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Master d'Economie du Secteur Public
Dirigé par M. Jean MERCIER-YTHIER et M. Bruno JÉRÔME
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Asymmetric punishment, Leniency and Harassment Bribes in China: a survey

HU Jun

Sous la direction de Monsieur Jean MERCIER-YTHIER

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Contents

Abstract

Following the Basu's proposal in 2011 of legalizing the bribe giving, enormous theorical and experimental work appears afterwards in studying the effectiveness of the asymmetric punishments and leniency on anti-corruption in developing countries like China. This paper tries to have an objective and just survey of the relative important researches on this subject, aiming to approach an agreement on the conclusion and to provide some enlightenments for further studies.

Keywords: Corruption, Asymmetric Penalties, Leniency, Whistle-blowing, China

I Introduction

According to the newest corruption perceptions index 2017, the current progress on anti-corruption is not optimistic: over 67% countries in the worldwide have a high level of corruption.[1]

Economic analyses on corruption are classified into four categories: efficient corruption, corruption with a benevolent principal, corruption with a non-benevolent and self-reinforcing corruption. (Aidt TS, 2003) The most frequent form of corruption being studied by economises is bribery. The standard theoretical literature concentrates on principal-supervisor-agent model in which the society (public, voters in a representative democracy) - as a principal - delegates the right to a bureaucrat (a supervisor) to interact with the third party (a citizen or a firm). Bribery happens when the supervisor and the third part collude a bargain on hiding information from the public (Troya-Martinez, Marta, and Michele Valsecchi, 2017).

For the three special characteristics of corruption: reciprocity, negative externalities and inherent risky property (Abbink, 2002), the self-enforced power can be strengthened as long as the legislations is harsh on both parts of bribery. Therefore, economists set about to break the inside trust between the two participants in a corruption relationship as they deal with cartel organisations (Buccirossi and Spagnolo, 2005), especially for the collusive bribe when the bribers get the undue service from the bureaucrat.

After Basu's proposition of treating the bribe-giving legal in 2011, heated discussions about whether the asymmetric punishment is effective in anti-corruption have taken place in recent years. In a harassment bribe (called also "extortionary corruption or discharge-of duty bribes"), a citizen is demanded to pay to get a public service which belongs to him/her legally. In that case, a bribe-giver should be less punished than the bribe-taker (Basu, 2011). Furthermore, an immunity from punishment for the bribe-giver who reports first the bribery will destroy the dominant position of the bribe taker and will encourage the briber to blow the whistle. However, some economists worry about the difficulties of its implementation in reality; some concern more the backfire of this proposal, including the "credible threat" of the briber once with a low moral cost in whistle-blowing (Drèze 2011, Buccirossi and Spagnolo 2005), the retaliation from the bureaucrat after the whistle-blowing…; some try to complement Basu's proposal by designing better mechanisms in the details (with or without refund, monetary or non-monetary incentives, endogenous and exogenous penalties…).

This paper is aimed to have a survey on the recent (game-) theoretic and experimental analyses on the effectiveness of asymmetric punishment and leniency on anti-corruption policies, especially in case of harassment bribes. The section II is a literature review of the most frequented cited game theoretical theories, with some complements or modifications from the author's point of view. The section III is a review of the experimental studies on the effectiveness of asymmetric punishment and leniency on fighting with the corruption especially in the case of the harassment bribe, particularly in China – one of the most corrupt countries in the world.

[1] Source : https://www.transparency.org/news/feature/corruption_perceptions_index_2017

II A survey of the game-theoretic analysis of the effects of asymmetric punishment and leniency policy on bribery

2.1 Asymmetric penalties, leniency and bribery
– a complementary study on the game of Lambsdorff and Nell in 2007.

Before Basu's proposal to legalize the bribe by the impunity of bribe-givers but heavier sanctions on bribe-takers, there are theoretical analyses of the asymmetric penalties' impacts on corruption.

