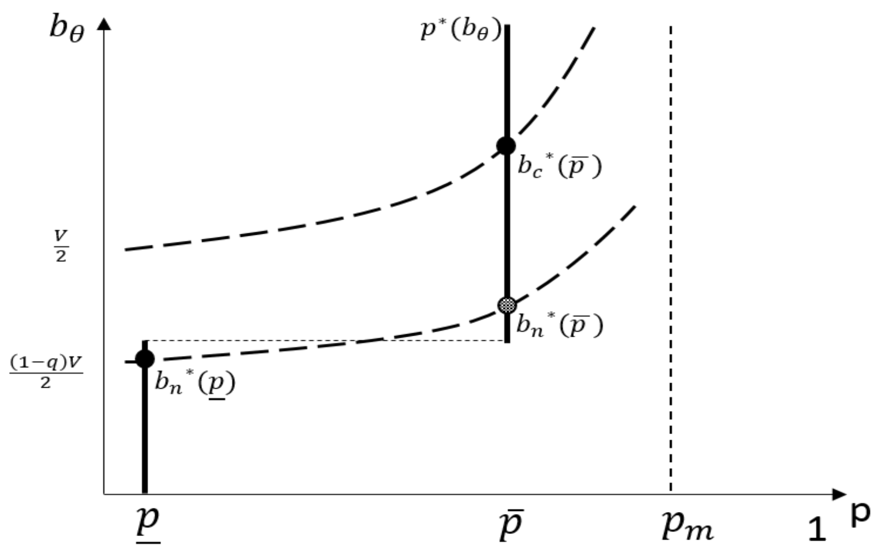


Figure 2.4: Equilibrium under asymmetric punishment with intermediate k when $\lambda = 0$

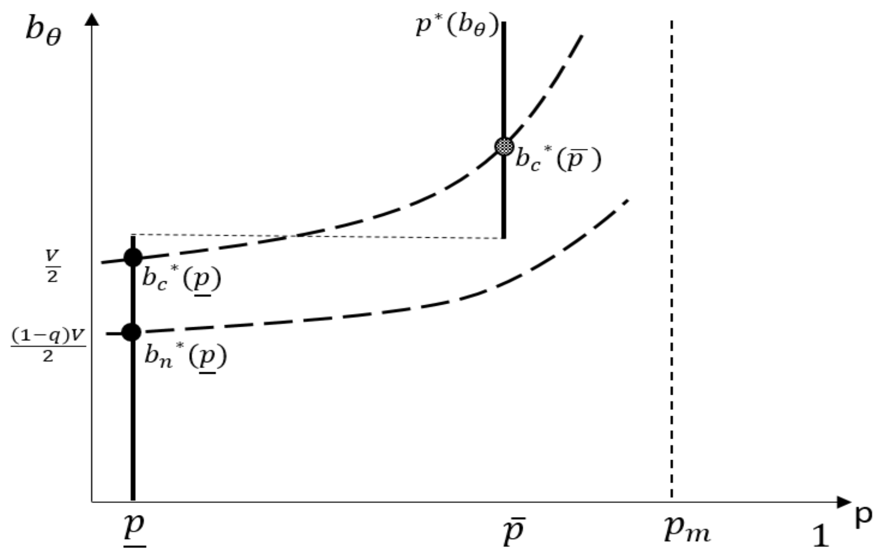
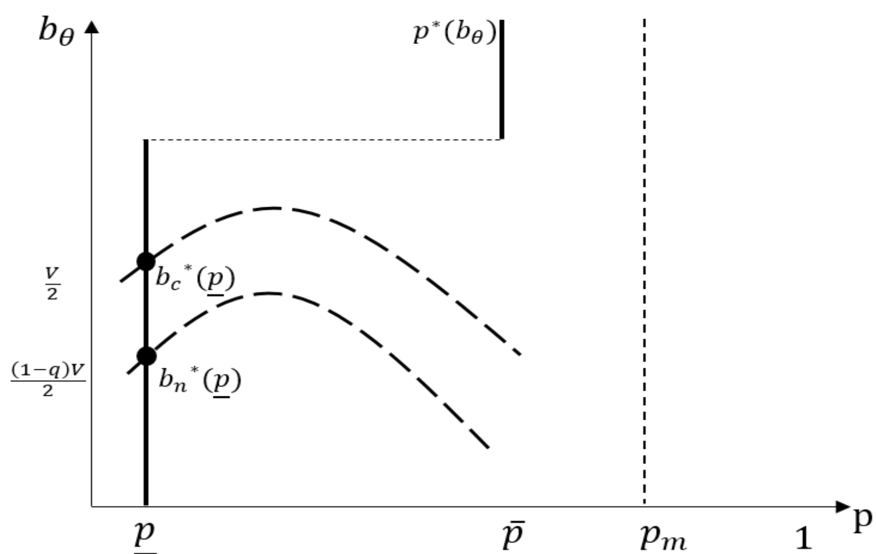


Figure 2.5: Equilibrium under asymmetric punishment with large k when $\lambda = 0$



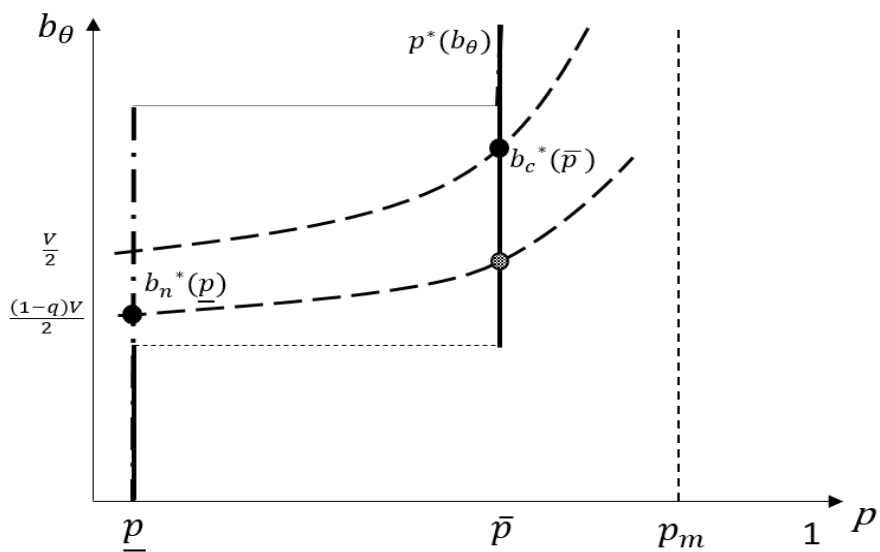
Therefore, if $\bar{p} < p_m$ such that bribery cannot be eliminated and $\lambda = 0$, there are three possible equilibrium outcomes under asymmetric punishment[11]: one is that neither type

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

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 2.6-2.8, 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 2.6: Equilibrium under asymmetric punishment with small k when $\lambda = 1$



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

Figure 2.7: Equilibrium under asymmetric punishment with intermediate k when $\lambda = 1$

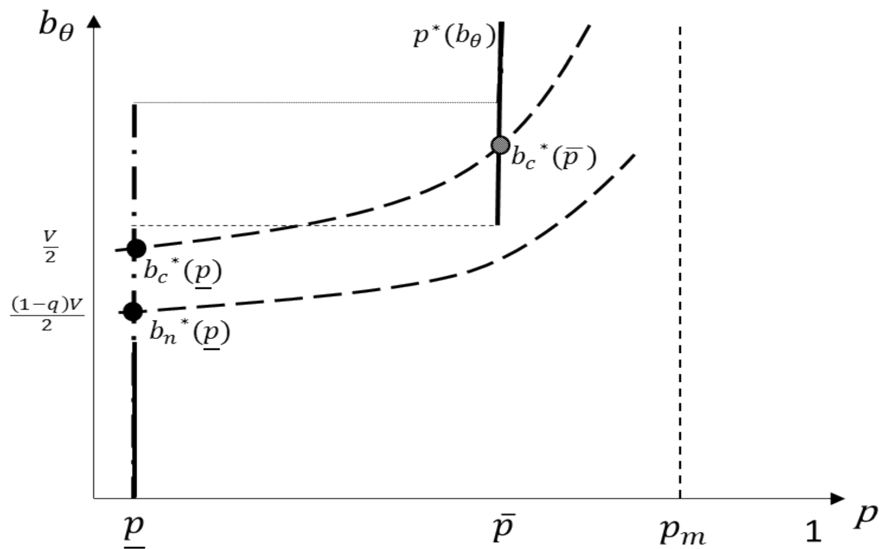
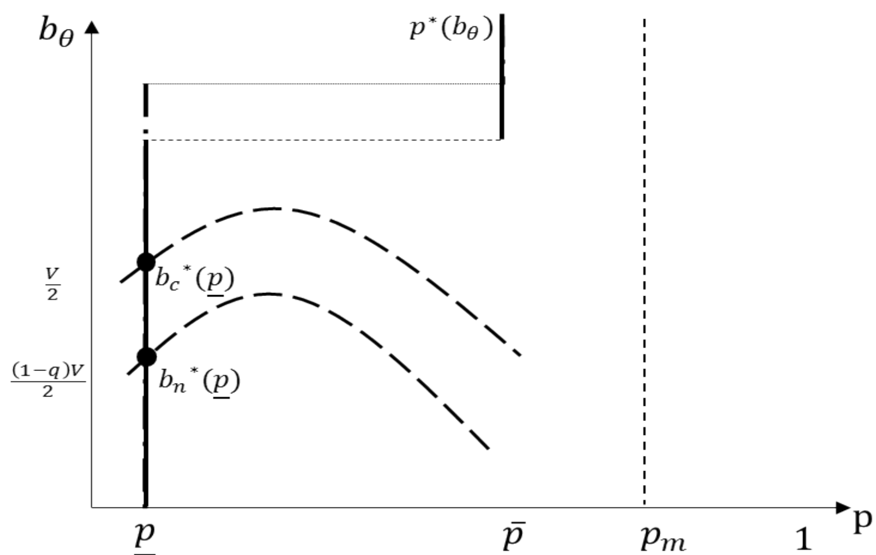


Figure 2.8: Equilibrium under asymmetric punishment with large k when $\lambda = 1$



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., $p_c^* = p_n^* = \underline{p}$, and

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

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 (2.28) yields the following results:

Table 2.1: 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 (2.29) 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 2.3.