Spagnolo et al. have pointed out that leniency policy (reduce the sanction for the criminal who reports his wrongdoings to legislative institutions) may be helpful in deterring illegal transactions such as corruption in the long term.

Lambsdorff and Nell (2007) built a model to analyze the impact of ex-ante and ex-post penalties on the bribers and bribees in the interaction of the bribery. They found that using asymmetric sanctions and leniency can break the "pack of silence" by the augment of risks, and finally destroy the trust of this bilateral agreement.
However, contrary to the proposal of Basu, they proposed a heavy (ex-ante) penalty for the bribers before receiving the service, a less penalty for accepting a bribe; while the bribee should be less punished before taking a bribe and more for delivering an illicit corrupt service favor, i.e. only an ex-ante leniency policy for a bribee and an ex-post leniency for a briber who reports.

They compare two models, one in an asymmetric penalty scenario and the other adding the leniency policy.

In the model of asymmetric penalties, there are two rational and risk-neutral players: a bureaucrat as player "B" and an entrepreneur as player "E".

An entrepreneur (E afterwards) moves first by offering a bribe (valued at *b*) for demanding a public contract (valued at *v*). And we suppose v > b.

A bureaucrat (B afterwards) has a monopoly position facing different offers of bribes from different enterprises and citizens. Therefore, B's primary option is not to reciprocate E, i.e. B is an opportunist.

There exist four different penalties if the bribery is detected or reported:
On the one hand, for the bureaucrat:

F_B^b represents the fine on B if he takes a bribe, and F_B^a means the fine on B for favoring E, approving a public contract for instance irrespective of E's ineligibility;
On the other hand, for the entrepreneur:

F_E^b is the sanction for the bribery action and F_E^a for accepting the illegal public service.

The assumed optimal penalty are $F^a = F_B^a + F_E^a$, $F^b = F_E^b + F_B^b$, i.e. an ex-ante fine before the transaction and an ex-post fine after the bribery. (according Rose-Ackerman 1999: 54-55 and Becker, 1968.) And to be simply, we note a full fine F_B=

$F_B^a + F_B^b$ or F_B^{a+b} for B, and $F_E = F_E^a + F_E^b$ or F_E^{a+b} for E, which aggregates the ex-ante and ex-poste fine.

2.1.1 A one-shot Game with Asymmetric Penalties

The game tree is as follows:
Figure 1: One-Shot Game with Asymmetric Penalties (Lambsdorff and Nell, 2007).

The timing of the game is:

E can offer a bribe (action *bo* in the game tree) to demand an offer of B. If there is no bribe offer (action *nbo*), the payoffs for E and B are both null.

If B accepts the bribe offer, he has three options:

- He mays denounce (action d_o) E to the relative legal institution, and then they both will be punished with an ex-ante fine F_E^b and F_B^b respectively, the bribe amount will be forfeited, so the final payoff set ($\prod_E^{do}$, $\prod_B^{do}$) is (-b-F_E^b, b-F_B^b);
- He can even renege by not approving E's demand (action na_o) but taking his bribe;
- Or he can approve (action a_o) E's demand.

If B reneges, E can denounce him (*d1*), and they both will be punished by the ex-ante fine, so the payoff set ($\prod_E^{d1}$, $\prod_B^{d1}$) is (-b-F_E^b, b-F_B^b); or E can choose to be silent, but they each will suffer a possible ex-ante fine, and the final payoff set ($\prod_E^{nd1}$, $\prod_B^{nd1}$) is (-b-αF_E^b, b-αF_B^b).

Facing B's approval decision, if E denounces B (*d2*), the two full punishment (F^a and F^b) are imposed on both respectively, and bribe is forfeited, so the final payoff set ($\prod_E^{d2}$, $\prod_B^{d2}$) is (v-b-F_E, b-F_B); if E does not denounce (action *nd2*), there stills exists a random detection risk with a probability of $\boldsymbol{\alpha \in (0,1)}$, and the final payoff set ($\prod_E^{nd2}$, $\prod_B^{nd2}$) equals (v-b- αF_E, b- αF_B).