Proposition 2.3. *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 $\overline{p}$ 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., $p_c^* = p_n^* = \overline{p}$; (b)

bribery can not be eliminated.

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.

2.5 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:

$$\begin{aligned}
\hat{u}^E(b_n) &= p_n[q'(0 - b_n - F_E - \varphi) + (1-q')(V - b_n - F_E + \beta b_n) + \\
&\quad (1-p_n)[q(0 - b_n - \varphi) + (1-q)(V - b_n)] - c(p_n) \\
&= (1 - \lambda p_n)(1-q)V - [1 - p_n(1-\lambda)(1-q)\beta)]b_n - \qquad (2.34) \\
&\quad p_n F_E - [q + (1-q)\lambda p_n]\varphi - c(p_n),
\end{aligned}$$

and of B it is:

$$\begin{aligned}
\hat{u}^B(b_n) &= p[q'(b_n - F_B - \varphi) + (1-q')(b_n - F_B - \beta b_n)] + \\
&\quad (1-p)[q(b_n - \varphi) + (1-q)b_n] \\
&= [1 - p_n(1-\lambda)(1-q)\beta)]b_n - p_n F_B - [q + (1-q)\lambda p_n]\varphi. \qquad (2.35)
\end{aligned}$$

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

$$\hat{b}_n^* = \frac{(1 - \lambda p_n^*)(1-q)V + p_n^*(F_B - F_E) - c(p_n^*)}{2[1 - p_n^*(1-q)\beta)]}, \qquad (2.36)$$

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:

$$\begin{aligned}
\overline{x}_m^{'} &= \frac{[q + (1-q)\lambda p_n^*]V + (p_n^* - p_c^*)F + c(p_n^*) - c(p_c^*)}{2} \\
&\quad + [q + (1-q)\lambda p_n^*]\varphi. \qquad (2.37)
\end{aligned}$$

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 2.1.

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.

2.6 Concluding Remarks

In this paper, we study the effects of asymmetric punishment on corruption control in a Nash-bargaining 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 related they are, the more likely a compliant 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, doing a compliant project brings a smaller expected payoff. As a result, the critical investment cost under asymmetric punishment becomes lower and 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 decision, 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.

Chapter 3

Corruption with Intermediaries under Asymmetric Punishment

3.1 Introduction

In developing countries it is common for individuals to pay a bribe to get a service at the government bureaucracy. Even after anti-corruption laws are introduced widely in these economies over recent years, corruption still remains a serious problem. Another feature of corruption is the role that intermediaries play in facilitating it. Anecdotal evidence suggests that intermediary agents facilitate corruption, resulting in welfare loss[1]. It is important to investigate causes and consequences of intermediaries in corruption market such that we can have a better understanding of it. However, limited formal analyses have been conducted in the economic area even though this problem does gain the attention of policy makers (see Hasker and Okten, 2008; Fredriksson, 2014 and Dusha, 2015).

[1] See Drugov et al. (2014) and Fredriksson (2014) for stylized facts about bureaucracy intermediaries.

Corruption here is defined as exchange of bribes to obtain an entitled service to which clients are entitled. This paper focuses on studying how the presence of an intermediary affects the effectiveness of Basu's proposal in combating corruption. This proposal, put forwarded by Basu in 2011, argues that asymmetric punishment can be taken as an instrument of corruption control in the case of harassment bribes. This class of bribes are paid for services which clients are entitled to receive for free, involving no social cost. Specifically, Basu's proposal suggests unconditional leniency on bribe-giver[2] but all punishment on bribe-taker if caught. Besides, the bribe paid is required to return. It has aroused animated discussion about its effectiveness. Some theoretical and experimental studies have further explored this idea (see Engel et al., 2013; Abbink et al., 2014; Basu et al., 2014; Berlin and Spagnolo, 2015; Dufwenberg and Spagnolo, 2015; Oak, 2015). Inspired by the discussion and the fact that intermediaries are widely used in the developing countries to facilitate corrupt transactions, we aim at examining the impact of asymmetric punishment on fighting corruption if an intermediary exists.

To better illustrate the kind of environment we are interested in studying, consider a government license that can only be obtained if a series of regulations are satisfied. Even though clients are entitled to receive it, they need to provide various kinds of information and documentation to prove this, and consequently need to fill out many forms (e.g., applying for a passport, obtaining an operation permit and registering a firm, etc). Time costs on figuring out how the procedure works vary across clients with different ability. Those with a high cost might pay a bribe to exchange guidance from the bureaucrat so that some costs can be removed. Besides, the bureaucrat might deliberately impose red tape to make the process more complicated such that he could elicit a bribe. For example, he could say that the information provided is not accurate and complete, forms are not filled properly and so on. Clients are therefore suffering

[2]See Dufwenberg and Spagnolo (2013) for a modified Basu's proposal with conditional leniency.

from both of the complicated regulations and the possible red tape. They will choose to get the license as long as the net gain is non-negative.

Direct corruption happens when a bribe is exchanged between the client and the bureaucrat such that time costs can be reduced by a certain fraction and more surplus can be generated. In addition to regular licensing procedure and direct bribing, a third option can be offered when the intermediary exists in the market. Clients can use an intermediary to interact with the bureaucrat on their behalf by paying a fee. The intermediary in turn pays a bribe to the bureaucrat to get the license. Therefore, intermediaries can be used to get rid of a complicated licensing procedure which could be very time-consuming to clients. This is different from taking them as guarantors between clients and bureaucrats in corrupt dealings as many authors have argued (Lambsdorff, 2002; Bayar, 2005; Hasker and Okten, 2008)[3]. Importantly, we assume that the intermediary is a monopolist in the market. The reason why the entry is so difficult is that the agent must be the one who has repeated relationship and close connection with bureaucrats.

Suppose that direct corruption will be detected with some probability and punishments will be applied if caught. Moreover, we assume that the intermediary can always stay bribed because he will not provide testimony which is required to convict a bureaucrat. First, for a given procedure, we characterize the equilibrium for the corruption game without and with the intermediary when bribery detection is exogenous. We then study how asymmetric punishment affects the license demand for bribing and the intermediary when the detection probability is endogenized through whistle-blowing by clients. If direct corruption persists with whistle-blowing under asymmetric punishment, this policy leads to a reduced incidence of bribery but a raised demand for the intermediary. Next, we modify the model by assuming that the procedure length is determined by

[3]Intermediaries can guarantee that a corrupt bureaucrat is matched and no hold-up occurs.

the bureaucrat, and investigate how asymmetric punishment influences its optimal level. Results show that, if asymmetric punishment leads to whistle-blowing and a larger size of direct bribe, it is effective in reducing the length in the absence of the intermediary. However, it backfires by making the procedure longer when the intermediary exists.

The paper proceeds as follows. Related work is summarized in the Section 3.1.1. Section 3.2 presents a formal model and the equilibrium outcomes. In Section 3.3, the optimal length of the procedure is investigated when it is endogenously decided by the bureaucrat. Conclusion is given in the last section.

3.1.1 Related Work

There is an immense literature studying corruption in various aspects, including causes, consequences and remedies. For recent useful surveys, one can turn to Bardhan (1997), Lambsdorff (2001) and Aidt (2003). However, according to Bose (2010), the process of corruption is not attached much attention and is simplified drastically. Lamsdorff (2002) also mentions that it is very likely that middlemen are employed in corrupt market, making the transaction look like legal. In Bertrand et al. (2007), hiring intermediaries to get a driving license without proper skills in India is documented. As mentioned above, Basu's proposal has aroused animated discussion on the possibilities and limitations of asymmetric punishment on fighting corruption. However, intermediaries are not taken into account. This paper explores how the presence of a monopolist intermediary affects the efficacy of asymmetric punishment.

In the limited literature studying the role of intermediaries in corrupt transactions, Bayar (2005) argues that the presence of intermediaries makes clients better off but also encourages more corruption. Intermediaries in her paper play a role as observed in Bertrand et al (2007). Furthermore, Hasker and Okten (2008) develop a formal model in which bribing through the intermediary can ensure corrupt deal and will not be caught, showing that the existence of intermediaries leads to reduced regulations. In the meantime, they find that traditional anti-corruption policies, such as improving expected punishment and decreasing the reliability of bureaucrats, are less effective or even counterproductive if intermediaries exist, which is similar to the result of Bayar (2005) in the view of policy efficacy.

Except for the collusive bribery discussed in those papers, the extortive bribery with intermediaries is also analyzed. Lambert-Mogiliansky et al. (2009) study such a game in which a track of bureaucrats ask bribes on a "take-it-or-leave-it" basis sequentially. They argue that, compared to equilibrium outcome in a direct corruption game, the intermediary strategy profile equilibrium could be efficient if the intermediary can apply to bureaucrats at a lower cost than entrepreneurs.

This paper is closely related to Fredriksson (2014) which focuses on the "time saving" attribute of intermediaries and studies the incentives of bureaucrats to create red tape. In his paper, a government license can be obtained by going through several identical steps and the procedure length could be decided by the bureaucrat. Fredriksson finds that more red tape is implemented and clients are unambiguously worse off in the presence of intermediaries compared to the corruption only model. Different from the endogenous intermediary market in his work, there is only a single intermediary in our model. Moreover, we particularly analyze how asymmetric punishment affects the endogenous choice of procedure length when the intermediary exists.

In a different vein, Dusha (2015) analyzes the impact of intermediaries on corruption in a consignment framework. In his model, intermediaries can choose to cheat and steal from officials. The results show that clients prefer using an intermediary to going through the legal procedure to get the license when investment and red tape costs are high. Techniques to fight corruption, like increasing the frequency of audits, actually lead to greater corruption and higher price of licenses.

The empirical evidence on the facilitating role of intermediary agents in corruption is rare. Drugov et al. (2014) examine if intermediaries increase corruption by lowering moral costs of players with experimental data and their results confirm this conjecture.

3.2 The Model

This paper develops a model in which a government license can generate a benefit to the client– an individual or a firm. There are three possible ways to obtain the license at the government bureaucracy: through a regular procedure, through bribing or through an intermediary. We first study the setting without the intermediary, and then the one with it.