The participation condition is that the best possible payoff ($\prod_E^{nd2}$, $\prod_B^{nd2}$) is positive, which is, in the situation that E does not denounce B who accepts his bribe and approve his demand. So, for E to participate, the maximal bribe amount that E can pay is the value of the contract v minus his possible cost, i.e. $b_{min} = \alpha (F_E^a + F_E^b)$ (noted as αF_E for simplify). Similarly, the minimum bribe amount that B can accept is to cover his possible loss when the bribery is detected, i.e. $b_{max} = \alpha F_B = \alpha (F_B^a + F_B^b)$.

It's not mentioned in the article, but we can notice that, here authors suppose que there is no cost for the bureaucrat to provide a public service, and also if either part reports the bribery, the conviction is to be sure.

The authors have just analyzed several sub games and the strategies by following the timing of the game and get some conclusions, which I think is not persuasive enough, so here I use the traditional backward deduction to find the subgame perfect Nash equilibrium. Thus, we can get a full picture and the corresponding policy propositions which are more reasonable.

2.1.1.1 The equilibrium Results and their Policy Implications

Using the backward deduction, we can get the following table:

<table>
<tr><th colspan="7">Table 1: The subgame perfect Nash equilibrium results for a one-shot bribe game with asymmetric penalties</th></tr>
<tr><td colspan="7">The participation contraints : $b_{min} \le b \le b_{max}$, ou $v \ge \alpha(F_B + F_E)$</td></tr>
<tr><td></td><td colspan="2"></td><td colspan="2">a</td><td>b</td><td>c</td></tr>
<tr><td>Dominant strategies</td><td colspan="2">E_1/ E_2</td><td colspan="2">do</td><td>na_o</td><td>a_o</td></tr>
<tr><td></td><td>F_E^b</td><td>F_E</td><td colspan="2"></td><td></td><td></td></tr>
<tr><td>① (d1, d2)</td><td>< 0</td><td>< 0</td><td colspan="2">$F_B^b < F_B$</td><td></td><td>$F_B^b \ge F_B$</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">$F_E^b <$ -b</td><td>{(bo, d1, d2), (do, na_o)}</td><td rowspan="2"></td><td rowspan="2">{(bo, d1, d2), (a_o)}</td></tr>
<tr><td>(-b- F_E^b, b-F_B^b) & (-b- F_E^b, b-F_B^b)</td></tr>
<tr><td>SPE</td><td></td><td></td><td>-b ≤ $F_E^b \le 0$</td><td>{(nbo, d1, d2), (do, na_o)}
(0, 0)</td><td></td><td>(v-b-F_E, b-F_B)</td></tr>
<tr><td>② (d1 , nd2)</td><td>< 0</td><td>≥ 0</td><td colspan="2">$F_B^b < \alpha F_B$</td><td></td><td>$F_B^b \ge \alpha F_B$</td></tr>
<tr><td colspan="2" rowspan="3">SPE</td><td rowspan="2">$F_E^b <$ -b</td><td>{(nbo, d1, nd2), (do, na_o)}</td><td></td><td>{(bo, d1, nd2), (a_o)}</td></tr>
<tr><td>(-b- F_E^b, b-F_B^b) & (-b- F_E^b, b-F_B^b)</td><td></td><td>(v-b-αF_E, b-αF_B)</td></tr>
<tr><td rowspan="2">-b ≤ $F_E^b \le 0$</td><td>{(bo, d1, d2), (a_o)}</td><td></td><td></td></tr>
<tr><td>(0, 0)</td><td></td><td></td></tr>
<tr><td>③ (nd1, d2)</td><td>≥ 0</td><td>< 0</td><td colspan="2">$F_B^b < F_B$, $F_B^b < 0$</td><td>$F_B^b > 0$, $F_B > \alpha F_B^b$</td><td>$F_B^b > F_B$, $F_B < \alpha F_B^b$</td></tr>
<tr><td colspan="2" rowspan="2">SPE</td><td colspan="2">{(nbo, nd1, d2), (do)}</td><td>{(nbo, nd1, d2), (na_o)}</td><td>{(bo, nd1, d2), (a_o)}</td></tr>
<tr><td colspan="2">(0,0)</td><td>(0,0)</td><td>(v-b-F_E, b-F_B)</td></tr>
<tr><td>④ (nd1, nd2)</td><td>≥ 0</td><td>≥ 0</td><td colspan="2">$F_B^b < 0$, $F_B^b < \alpha F_B$</td><td>$F_B^b > 0$, $F_B^b < F_B$</td><td>$F_B^b > F_B$, $F_B^b > \alpha F_B$</td></tr>
<tr><td colspan="2" rowspan="2">SPE</td><td colspan="2">{(nbo, nd1, nd2), (do)}</td><td>{(nbo, nd1, nd2), (na_o)}</td><td>{(bo, nd1, nd2), (a_o)}</td></tr>
<tr><td colspan="2">(0,0)</td><td>(0,0)</td><td>(v-b-αF_E, b-αF_B)</td></tr>
</table>