3.2.1 Setup

Clients could benefit from a government license awarded by the bureaucrat. The value of the license is denoted by $v\,(> 0)$, and it is common knowledge to all the players. To obtain it, the client needs to submit an application and go through a procedure which consists of several steps. The length of this licensing procedure is denoted by r. We first assume that it is given as the baseline, and then modify the assumption by regarding it as a choice variable for the bureaucrat. Clients indexed by i differ in A_i, the time costs of figuring out how the procedure works, which we also refer as "complexity" of regulations to clients. In other words, even if the regulations faced by applicants are all the same, the complexity of them is different across individuals. Besides, the longer the procedure is, the more complicate clients feel about it. Let rA_i denote the opportunity cost of time for the client to get the license. It is also the total license cost because we assume that there is no administrative cost for processing the application. Let A_i be uniformly distributed on the unit interval $[0, 1]$. As long as the net gain $v - rA_i$ is non-negative, clients will choose to get the license.

In addition to the regular procedure, clients can also get the license by paying a bribe directly or hiring an intermediary to interact with the bureaucrat on their behalf. Moreover, we assume that there is only one intermediary in the market. For direct applications, the bureaucrat may demand a bribe to exchange tips of completing the procedure such that time costs can be reduced by a fraction $\alpha \in (0, 1)$. For intermediary applications, by paying a license fee f, clients hire the middleman to go through the procedure such that all the bureaucracy-related time costs can be removed. The intermediary in turn needs to pay a bribe to the bureaucrat. That is because the bureaucrat is the one who has discretionary power on awarding the license and therefore can capture part of surplus related to the intermediation transactions.

The bureaucrat set two bribe rates for the client and the intermediary respectively, and they are denoted as b and b_I. An exogenous detection is undertaken by the government towards corrupt transactions. However, the intermediary will not be caught because there will be no briber's testimony which is required by the government to convict a bureaucrat. Specifically, direct corruption can be detected with probability $p \in (0, 1)$. If it is detected, the client and the bureaucrat are penalized $F_C\,(\geq 0)$ and $F_B\,(\geq 0)$ respectively. We assume that $F_B \geq F_C$. The total penalty is defined as $F = F_C + F_B$ and it is fixed no matter how the penalty burden is allocated. Besides, a fraction (denoted as $\beta \in [0, 1]$) of bribe is required to return to the client.

The timeline is as follows: Given whether or not there is an intermediary and the length of the licensing procedure r (which will be endogenized later in the paper), the bureaucrat first sets bribe rates b or b_I for direct and indirect bribing respectively. The rates are known to the client and the intermediary. Next, if an intermediary does exist and related bribe rate is set, the intermediary determines a commission fee f. Third, the client, taking b and f as given, decides if and through which way to bribe the bureaucrat. Backward induction is used to solve the equilibrium.

3.2.2 Equilibrium without the Intermediary

We now present the base case in which there are no intermediaries such that only direct bribe will be accepted by the bureaucrat if clients choose to bribe. Getting the license through bribing is preferred to through the regular procedure if it can bring a larger profit. Let u and u_b denote the expected payoff for the client from receiving the license without and with bribery respectively. Therefore,

$$u = v - rA_i, \tag{3.1}$$

$$u_b = v - (1 - p\beta)b - (1 - \alpha)rA_i - pF_C. \tag{3.2}$$

Bribing the bureaucrat will imply a higher gain if (3.2) $\geq$ (3.1), that is, if

$$A_i \geq A^1 = \frac{(1 - p\beta)b + pF_C}{\alpha r}, \tag{3.3}$$

where A^1 is the threshold of the complexity beyond which the client will pay a bribe to get the license. Furthermore, for those with a large A_i, there is a choice between bribing and giving up the license when the procedure length r is large. In other words, they only apply for a license if the net gain is not negative. Solving (3.2) ≥ 0 derives another threshold of A_i and we denote it as A^2 below which clients choose to obtain the license through bribing, i.e.,

$$A_i \leq A^2 = \frac{v - (1 - p\beta)b - pF_C}{(1 - \alpha)r}. \tag{3.4}$$

Recall that A_i is uniformly distributed over $[0, 1]$. As a result, the condition (3.4) binds if it is smaller than 1. Therefore, the total license demand through bribing is $Min\{1, A^2\} - A^1$. The bureaucrat decides the size of direct bribe b by maximizing his expected bribe income (denoted by π):

$$\begin{aligned} &\underset{b}{Max}\, \pi = ((1 - p\beta)b - pF_B)(Min\{1, A^2\} - A^1) \qquad (3.5) \\ &\quad s.t.\, (1 - p\beta)b \leq \alpha v - pF_C. \end{aligned}$$

The constraint guarantees that there is a non-negative license demand for bribing. The result of $Min\{1, A^2\}$ depends on the value of r and therefore the solution to this bribe income maximizing problem is a piece-wise function:

$$b^*(r) = \begin{cases} \frac{\alpha r + p(F_B - F_C)}{2(1-p\beta)}, & if\, 0 \leq r < r_1^* = \frac{2v - pF}{2-\alpha}; \\ \frac{v-(1-\alpha)r - pF_C}{(1-p\beta)}, & if\, r_1^* \leq r \leq r_2^* = \frac{(2-\alpha)v - pF}{2(1-\alpha)}; \\ \frac{\alpha v + p(F_B - F_C)}{2(1-p\beta)}, & otherwise. \end{cases} \tag{3.6}$$

These three cases are defined as small-, middle-, large-r, with bribe income π_s, π_m and π_l respectively. Therefore, when there are no intermediaries in the market, the bureaucrat just needs to decide the equilibrium bribe b^* based on a given length of the licensing procedure. It is easy to find out how b^* changes in response to r in different range. For small values of r, $\frac{\partial b^*}{\partial r} > 0$; for intermediate values of r, $\frac{\partial b^*}{\partial r} < 0$; for large values of r, $\frac{\partial b^*}{\partial r} = 0$. Besides, b^* is rising in α no matter what r is. Intuitively, in the small-range of r, optimal bribe is such that clients with higher time costs choose to bribe. The longer the procedure is, the more they would like to pay. In the middle-range, the bureaucrat set the equilibrium bribe such that client with the highest time cost is indifferent between bribing and giving up the license. As a result, b^* in this range is decreasing in r. The results can be summarized in the following lemma:

Lemma 3.1. *In a direct corruption game with a given procedure length r, the equilibrium bribe b^* is depending on the value of r. There are three ranges for r: small, middle and large. In the small and middle range b^* is increasing and decreasing in r, while it is irrelevant to r in the large range. Irrespective of r, b^* is increasing in α, the fraction of time costs that bureaucrats can remove.*

3.2.3 Equilibrium with an Intermediary

Now we discuss the game in which clients can either bribe directly or use an intermediary, in addition to the regular procedure. Let u_I denote the expected payoff for the client if an intermediary is used. Recall that a fixed fee f has to be paid to hire an intermediary. Therefore, irrespective of A_i, any clients using an intermediary can get the following profit:

$$u_I = v - f. \tag{3.7}$$

The threshold between bribing and using an intermediary can be given by solving $u_I = u_b$, i.e., (3.7) = (3.2). Denote it as A^3 and clients with complexity above it will use an intermediary, i.e.,

$$A_i \geq A^3 = \frac{f - (1 - p\beta)b - pF_C}{(1 - \alpha)r}. \tag{3.8}$$

As the intermediary's fee cannot be larger than the license value, even clients with high A_i will always get the license, irrespective of r. We can therefore write the demand for intermediaries as $1-A^3$, and the demand for direct bribing as A^3-A^1. Using backward induction, the intermediary's problem is firstly solved to determine the optimal fee, and then the bureaucrat, taking it as given, chooses equilibrium bribe rates to maximize his expected bribe income.

3.2.3.1 The intermediary's problem

An intermediary can be hired by the client to interact with the bureaucrat if a fixed commission fee f is paid. The fee is set by the intermediary to maximize his profit which is denoted as π_I. Therefore, the intermediary solves the following problem:

$$\underset{f}{Max}\, \pi_I = (f - b_I)(1 - A^3). \tag{3.9}$$

It is maximized when

$$f^* = \frac{(1-\alpha)r + b_I + (1-p\beta)b + pF_C}{2}. \tag{3.10}$$

As the above formula shows, given procedure length r, punishment structure (p, β, F_C) and the bureaucrat's discretionary power α, the optimal intermediary's fee is a function of bribe rates b and b_I. Clearly, f^* is positively related to these bribes. Next we analyze the bureaucrat's problem to work out the equilibrium bribe rates so that we can get the exact f^*.

3.2.3.2 Bureaucrat's problem

When it is feasible to use an intermediary, the bureaucrat, taking the procedure length r as given, chooses b and b_I to maximize his bribe income (denoted by Π) from direct and indirect demand:

$$\underset{b,\, b_I}{Max}\, \Pi = ((1-p\beta)b - pF_B)(A^3 - A^1) + b_I(1-A^3) \tag{3.11}$$
$$s.t.\ f \leq v,\ (1-p\beta)b \leq \alpha f - pF_C.$$

The constraints are that the intermediary's fee cannot exceed the license value, and that the demand for direct bribing is not negative even when the intermediary exists.

Substituting the optimal intermediary fee f^* from equation (3.10) into A^3 from equation (3.8) derives:

$$A^3 = \frac{(1-\alpha)r + b_I - (1-p\beta)b - pF_C}{2(1-\alpha)r}. \tag{3.12}$$

Plug A^1 and A^3 from equation (3.3) and (3.12) into the bribe income maximizing problem (3.11) and solve the first order condition $\frac{\partial \Pi}{\partial b} = 0$. We get:

$$b^* = \frac{\alpha(1-\alpha)r + 2\alpha b_I + (\alpha - 2)p(F_C - F_B)}{2(2-\alpha)(1-p\beta)}. \tag{3.13}$$

It shows that the optimal direct bribe b^* is a function of the indirect bribe b_I, and it's easy to have $\frac{\partial b^*}{\partial b_I} = \frac{\alpha}{(2-\alpha)(1-p\beta)}$. Based on this, the optimal bribe rate set for the intermediary can be derived by solving $\frac{\partial \Pi}{\partial b_I} = 0$, and it is:

$$b_I^* = \frac{r}{2}. \tag{3.14}$$

It turns out that the optimal indirect bribe b_I^* is only related to the procedure length r. The intuition is that the intermediary has perfect information about how the procedure works and faces no risk of being detected such that the bribe set for him is not affected by α , the fraction of time costs that the bureaucrat can remove, and the punishment parameters (p, β, F_C). Consequently, the optimal bribe rate set for an intermediary is a constant for a given procedure.

Now, substituting b_I^* back into the formula of b^* (shown as (3.13)) gives us the equilibrium bribe paid by a client to the bureaucrat. That is:

$$b^* = \frac{\alpha r + p(F_B - F_C)}{2(1 - p\beta)}. \tag{3.15}$$

According to the above expression, the equilibrium direct bribe b^* is increasing in α, r, F_B and β, but decreasing in F_C. Intuitively, the longer the procedure is, the more time costs can be removed and the more penalty is on the bureaucrat, the higher bribe is set for clients. In addition, we are interested in analyzing how b^* changes with respect to p :

$$\frac{\partial b^*}{\partial p} = \frac{\alpha\beta r + (F_B - F_C)}{2(1 - p\beta)^2},$$
$$\frac{\partial^2 b^*}{\partial p^2} = \frac{\beta(\alpha\beta r + (F_B - F_C))}{(1 - p\beta)^3}.$$

According to the assumption that $F_B \geq F_C$, both the first and second derivatives are weakly positive. Particularly, they are positive under asymmetric punishment, meaning that a higher detection probability leads to a lager size of the equilibrium direct bribe.

The equilibrium license fee charged by an intermediary now can be given by substituting b^* and b_I^* back into the equation (3.10), and it is:

$$f^* = \frac{(3 - \alpha)r + pF}{4}. \tag{3.16}$$

The optimal intermediary's fee is increasing in the procedure length r and the total expected punishment pF, but is decreasing in α, the fraction of time costs that the bureaucrat can remove. The more an intermediary can facilitate the licensing procedure, the higher fee he will charge to clients.

We thereby get the following lemma:

Lemma 3.2. *For a given procedure length r, penalty structure (p, β, F_C, F_B), fraction of removed time costs α, in a corruption game with a monopolist intermediary: 1) the equilibrium indirect bribe set for the intermediary is only related and proportional to r; 2) the equilibrium direct bribe set for clients is increasing in r, α, F_B, β and p, but decreasing in F_C; 3) the optimal intermediary's fee is increasing in r, F_c, F_B and p, but decreasing in α.*

So far, for a given licensing procedure, we get the the equilibrium outcome (b^*, b_I^*, f^*) of a "bribe and intermediary" game when the detection probability is exogenous. Next we study the equilibrium of the game when the bribery detection is endogenous under asymmetric punishment.

3.3 Endogenous Bribery Detection Probability

In this section, the detection probability can be raised through whistle-blowing by clients. With this endogenous detection probability, we study how asymmetric punishment affects the equilibrium outcome of this corruption game in presence of intermediaries. Asymmetric punishment, as the name implies, means that penalties on bribe giver and taker are different when corruption is caught. As an anti-corruption policy instrument, it works by creating an ex-post incentive for the players to stop colluding which is an important reason why corruption is hard to detect.

Particularly, in this paper we focus on perfectly asymmetric punishment regime suggested in Basu's proposal[4]. It means that all the punishment is imposed on the bureaucrat and all the bribe received needs to be returned to the client. Therefore, we write a perfectly asymmetric punishment as $F_B > F_C = 0$ and $\beta = 1$.

3.3.1 Whistle-blowing Cost Function

When whistle-blowing is feasible, clients can choose to report bribery by incurring a cost in terms of time and money such that p can be increased to a certain level. The cost is a function of p and denoted as $c(p)$. Notice that endogenizing the detection probability does not affect the optimal indirect bribe because the intermediary always stays bribed as assumed. We instead analyze how it affects the optimal choice of direct bribe and intermediary fee under asymmetric punishment.

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 the client through whistle-blowing at a cost $k > 0$. Therefore the cost function can be written as:

$$c(p) = \begin{cases} 0, & if\, p = \underline{p}; \\ k, & if\, p = \overline{p}. \end{cases} \tag{3.17}$$

We assume that direct corruption cannot be eliminated with the benchmark detection probability $\underline{p}$. Clients make their whistle-blowing decision by comparing the corresponding benefits and costs. Bribe rate is still chosen by the bureaucrat to maximize his bribe income, taking the endogenous detection probability into account. Therefore, when p is endogenous, the equilibrium direct bribe and optimal report decision are the best response to each other such that $b^* = b^*(p^*)$ and $p^* = p^*(b^*)$.

[4]In the following sections, we refer it as asymmetric punishment.

3.3.2 Equilibrium

In order to characterize the equilibrium when the detection probability is endogenous, the whistle-blowing cost should be incorporated into client's expected payoff function for direct bribing:

$$u_b(p) = v - (1 - p\beta)b - (1 - \alpha)rA_i - pF_C - c(p). \tag{3.18}$$

The expected payoff for clients from hiring an intermediary is the same as before. Using the similar method, we can have the following equilibrium outcomes:

$$b_i^* = \frac{r}{2}; \tag{3.19}$$

$$b^*(p^*) = \frac{\alpha r + p(F_B - F_C) - c(p)}{2(1 - p\beta)}; \tag{3.20}$$

$$f^*(p^*) = \frac{(3 - \alpha)r + pF + c(p)}{4}. \tag{3.21}$$

Compared to the model with exogenous bribery detection, we find that the equilibrium bribe paid by the intermediary to the bureaucrat does not change. This is because the interaction between them is irrelevant to the detection probability and therefore the possibility of whistle-blowing. However, the optimal intermediary's fee rises if the client chose to whistle-blow under asymmetric punishment. With an increased corruption detection probability, the intermediary offers more protection such that he would like to set a larger fee. For the equilibrium bribe paid by the client to the bureaucrat, how its size changes in p is depending on the magnitude of the whistle-blowing cost k. It is increasing in p for a small and intermediate k, but decreasing in p for a large k. In other words, if clients chose to report, the optimal direct bribe size rises when whistle-blowing is relatively cheap, otherwise it drops.

In addition, allowing a costly whistle-blowing can affect the distribution of license demands for direct bribing and the intermediary. From the above analysis in a game with intermediaries, we know that clients with complexity from A^1 to A^3 choose to bribe directly, and those beyond A^3 prefer using an intermediary. Based on the equilibrium bribe rates derived above (shown as (3.19) and (3.20)), the specific values for these thresholds can be worked out when the detection probability p is endogenous:

$$A^1(p) = \frac{1}{2} + \frac{pF + c(p)}{2\alpha r}, \tag{3.22}$$

$$A^3(p) = \frac{3}{4} - \frac{pF + c(p)}{4(1-\alpha)r}. \tag{3.23}$$

Given the procedure length r, the fraction of time costs that bureaucrats can remove α, and the total penalty F, the value of A^1 and A^3 depends on the detection probability p. In order to analyze how asymmetric punishment affects the demand for bribing and the intermediary, we need to find out the optimal whistle-blowing decision p^* under this punishment scheme.

Asymmetric punishment

Under asymmetric punishment, the client 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 the client choose $p^* = \overline{p}$. Based on equation (3.18), solving $u_b(\overline{p}) > u_b(\underline{p})$ yields the best response function $p^*(b)$. Therefore, for any b to the client:

$$p^*(b) = \begin{cases} \overline{p}, & if\, b > \frac{k}{\overline{p}-\underline{p}}, \\ \underline{p}, & otherwise. \end{cases} \tag{3.24}$$

If $b^*(\underline{p})$ is paid, the client should prefer not to report ($p^*(b^*(\underline{p})) = \underline{p}$). Combining (3.20) and (3.24), an equilibrium ($\underline{p}$, $b^*(\underline{p})$) exists if

$$k > k_L = \frac{(\alpha r + \underline{p}F_B)(\overline{p} - \underline{p})}{2(1-\underline{p})}. \tag{3.25}$$

If $b^*(\bar{p})$ is paid, direct corruption should leave clients with positive surplus at the high detection probability, and the the client should prefer to whistle-blow. An equilibrium $(\overline{p},\, b_c^*(\overline{p}))$ exists if

$$k < k_H = \frac{(\alpha r + \overline{p}F_B)(\overline{p} - \underline{p})}{2 - (\overline{p} + \underline{p})}. \tag{3.26}$$

It is easy to verify that $k_L < k_H$. Let $\widetilde{p}$ denote the detection probability above which there will be no direct corruption. This establishes the following results: 1) If $\bar{p} <\widetilde{p}$, direct corruption survives. A unique equilibrium $(\overline{p},\, b_c^*(\overline{p}))$ exists if $k < k_L$, a unique equilibrium $(\underline{p},\, b^*(\underline{p}))$ exists if $k \geq k_H$, and there will be two equilibria if $k \in [k_L,\, k_H)$. 2) If $\bar{p} \geq \widetilde{p}$, a unique equilibrium $(\underline{p},\, b^*(\underline{p}))$ exists if $k > k_L$, and otherwise the license is awarded without a bribe in the direct corruption game.

Therefore, asymmetric punishment can eliminate direct corruption only if the whistle-blowing is cheap and effective, otherwise it either has no impact or makes bribery persist with a larger bribe size. According to equation (3.22) and (3.23), $A^1(\bar{p}) > A^1(\underline{p})$ and $A^3(\bar{p}) < A^3(\underline{p})$. It means that, if bribery persists with whistle-blowing, the license demand for direct bribing is less while that for the intermediary is more, compared to base model in which p is exogenous. Specifically, the direct and indirect license demand through bribery are:

$$A^{3-}A^1 = \frac{1}{4} - \frac{(2-\alpha)(pF + c(p))}{4\alpha(1-\alpha)r}, \tag{3.27}$$

$$1 - A^3 = \frac{1}{4} + \frac{pF + c(p)}{4(1-\alpha)r}. \tag{3.28}$$

The total demand through corruption is thus the sum of the those two, which is:

$$1 - A^1 = \frac{1}{2} - \frac{pF + c(p)}{2\alpha r}. \tag{3.29}$$

Obviously, it is decreasing in p. As a result, the total demand through bribery drops when asymmetric punishment encourages clients to report in the bribe and intermediary game. The results can be summarized in the following proposition.