The assumption of positive total fine on both players is released to get a border discussion.

We can find clearly that there are four situations that are worth studying:

The worst situations (for anti-corruption and for the collective welfare) appear in scenarios ② and ④ with $F_E > 0$; while the best is the first one with both penalties on E are negative; and scenario ③ is the second best.

1)The two situations for an illegal corrupt deal to be made successful ("successful corruption"): ②**.c** and ④**.c** (the red parts in the table).

And they are both in the same condition of $F_E>0$, which approves the argument that harsh penalty on bribe-giver will discourage the whistle-blowing.

The conditions for ④**.c** to be realized are $F_E^b \geq 0$, $(v-b)/\alpha \geq F_E \geq 0$, $F_B^b > F_B$, $b/\alpha \geq F_B$ and $F_B^b > \alpha F_B$, which is the worst scenario.
Obviously, the penalties for E ($F_E^b > 0$, $F_E > 0$) are both positive.

Notice that $F_B^b > F_B$ means $\mathbf{F_B^a < 0}$, so keeps a heavier ex-post fine on bureaucrat is recommended to prevent effectively the reciprocity after the transaction of the bribe.

And $F_B^b > \alpha F_B$ means $F_B^b > \alpha/(1-\alpha)F_B^a$. If the penalty before the reciprocity **(F_B^b)** is too high, a rational B will not go to self-report because he will also be heavily punished even he has not done the favor. It seems reasonable that a low ex-ante fine on bribe-taker can also encourage him to voluntarily report E's illegal bribe. In anticipation of this behavior, E may not want to take such a great risk to offer a bribe.

However, with the penalties on E are always positive, even with a lower ex-ante punishment on B (extremely, a negative one in scenario ④**.a**), or a higher ex-post punishment on B (scenario ④**.a**), the best results that we can achieve is that Eo chooses not to offer a bribe. The reason is that when the road to approve a public contract for B (a_o) is blocked by a lower ex-ante punishment on B or a higher ex-post punishment on B, with the positive penalties on E, E still does have an enough motivation to report B even when B breaks his promises after receiving the bribe.

***Proposition 1.1*:**

A lower penalty on bribe-takers for taking a bribe and a higher for reciprocating a bribe seem to be effective by encouraging the bureaucrat to report the illegal bribe offers. This, at the same time, discourages the bribe-givers by augmenting the risk for an enterprise to be reported.

Nevertheless, When the penalties on the enterprise are high, the best scenario we can get is that enterprise will not offer a bribe on one's own initiative. On the contrary, the bureaucrat can demand a bribe in the first place, which will change the whole game tree that we discussed above. (For this part of discussion, see the following parts in this section)

To achieve ②**.c**, the following conditions are indispensable: $F_E^b \leq 0$, $F_E > 0$ and $F_B^b \geq \alpha F_B$.

To prevent this situation from happening, we can try to induce the strategies to divert from ②**.c to** ②**.a** or ②**.b**, especially on the condition of $F_E^b < 0$, $F_E \geq 0$, $F_B^b < \alpha F_B$ and $F_E^b \leq -b$.

Combining this with the participation constraints, we can get $F_B < \alpha F_B \leq b$, $F_B^b \leq -b < 0$, $0 < F_E \leq (v-b)/\alpha$.

To encourage E to divert the strategy to ②**.b**, that is to denounce B when B breaks his promise after accepting the bribe (a "non-credible" bureaucrat)**,** the penalty on E before the reciprocity needed to be cut down. The most attractive policy for E to report is when his payoff is positive, which lead to $F_E^b \leq -b$. The extreme example is to give a whistle-blower a positive award to encourage the reporting or self-reporting of a bribery by a bribe-giver.

Proposition 1.2:
A lower ex-ante penalty on the bribe-giver can also induce the bribe-giver to denounce a bureaucrat who does not return a favor after accepting a bribe.

However, this policy is risky as the bribe-giver can use it to threaten the bureaucrat to guarantee a reciprocity when he offers a bribe (Buccirossi and Spagnolo,2005).

2) The other two situations, on the contrary, relate to the whistle blowing ("unsuccessful corruption"): ①**.c** and ③**.c** (the dark green parts in the table).

The first scenario ①**.c** implies the following conditions: $F_E^b < 0$, $F_E < 0$ and $F_B^b \geq F_B$, that is, $F_E^b < 0$, $F_E < 0$ and $F_B^a < 0$. The conditions on penalty on B for approving the contract is the same with the scenario ④**.c**, but the resulting equilibrium is totally different.
The only different condition is that the penalties on E are both negative. In this way, even the bureaucrat approves E's illegal demand on a contract after accepting the bribe (a "credible" bureaucrat), an entrepreneur still has enough motivation to report the bureaucrat as he can get an award from self-report.

Proposition 1.3 *is complementary to proposition 1.1*:

To encourage an effective self-report of a bribe-giver, a lower penalty on bribe-takers for taking a bribe should be accompanied by the leniency on a self-reporting bribe-giver, i.e. no penalties or even awards on the bribe-giver before and after the reciprocity.

The second scenario ③**.c** is achieved when $F_E^b \geq 0$, $F_E < 0$, $F_B^b > F_B$, and $F_B < \alpha F_B^b$, i.e. $-F_E^a > F_E^b > 0$, $F_B^a < 0$, $F_B < F_B^b < \alpha F_B^b$.

The subgame perfect Nash equilibrium is the same with scenario ①**.c**.

What's different is this scenario is that the penalty on E before the reciprocity (F_E^b) is positive, while he penalty on E and B after the reciprocity (**F_E^a and F_B^a**) is negative. The logic of the game is that when the penalty on B after a reciprocity is negative, B will prefer to approve E's demand instead of not approving and denouncing E. At the same time, the negative penalty on E after the reciprocity will encourage him to a whistle-blowing even after receiving the contract.

Proposition 1.4**:**

A high sanction on bribe-giver is effective if and only if when the sanctions on both bribe-giver and bribe-taker are enough low. Only in this way can the policy encourage the whistle-blowing of the bribe-giver.

It's disputable to exempt a punishment of a bribe-giver or a bribe-taker, not to mention to give him a reward for the self-reports. A negative penalty on E when B breaks his promise can be considered as a refunded bribe amount, but a reward on E or B when the bribe transaction is finished (F_E, F_B) is unreasonable. So in reality, with F_E, $F_B > 0$, the scenarios ① and ③ are inexistent**.**

In summary, a higher penalty on bribe-taker for reciprocating a bribe is only effective when the penalty on bribe-taker for taking a bribe and the penalties on bribe-giver (ex-ante and ex-post) are low enough; a low ex-ante punishment on bribe-giver will be helpful in encouraging him to report the "non-credible" bureaucrat; on the contrary, a high sanction on bribe-giver can also be effective in whistle-blowing when the ex-ante sanctions on both bribe-giver and bribe-taker are low.