Proposition 3.3. *For a given procedure, in a corruption game with a monopolist intermediary, the license demand for direct bribing drops, the demand for the intermediary rises, and the total demand through bribery decreases if direct corruption persists with whistle-blowing under asymmetric punishment.*

The interpretation of the proposition is straightforward. When asymmetric punishment leads to an increased detection probability and a larger direct bribe rate, using an intermediary which will not be detected becomes more attractive. Even clients can get more bribe recovery at a high detection probability, the whistle-blowing cost involved reduces the surplus from bribing. Therefore, the surplus difference between getting the license through regular procedure and through bribing becomes smaller, leading to a higher threshold above which clients would like to pay a bribe.

3.4 Endogenous Procedure Length

In the above analysis, we take the procedure length r as given. We are now interested in finding out what will happen if it can be determined by the bureaucrat. As the bureaucrat is the monopolist along the licensing procedure, it is reasonable to assume that there are incentives for him to create red tape. In this case, we examine how asymmetric punishment affects the optimal length in a setting with and without the intermediary, allowing clients to whistle-blow.

3.4.1 Without the Intermediary

When the procedure length can be chosen by the bureaucrat, the bribe income maximizing problem becomes:

$$
\begin{aligned}
&\underset{b,\,r}{Max}\,\pi = ((1-p\beta)b - pF_B)(Min\{1,\, A^2\} - A^1) \qquad (3.30)\\
&s.t.(1-p\beta)b \leq \alpha v - pF_C - c(p).
\end{aligned}
$$

Compared to a the bureaucrat's problem in the direct corruption game with given procedure, the only difference is that r is now a choice variable. Recall that there are three cases for r when it is exogenous. To determine in which range the bribe income is maximized, we need to figure out how bribe income changes in r in each range. Substituting the corresponding b^* into the profits function (3.5), we can solve the corresponding bribe income in the small and large case as follows:

$$
\pi_s = \frac{(\alpha r - pF - c(p))^2}{4\alpha r}, \qquad (3.31)
$$

$$
\pi_l = \frac{(\alpha v - pF - c(p))^2}{4\alpha(1-\alpha)r}. \qquad (3.32)
$$

Solving the first order conditions of them with respect to r derives:

$$
\frac{\partial \pi_s}{\partial r} = \frac{(\alpha r)^2 - (pF + c(p))^2}{4\alpha r^2}, \qquad (3.33)
$$

$$
\frac{\partial \pi_l}{\partial r} = -\frac{(\alpha v - (pF + c(p))^2}{4\alpha(1-\alpha)r^2}. \qquad (3.34)
$$

It is clear that π_l is decreasing in r. However, the sign of $\frac{\partial \pi_s}{\partial r}$ depends.

First, if $\alpha r > pF + c(p)$, it is positive and π_s is increasing in r. In this case, the bribe income is maximized in the middle range, that is, when $A^2 = 1$. As a result, we can get the optimal choice of the procedure length by solving $\frac{\partial \pi_m}{\partial r} = 0$ and it is[5]:

$$r^* = (\frac{v(v - pF - c(p))}{1-\alpha})^{\frac{1}{2}}. \tag{3.35}$$

It is certain that $\pi(r^*)$ is the maximized bribe income for the bureaucrat as $\frac{\partial^2 \pi(r^*)}{\partial r^2} = \frac{-2v(v-pF-c(p))}{\alpha r^3} < 0$. If direct corruption persists with whistle-blowing under asymmetric punishment, the increased detection probability ($p = \bar{p}$) and the report cost ($c(p) = k$) incurred lead to a smaller r^*. It indicates that asymmetric punishment is effective in reducing the red tape in a direct corruption game if it does encourage clients to report.

Second, if $\alpha r \leq pF + c(p)$, $\pi_s = \frac{(\alpha r - pF - c(p))^2}{4\alpha r} \leq 0$. The bureaucrat thereby will not consider choosing a small-r in this case. As $\pi_m(r_2^*(p)) = \pi_l(r_2^*(p))$ and π_l is decreasing in r, we know that the bribe income is still maximized in the middle range[6]. The optimal length is still shown as (3.35).

3.4.2 With the Intermediary

In the presence of the intermediary, the bribe income maximizing bribe rates and intermediary's fee are unique as shown in equation (3.19), (3.20) and (3.21). Based on the equilibrium ($b^*(p^*)$, b_I^*, $f^*(p^*)$) when whistle-blowing is possible, the bureaucrat's bribe income Π can be simplified into the following formula:

$$\Pi = \frac{(1+\alpha)r}{8} - \frac{2(\alpha-1)(pF + c(p))}{8(1-\alpha)} + \frac{(2-\alpha)(pF + c(p))^2}{8\alpha(1-\alpha)r}. \tag{3.36}$$

The optimal length of the procedure can be then given by solving $\frac{\partial \Pi}{\partial r} = 0$. To distinguish it with the optimal procedure length r^* in the direct corruption game, we denote it in

[5] $\pi_m = \frac{-(1-\alpha)r^2 + (2-\alpha)vr - (pF + c(p))r - (v^2 - pFv - c(p)v)}{\alpha r}$.

[6] $r_2^*(p) = \frac{(2-\alpha)v - pF - c(p)}{2(1-\alpha)}$. At $r_2^*(p)$, $\pi_m = \pi_l = \frac{(\alpha v - pF - c(p))^2}{2\alpha((2-\alpha)v - pF - c(p))}$.

this game as r_I^*. The solution is:

$$r_I^* = (\frac{2-\alpha}{\alpha(1-\alpha^2)})^{\frac{1}{2}}(pF + c(p)). \tag{3.37}$$

It shows that r_I^* is positively related to the total expected punishment pF and the whistle-blowing cost $c(p)$. As a result, under asymmetric punishment, if direct corruption persists with whistle-blowing such that a positive report cost k is incurred and the detection probability is raised to $\bar{p}$, the equilibrium procedure length r_I^* goes up. It indicates that the bureaucrat tends to create more red tape under this condition. Combining the result in the above subsection, we learn that, if asymmetric punishment results in survived bribery with whistle-blowing, it is effective in reducing red tape in a direct corruption game, but it has an adverse effect if there exists a monopolist intermediary. This develops a main proposition as follows:

Proposition 3.4. *Under asymmetric punishment, if direct corruption persists with whistle-blowing, the bureaucrat implements less red tape in a bribe only game, but more red tape in a game with a monopolist intermediary.*

Now we discuss the proposition intuitively. In a bribe only game, if clients chose to raise the detection probability with which the direct corruption cannot be eliminated, the bureaucrat is facing a higher probability to be punished. As a result, the bureaucrat needs more compensation in terms of a larger bribe and a smaller time saving offered to clients. Given the fraction of time costs that the bureaucrat can remove, he can only reduce the procedure length to maximize his bribe income. In a bribe and intermediary game, taking a bribe from the intermediary can protect the bureaucrat from detection and punishment under asymmetric punishment when whistle-blowing is feasible. Therefore, if the detection probability is raised by the client, taking direct bribe is more costly for the bureaucrat. He just turns to capture the surplus through the intermediation activities by making the licensing procedure longer.

3.5 Conclusion

This paper examines the efficacy of asymmetric punishment in reducing corruption when a monopolist intermediary exists. In the model, clients interact with the bureaucrat by themselves or by hiring the intermediary, applying for a government license which can bring a benefit to them. They can only get the license by going through a procedure to make sure all the regulations are satisfied. Complexity of figuring out how this licensing procedure works varies across clients. It is also positively related to the procedure length. First, the length is assumed to be given and we compare the equilibrium in a model with exogenous and endogenous bribery detection probability. Next, it is supposed to be chosen by the bureaucrat and we explore incentives of the bureaucrat to create red tape.

For a given procedure, endogenizing the detection probability under asymmetric punishment does not affect the equilibrium indirect bribe rate. This is because we assume that the intermediary will not be caught for bribing. However, the license demand through bribery is affected. When direct corruption persists with whistle-blowing under asymmetric punishment, the incidence of total corrupt activities drops while the use of the intermediary increases. If now the bureaucrat can choose the procedure length, he just implements more red tape to capture the benefits. However, if the intermediary does not exist in the same situation, the bureaucrat implements less red tape. To sum up, if asymmetric punishment results in a persisting direct corruption with whistle-blowing, it is effective in reducing red tape in a bribe only game, but it is counterproductive in a bribe and intermediary game.

A natural extension is to relax the assumption by making the intermediated corruption detectable. If so, getting a license through the intermediary generates a lower surplus. The demand for the intermediary would be decreased, and the bureaucrat could just capture less surplus from the intermediation corruption so that the procedure length can not be extended by such a large amount. Besides, the model can be extended by assuming that the license value is private information for clients. It is also interesting to take non-harassment bribery into account and study the the impact of asymmetric punishment on clients' choice of bribe type in the presence of intermediaries.

Chapter 4

Strategic Analysis of Petty Corruption with Entrepreneur and Multiple Bureaucrats

4.1 Introduction

Corruption, defined normally as the abuse of public office for private gain, is a major concern in many countries because it could have substantial consequences. A recent estimate says that the annual cost of bribery is roughly 2 percent of global GDP, and therefore the overall economic and social costs of corruption could potentially be even larger (see IMF survey, 2016). In addition, the existing voluminous literature (see reviews by Andvig 1991; Ades and Di Tella 1996; Bardhan 1997; Lambsdorff 1999; Aidt 2003) tells that corruption is an important issue over time and across countries. It's been argued that corruption is harmful on the investment, economic growth and development.

This paper focuses on the game-theoretic analysis of "petty corruption" of which the harmful effects on economic growth has been emphasized by policy makers at top level (see Jalan, 2005). Petty corruption occurs when relative low level bureaucrats demand small bribes in exchange for providing permits, licenses and approvals to private citizens, which is more pervasive in developing countries compared to developed ones. However, it is crucial to note that the term "petty" here just refers to bribe size and not to its total effect on the efficiency and welfare of many developing countries.

In addition, an important feature of the transaction between the citizens and the bureaucrats in developing economies is the system of multiple approvals. Lambert-Mogiliansky et al. (2007, to be referred as L-M-R) took it into account and developed a game-theoretical model which is rarely used in this area to investigate petty corruption with the entrepreneur and a track of bureaucrats. By modeling the structure of bureaucratic sequence and the information flows among players, as the first theoretic analysis, their paper shows that: no project, of which the value is uniformly distributed over $[0, 1]$, ever gets approved in a one-shot situation; while in an infinitely repeated game, trigger strategy profile (TSP) which can trigger the one-shot game result once a defection happens is an equilibrium if bureaucrat's discount factor δ is sufficiently large. Following by this, Seung Han Yoo (2008) explores further and shows that the result can be generalized on the continuous distribution function over $[0, 1]$.

Different from their study, the multiple bureaucrats in this paper are approached simultaneously rather than in a specified order. In other words, the entrepreneur apply to the bureaucrats simultaneously to obtain approvals which are required to operate the project. It is common in developing countries that starting a project needs multiple permits from different departments at the same time. For example, to obtain a business license for opening a restaurant, the entrepreneur needs to get several approvals simultaneously on hygiene, fire safety, environmental compliance and so on. Due to the take-it-or-leave-it rule, bureaucrat's threat to an entrepreneur of blocking up her project is credible enough, and she will pay the bribe as long as the project value is greater than the total bribe.

To deter corruption, we introduce legal recourse into the model: the entrepreneur can appeal the bureaucrat's non-approval decision by incurring a fixed cost in terms of money and time and then get her project approved. With the legal recourse, a rational bureaucrat would never ask a bribe bigger than the legal cost, otherwise the entrepreneur will refuse to pay and report his non-approval decision such that he will receive a zero payoff. For simplicity sake, we assume that the entrepreneur can provide enough evidence to prove that the project is qualified and the bureaucrats block it just because bribes are not paid. That is to say, the appeal will be definitely successful.

Starting with a benchmark one-stage game without legal recourse, we find that there exist multiple equilibria in which the project is approved. We then allow the entrepreneur to appeal in the event of non-approval. In this modified one-shot game, there are still multiple equilibria among which the legal cost is the worst one. Next we analyze an infinitely repeated game in which an assumption about the information flows is added: the players will know the transaction history with one-period delay. If a defection happened, the bureaucrats will know it in the beginning of next period and play the worst equilibrium of one-shot game in all the subsequent periods. It turns out that there are also many eqilibria in this repeated game. We focus on one class of the extreme equilibria called "bribe-income-maximizing-equilibrium (BIME)" which maximize the expected bribe income of the bureaucrat. Interestingly, the results show that BIME is decreasing in the legal cost within a certain range in the repeated game. However, when the legal cost is reduced to a very low level, BIME is positively related to the legal cost as the government efficiency is high enough.

Section 4.2 presents a benchmark model without legal recourse in the form of one-stage game, showing that there exist multiple equilibria. Legal recourse is introduced in section 4.3 to enrich the benchmark case. The results show that legal cost is the worst equilibrium bribe in one-stage game, and more importantly, BIME is not unambiguously positively related to the legal cost in an infinitely repeated game. In section 4.4, we characterize the equilibrium in a sequential petty corruption game and compare it with that in the simultaneous game. Concluding remarks and policy implication are given in the last section.

4.2 Benchmark Model

In the benchmark model, we analyze a one-stage game without legal recourse to fight corruption. The players consist of an entrepreneur (E) and $N(\geq 2)$ bureaucrats (Bs). E has a project of which the potential value is her private information. In order to make the project approved and then its value realized, E has to apply to the multiple bureaucrats simultaneously and obtain approvals from all of them. It's assumed here that the project is qualified to get the permits but Bs are corrupt. As a condition of approval, every bureaucrat demands a positive bribe when E applies to him. Moreover, as there is no order among Bs and symmetric equilibrium is focused on, the bribe rate set by every bureaucrat is the same on the equilibrium path. If E cannot receive all the required approvals, the project cannot go through and its value will not be realized.

The extensive form of this game can be formally described as follows: E has a project of which the potential value is denoted by $V\ (> 0)$ and its realized value is only known to E at the beginning of the game. However, its probability distribution is common knowledge, which is uniformly distributed on $[0, 1]$. Applying to each bureaucrat could incur a cost for E, but it makes no difference to the main result and we normalize it to 0. Therefore, E applies to Bs simultaneously without paying an application cost. Let $b\,(> 0)$ denote the symmetric bribe asked by each bureaucrat on a "take-it-or-leave-it" basis. After applying to Bs, E learns the actual magnitude of bribes demanded to exchange permits she is entitled to have. We assume that no bureaucrat knows the actual bribes asked by others. If E refuses to pay, the application is turned town and the game ends.

In the benchmark analysis, the bureaucrat's threat to E of blocking up her project if the bribe is not paid is perfectly credible. This is because the bureaucrats have the full bargaining power and there is no legal recourse for E to appeal non-approval decisions. Consequently, E will pay the bribes if V exceeds the total bribe demanded, otherwise she will lose the project. This is called the normal behavior of the entrepreneur in the benchmark case.

Here is the timeline of the game:

Time 1. "Nature" determines the project value V, and E learns the magnitude.

Time 2. E applies to all Bs simultaneously and is asked a positive bribe by each of them.

Time 3. E observes the actual bribes demanded and then decides whether to do the project or not.

Let $p \in \{0, 1\}$ denote the entrepreneur's strategy of whether or not to do the project. Specifically, $p = 1$ presents that E does pay the bribe and refers to the situation where the project value is bigger than the total bribe being asked by all the bureaucrats, and

$p = 0$ otherwise. On the other hand, the strategy for each bureaucrat is the magnitude of bribe he demands. If the bribes are paid, the payoff for E is the project value less the total bribe, and for the bureaucrat it is just the bribe demanded. Let u_E and u_B denote the payoffs for the entrepreneur and each bureaucrat, and they are:

$$u_E = p(V - Nb), \tag{4.1}$$

$$u_B = pb \tag{4.2}$$

Equilibrium

In a Nash equilibrium, no one can increase his or her expected payoff by defecting unilaterally. In this petty corruption game, we define a defection happens when a bribe charged is larger than the symmetric equilibrium bribe b. Suppose a bureaucrat considers defecting at a bribe b' $(> b)$, E is willing to do the project if and only if her project value is still bigger than the new total bribe, that is, if $V > b' + (N-1)b$.

Hence b' maximizes

$$b' \frac{1-(N-1)b-b'}{1-Nb},$$

and the solution is:

$$b' = \frac{1-(N-1)b}{2}. \tag{4.3}$$

The bureaucrat will only defect if the above bribe b' is larger than the initial symmetric equilibrium bribe b. So, the optimal bribe is maximum of those two:

$$b' = max\left\{\frac{1-(N-1)b}{2}, b\right\}. \tag{4.4}$$

We can easily derive a critical value $b = \frac{1}{N+1}$ beyond which the defection can be deterred. Therefore, there are multiple equilibria in the benchmark one-stage game. It can be summarized in the following proposition.

Proposition 4.1. *When legal recourse is infeasible, in a one-stage petty corruption game with an entrepreneur and multiple bureaucrats, there exist multiple equilibria if symmetric bribe* $b \geq \frac{1}{N+1}$.

According to L-M-R (2007), the null strategy profile (no E applies to Bs) is an equilibrium of the one-stage petty corruption game under sequential regime. It's quite different from what we get in Proposition 1, meaning that whether the bureaucrats are set in order is really important to the results. Moreover, we are interested in knowing what the equilibrium will be in a model where legal recourse is considered, and it is analyzed in the next section.

4.3 Legal Recourse against Non-approval Decisions

As we can see from the benchmark model, take-it-or-leave-it rule gives Bs full bargaining power, making their threats of holding up the project credible if bribes are not paid. However, the credibility of these threats still depends on whether there is legal recourse with which E could apply in the event of non-approval. It is introduced in this section.

This modified model sets up the legal recourse as follows: if any permit is denied, E can appeal the bureaucrat's non-approval decision to a certain government department by incurring a legal cost denoted as L. As we focus on the harassment bribery where the project is qualified to be approved and E can prove this fact with enough evidence, it is reasonable to assume that the appeal will be successful and the project can proceed afterwards. In this section, we analyze the equilibrium outcome of the one-shot game in this modified model. Moreover, we investigate how would the equilibrium bribe change as the legal cost decreases in the long run.

4.3.1 A One-stage Game

In the modified game with legal recourse, timeline of the story is the same except that the legal cost L is given and known to everyone in the first place. As a result, the strategies for E and Bs are different from those in the benchmark model. For the entrepreneur, she will only pay a bribe which is less than the legal cost. The reason is straightforward: E would rather appeal than paying a bribe which exceeds the legal cost because this makes her project approved with a lower cost. At the same time, the appeal will result in a zero payoff to the relevant bureaucrat. Therefore, for each bureaucrat, the bribe demanded cannot be larger than the legal cost. As a consequence, we get a constraint to the bribe, i.e., $b \in (0, L]$. Importantly, if L is too large to afford, legal recourse would be useless and that's not the case we are interested in. Instead we focus on the situation where E who has the largest project value can afford the cost to appeal all Bs. Hence, we restrict that the legal cost cannot be more than $\frac{1}{N}$, i.e., $L \leq \frac{1}{N}$.

Recall that there are the multiple equilibria if $b \geq \frac{1}{N+1}$ in the benchmark analysis. In the modified model, the existence of legal recourse requires that the bribe asked cannot be more than the legal cost. Consequently, if $L \geq \frac{1}{N+1}$, there exists multiple equilibria which lie in a close interval $[\frac{1}{N+1}, L]$; if $L < \frac{1}{N+1}$, the defection will take place because $b \leq L < \frac{1}{N+1}$, and the defection bribe is the minimum of the legal cost and the best response bribe shown as formula (4.3). In the case where multiple equilibria exist, the worst bribe is the legal cost L because it is the upper bond of the bribe can be demanded by bureaucrats. Therefore, the equilibrium of a modified one-shot game can be summarized as follows:

Corollary 4.2. *In a one-stage petty corruption game with legal recourse, there exist multiple equilibria which lie in the interval* $[\frac{1}{N+1}, L]$. *The legal cost* L *is the worst* *equilibrium among them.*

Recall that a defection happens if $b < \frac{1}{N+1}$ and the best deviation bribe has been shown as formula (4.3) in the benchmark model. However, when legal recourse is feasible, the bribe cannot be larger than L as we mentioned above. Denote $b_m^{'}$ as the best response for the bureaucrat who plans to defect in the modified model, and it is:

$$b_m^{'} = Min\left\{\frac{1-(N-1)b}{2},\ L\right\}, \tag{4.5}$$

which can be written as a piece-wise function:

$$b_m^{'} = \begin{cases} L & , if\ b \leq \frac{1-2L}{N-1}, \\ \frac{1-(N-1)b}{2} & , if\ b > \frac{1-2L}{N-1}. \end{cases} \tag{4.6}$$

It shows that the magnitude of deviation bribe $b_m^{'}$ depends on the value of b. When b is relatively small, the bureaucrat who would like to defect will ask a bribe to its upper bond L; when b is relatively large, he would insist on demanding the previous best deviation bribe. Furthermore, the cut-off value of b depends on the value of L. As the defection happens if $b < \frac{1}{N+1}$, we need to make sure both pieces in function (4.6) satisfy this condition. When $L \leq \frac{1}{N+1}$, the best response function is depicted as the first piece, and the defection condition is satisfied as $b < \frac{1}{N+1} \leq \frac{1-2L}{N-1}$; when $L > \frac{1}{N+1}$, the second piece shows up and the condition is also satisfied because $\frac{1-2L}{N-1} < b < \frac{1}{N+1}$.

4.3.2 A Repeated Game

Based on the results in the one-stage game, we can now characterize the equilibrium outcomes in a dynamic setting, and study the effects of reducing the legal cost on bribe size. It is found that there are also many equilibria in the repeated game and they are functions of the legal cost. Among these equilibria, we still focus on BIME which maximizes the expected bribe income of each bureaucrat. The results show that, for any discount factor δ, there exists a legal cost L such that BIME is decreasing in it. In other words, the efforts of government to improve its efficiency by decreasing the legal cost actually could end up with a larger size of BIME.

4.3.2.1 Set up

A repeated game here refers to a game which repeats the one-stage game infinitely, with a sequence of entrepreneurs and the same set of bureaucrats. Even though the entrepreneurs are different over periods, it's assumed here that the project values for them are independent and identically distributed ($i.i.d$). In this repeated game, Bs are trying to make their expected bribe income maximized by cooperation. Similarly, a defection happens if any bureaucrat demands a bribe that exceeds the symmetric equilibrium bribe in any period. An important assumption in the long run is that players will know all the transaction information with one-period delay. Consequently, if the cooperation is broken in a certain period, all the other Bs will learn it in the beginning of next period. Moreover, the defection will trigger the punishment phase in the following periods. That is, if and when a defection has occurred, all the bureaucrats will play the worst equilibrium strategy of one-shot game in all subsequent periods by asking a bribe which is equal to the legal cost.

The more formal description of the model is as follows:

Let $t \in [0, \infty)$ denote the infinite sequence of periods of the repeated game. Correspondingly, in period t, the entrepreneur is denoted by $E(t)$ and her potential project value is denoted by $V(t)$. The unit uniformal distribution of $V(t)$ is still common knowledge. Besides, the project values for all the entrepreneurs are independent and identically distributed along the sequence of periods. However, the realized value of $V(t)$ is private information to $E(t)$. In each single period t, $E(t)$ and Bs still play the one-stage game described in the proceeding subsection. Obviously, the corresponding notation for the action variables in repeated game are $p(t)$ and $b(t)$ for E and Bs respectively. The payoff for $E(t)$ is nothing different from that in the one-stage game because the entrepreneur changes from period to period; but for each bureaucrat, it is the sum of his discounted one-period payoff, where the common discount factor is denoted by $\delta \in (0, 1)$. Let $u_B(t)$ denote the expected payoff for each bureaucrat in the relevant period, and it can be expressed as:

$$u_B(t) = \sum_t \delta^t p(t)b(t). \tag{4.7}$$

The set of equilibria of this repeated game depends on what information the players have about previous history of the game. To this effect, the following assumption is made about the information flow among them.

Assumption 1. *In each period t, only the entrepreneur knows the project value and the actual amount of bribe demanded by each bureaucrat. All the players learn the history of the transactions with one-period delay such that everyone will know the defection (if any) in the beginning of the next period.*

4.3.2.2 Equilibrium

If a defection happened, it will be known in the next period and the punishment phase takes place. It means that all Bs will play the worst equilibrium strategy of one-stage game, demanding a bribe which is equal to the legal cost L. The expected payoff from a defection in an infinitely repeated game is therefore a function of the bribe and the legal cost, which is denoted as $G(b, L)$. Suppose the defection occurs in period 0, the payoff at that period can be solved by equation (4.6) - the best response function of defection in the modified one-stage game. In addition, the expected payoff for the subsequent periods is the sum of each period discounted payoff in terms of playing $b = L$. On the other hand, each bureaucrat's total expected payoff on the equilibrium path is just a function of the symmetric equilibrium bribe b, which is denoted as $F(b)$.

A defection will be deterred if the following condition is satisfied:

$$F(b) - G(b, L) \geq 0, \tag{4.8}$$

which is called the incentive constraint.

On the equilibrium path, the expected payoff $F(b)$ for a bureaucrat in the long run is the sum of discounted one-period payoff with discount factor δ. We define it as the normal total expected payoff for the bureaucrat and it can be written as

$$F(b) = \frac{b(1 - Nb)}{1 - \delta}. \tag{4.9}$$

Suppose a bureaucrat defects in period 0, his corresponding total expected payoff $G(b, L)$ is then the sum of defection payoff plus the punishment phase payoff. In any single period of the punishment phase, E will choose to do the project if and only if her project value is still bigger than the total bribe, i.e., $V > NL$. Given that deviation bribe $b_m^{'}$ is a piece-wise function as shown in equation (4.6), the long-term expected payoff for a bureaucrat from a defection will be the same. We can derive it as follows:

$$G(b, L) = \begin{cases} L\left[1 - (N-1)b - L\right] + \frac{1-\delta}{\delta}(1 - NL)L & , if\ b \leq \frac{1-2L}{N-1}, \\ \frac{(1-(N-1)b)^2}{4} + \frac{1-\delta}{\delta}(1 - NL)L & , if\ b > \frac{1-2L}{N-1}. \end{cases} \tag{4.10}$$

According to the graphs of $F(b)$ and $G(b, L)$ and incentive constraint (4.8), we find that there are many equilibria in the repeated game. Denote the two intersection points of curves of $F(b)$ and $G(b, L)$ as b_1 and b_2. The multiple equilibria just lie in the closed interval between them.

The two roots can be given by solving the binding incentive constraint $F(b) = G(b, L)$, and they are:

$$b_1 = L \text{ and } b_2 = \frac{1 - [1 + (N-1)\delta]\, L}{N}.$$

The above result can be summarized in the following proposition:

Proposition 4.3. *When legal recourse is feasible, in an infinitely repeated petty corruption game with a sequence of entrepreneurs with i.i.d project value and a set of bureaucrats, there exist multiple equilibria in which the project will be approved and they lie in the closed interval between b_1 and b_2.*

4.3.2.3 Effects of reducing legal cost on BIME

Now we investigate what BIME is among those many equilibria. In order to do so, the position of the roots has to be analyzed firstly. There are two possible outcomes: one is that the two roots are falling on either side of the peak of $F(b)$, and another one is that they are both on its right side. In the first case, BIME would be either b_1 or b_2, depending on which one is smaller. If b_1 is smaller, BIME is the legal cost because of the bribe constraint caused by the legal recourse; If b_2 is smaller, BIME will always be the peak ($\frac{1}{2N}$) of $F(b)$ as it generates the maximum bribe income for the bureaucrat. In other words, BIME will not be affected by the legal cost if b_2 is the smaller root when two roots falling on either side. In the second case where both roots lie in the downward side of $F(b)$, it is no doubt that the smaller one yields a higher expected payoff. Besides, the legal recourse determines that the bribe demanded can not exceed the legal cost L which is one of the roots. As a result, in this case, BIME is definitely the smaller root. Let b^* and b_s denote BIME and the smaller root respectively. The equilibrium in each case is depicted in the following figures.

Figure 4.1: Equilibrium in the first case

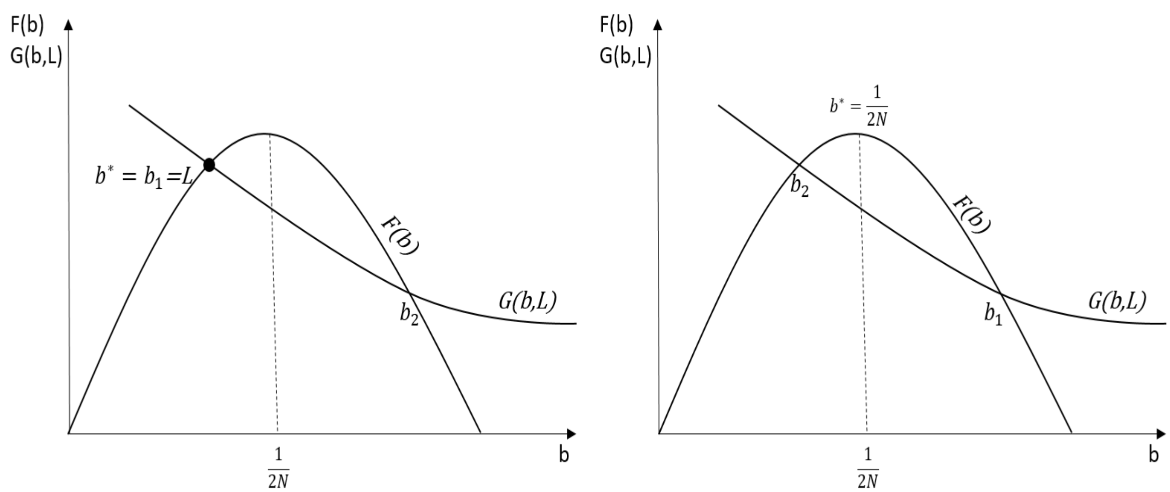
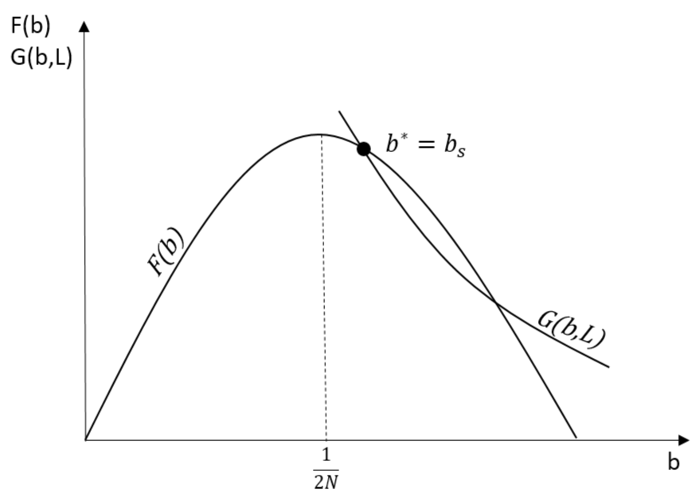


Figure 4.2: Equilibrium in the second case



In both cases, which root is smaller depends on the value of legal cost (L) if the number of bureaucrats (N) and discounter factor (δ) are given. We can then write b_s as a function of L:

$$b_s = \begin{cases} L, & if\ L \leq \frac{1}{(N+1)+(N-1)\delta}, \\ \frac{1-[1+(N-1)\delta]L}{N}, & otherwise. \end{cases} \tag{4.11}$$

It's no doubt that $b^* = b_s = L$ if the first piece shows up; otherwise the second piece takes place and the value of b^* depends on whether or not b_s is bigger than $\frac{1}{2N}$. If it is, $b^* = b_s$; if not, $b^* = \frac{1}{2N}$. Solving $b_s = \frac{1-[1+(N-1)\delta]L}{N} > \frac{1}{2N}$ gives a more specific range $(\frac{1}{(N+1)+(N-1)\delta}, \frac{1}{2[1+(N-1)\delta]}]$ in which BIME is changing inversely with the legal cost. Therefore, b^* can be expressed as a piece-wise function of L as follows:

$$b^* = \begin{cases} L, & if\ L \leq \frac{1}{(N+1)+(N-1)\delta}, \\ \frac{1-[1+(N-1)\delta]L}{N}, & if\ \frac{1}{(N+1)+(N-1)\delta} < L < \frac{1}{2[1+(N-1)\delta]}\ , \\ \frac{1}{2N}, & \frac{1}{2[1+(N-1)\delta]} \leq L \leq \frac{1}{N}. \end{cases} \tag{4.12}$$

Let L_1, L_2 denote the two cut-off values in the above function. Importantly, we need to make sure that the range (L_1, L_2) does exist, that is, L_1 is really less than L_2. The solution for the inequality $L_1 < L_2$ is $\delta < 1$, meaning the relationship between them is always true.

Correspondingly, the complete first order derivative of BIME with respect to the legal cost L can be given:

$$\frac{db^*}{dL} = \begin{cases} 1, & if\ L \leq L_1, \\ -\frac{1+(N-1)\delta}{N}, & if\ L_1 < L < L_2\ , \\ 0, & L_2 \leq L \leq \frac{1}{N}. \end{cases} \tag{4.13}$$

It shows that, if $L \in (0, L_1]$, BIME changes in the same direction in L with the same degree; if $L \in (L_1,\ L_2)$, BIME and L are negatively related, indicating that the size of BIME goes up if the legal cost drops; otherwise BIME does not response to the change of legal cost because it is too large to affect the equilibrium.

The following proposition can be summarized:

Proposition 4.4. *When legal recourse is feasible, in an infinitely repeated petty corruption game with a sequence of entrepreneurs and a set of bureaucrats, for any discount factor δ, there exists a legal cost L such that the bribe-income-maximizing-equilibrium (*BIME*) is decreasing in the legal cost L, i.e.,* $\forall \delta \in (0, 1), \exists L,\ s.t.\ \frac{db^*}{dL} < 0$.

Legal cost (L) itself is BIME when it is small. Decreasing L is just like cutting down the equilibrium bribe size. For a large L, the deviation payoff $G(b, L)$ is relative small such that bureaucrats just choose the bribe size to maximize $F(b)$ on the equilibrium path. Therefore, reducing L in this range will not affect BIME. However, when L is in a range of intermediate values, a reduced L can bring a relative higher expected payoff for defection because punishment phase becomes less threatening. As a consequence, a larger size of BIME is needed for bureaucrats to stay on the equilibrium path.

4.4 Comparison to a Sequential Corruption Game

As mentioned in the introduction, L-M-R (2008) investigated a sequential petty corruption game in which E applies to a set of Bs in a specified order. However, the legal recourse is not taken into account in their model. In this section, we introduce it into the sequential game and characterize the corresponding BIME of a repeated game. Next, the total expected bribe of the simultaneous and sequential game can be calculated and compared with different parameter values. In the end we conclude that under what conditions which regime – simultaneous or sequential – is preferred in terms of the amount of total bribe.

4.4.1 Equilibrium of a Sequential Repeated Game

In the sequential game, Bs are arranged in a prescribed order and they are denoted from the first one to the last as B_1, B_2, ..., B_N. Correspondingly, the bribe asked by B_n is b_n. Without legal recourse, L-M-R (2008) find that, in an infinitely repeated game, BIME for B_n is:

$$b_n = \frac{(1-\delta)(1-B_{n+1})^2}{4(1-B)}, \tag{4.14}$$

where $B_n = \sum_{m \geq n} b_m$, $B = \sum b_n$ and $\delta \in (0,1)$ is still the discount factor.

Now we introduce legal recourse for E to appeal the bureaucrat's non-approval decision in this sequential game. This requires that the bribe demanded by each bureaucrat cannot exceed the legal cost L such that BIME for B_n becomes the minimum of b_n and L, that is

$$b_n^* = Min\{\frac{(1-\delta)(1-B_{n+1})^2}{4(1-B)}, L\}. \tag{4.15}$$

It is obvious that b_n^* is increasing in n because B_{n+1} is decreasing in it. This means that the equilibrium bribes are increasing in n for any binding BIME. However, it is not always true when we take the legal recourse into consideration. Compared to the situation where the legal cost is so large that it has no effect on b_n^*, we are interested in studying how would b_n^* change in the legal cost when it is relatively small. On the one hand, when L is small enough, bureaucrats can only ask a bribe which is equal to L no matter what position they are in. On the other hand, when it is not that small, b_n^* is still rising in order until it reaches L. By knowing b_n^*, we are able to compute the total bribe in the sequential repeated game and compare it with that in the simultaneous one.

4.4.2 Comparison of Total Bribe

Based on BIME expressions in equation (4.12) and (4.15) under simultaneous and sequential regime, we can calculate the total bribe in both games. Let B_{si} and B_{se} denote the expected total bribe in simultaneous and sequential game respectively. As the equilibrium bribe in the former case is symmetric, multiplying the number of bureaucrats and the equilibrium bribe derives:

$$B_{si} = Nb^*. \tag{4.16}$$

In the latter case, the equilibrium bribes might be different for bureaucrats because of the order, and B_{se} is:

$$B_{se} = \sum b_n^*. \tag{4.17}$$

According to formula (4.15), for each bureaucrat in the sequential game, BIME is actually a function of the total bribe B_{se} which is the sum of BIME for all Bs. We work out B_{se} by locating the fixed point. An arbitrary total bribe is substituted into (4.15) to calculate b_n^* for each bureaucrat, and they will be added up to get a new total bribe which is usually different from the initial one. Plug the new total bribe into (4.15) again and repeat the process until the fixed point shows up.

For illustration purposes we define a set of (in relative terms) plausible numerical values, with which we show how much the total bribe is in a repeated petty corruption game under each regime and then make a comparison. Define $N = 5$, $\delta = 0.25$ and various

$L \in [0.11, 0.19]$ as we are interested in the second case in which two roots lie on the downward side of $F(b)$ such that $\frac{1}{2N} < L < \frac{1}{N}$. The results are shown in table 4.1:

Table 4.1: Total bribe in simultaneous and sequential game

L	0.19	0.18	0.17	0.16	0.15	0.14	0.13	0.12	0.11
B_{se}	0.82	0.79	0.76	0.73	0.7	0.67	0.64	0.6	0.55
B_{si}	0.62	0.64	0.66	0.68	0.7	0.7	0.65	0.6	0.55

The above table shows that the value of legal cost L is crucial to the question that which regime is leading to the less total bribe. When L is relatively large, a simultaneous corruption game leads to a smaller total bribe; when L is relatively small, a sequential regime is better but the range is quite narrow. However, when L is small enough, it doesn't matter which regime is implemented because BIME is the legal cost itself in both games and the total bribe is the same. Therefore, in most cases, the simultaneous regime is preferred to the sequential one. This is because under sequential regime E undertakes more sunk cost once the application has started such that she is more likely to pay the bribe. We can summarize the results in the following Proposition:

Proposition 4.5. *When legal recourse is feasible, in an infinitely repeated petty corruption game with a sequence of entrepreneurs and a set of bureaucrats, applying to the bureaucrats simultaneously is leading to the smaller total bribe than applying sequentially if the legal cost L is relatively large, while applying sequentially is preferred when L is relatively small. There is no difference between them if L is small enough.*

4.5 Concluding Remarks

We construct a game theoretical model of petty corruption in which players consist of an entrepreneur and multiple bureaucrats. The entrepreneur applies to these bureaucrats simultaneously for approvals. It's assumed that every bureaucrat demands a bribe as a condition of approval on a take-it-or-leave-it basis. If a bribe is refused to pay, the project will be blocked by the bureaucrat. However, the legal recourse is introduced in the game to fight against non-approval decisions of bureaucrats. Specifically, it means the entrepreneur could appeal the bureaucrat if the permit is denied by incurring a legal cost L. That gives a constraint for the bribe can be demanded by each bureaucrat: $b \leq L$.

The game has many symmetric equilibria in both one-stage as well as the infinitely repeated game, which differ in the magnitude of bribe. We focus on one extreme equilibrium called BIME which maximizes the expected bribe income of the bureaucrat. The result shows that in an infinitely repeated game, for any discount factor δ, there exists a middle range of L in which BIME increases as L decreases. In such a range, reducing L–the worst equilibrium bribe–makes the threat of reverting a punishment phase less credible such that bureaucrats have incentives to raise the bribe size. Besides, when the legal cost is big enough, reducing it does not affect BIME. Only when it is quite small, cutting down the legal cost is effective on decreasing BIME.

In addition, we add legal recourse in the model of L-M-R (2008) and characterize the corresponding equilibrium bribe. Based on this, with a numerical example, we work out the expected total bribe in this sequential corruption game and compare it with that in the simultaneous game. We find that simultaneous regime is more effective in most situations than the sequential one. Therefore, our results suggest that simultaneous regime should be implemented in the context of multiple bureaucrats but cautious should also be taken because reducing legal cost might increase BIME and thus the total bribe.

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