2.1.2 A one-shot Game with leniency

The structure of the game is similar to the above one (see the game tree in figure 2.). But a rebate ***r***, i.e. a reduced sanction for self-reporting, on the original penalty is added when the players report. And the reduced sanctions for E are $r_{E1}*F_E^b$ (action d_1 at node E_1) or $r_{E2}\cdot F_E$ (action d_2 at node E_2), with $0\leq c \leq 1$; similarly, the reduced sanctions for B equals $r_{B0}*F_B^b$ (action d_0 at node B_0), $0\leq r_{B0} = r_B \leq 1$. A low rebate r means a high level of leniency with F_E, $F_B > 0$.
The subgame perfect Nash equilibrium results are shown in the following table:

Table 2: The subgame perfect Nash equilibrium results for a one-shot bribe game with leniency

The participation contraints : $b_{min} \leq b \leq b_{max}$, ou $v \geq \alpha(F_B + F_E)$							
			a		b		c
Dominant strategies	E_1/ E_2		*do*		*na*$_o$		*a*$_o$
	F_E^b (α-r_{E1})	F_E(α-r_{E2})					
			-b-F_E^b >0	**-b-F_E^b ≤0**			
① (*d*$_1$, *d*$_2$)	>0	>0	**F_B^b >0, F_B> $r_B F_B^b$**		**F_B^a >0, F_B^b <0**		**F_B^a <0, F_B< $r_B F_B^b$**
					-b- $r_{E1}F_E^b$ >0	-b-$r_{E1}F_E^b$≤0	
SPE			{(*bo*, *d*$_1$, *d*$_2$), (*do*)}	{(*nbo*, *d*$_1$, *d*$_2$), (*do*)}	{(*bo*, *d*$_1$, *d*$_2$), (*na*$_o$)}	{(*nbo*, *d*$_1$, *d*$_2$), (*na*$_o$)}	{(*bo*, *d*$_1$, *d*$_2$), (*a*$_o$)}
			(-b-F_E^b, b-$r_B F_B^b$)	(0,0)	(-b-$r_{E1}F_E^b$, b-F_B^b)	(0,0)	(v-b-$r_{E2}F_E$, b-F_B)
② (*d*$_1$, *nd*$_2$)	>0	≤0	**F_B^b >0, $r_B F_B^b$ < αF_B**		**F_B^b <0, F_B^b < αF_B**		**F_B^b > αF_B, $r_B F_B^b$ >αF_B**
			{(*bo*, *d*$_1$, *nd*$_2$), (*do*)}	{(*nbo*, *d*$_1$, *nd*$_2$), (*do*)}	{(*bo*, *d*$_1$, *nd*$_2$), (*na*$_o$)}	{(*nbo*, *d*$_1$, *nd*$_2$), (*na*$_o$)}	{(*bo*, *d*$_1$, *nd*$_2$), (*a*$_o$)}

			(-b-F_E^b, b-$r_BF_B^b$)	(0,0)	(-b-$r_{E1}F_E^b$, b-F_B^b)	(0,0)	**(v-b-αF_E, b-αF_B)**
					-b-αF_E^b>0	**-b-αF_E^b>0**	
③ (nd_1, or d_2)	≤0	>0	**(α- r_B) F_B^b >0, F_B> $r_BF_B^b$**		**(α- r_B) F_B^b <0, F_B>αF_B^b**		**F_B< $r_BF_B^b$, F_B<αF_B^b**
SPE			{(bo, nd_1, d_2), (do)}	{(nbo, nd_1, d_2), (do)}	{(bo, nd_1, d_2), (na_o)}	{(nbo, nd_1, d_2), (na_o)}	{(bo, nd_1, d_2), (a_o)}
			(-b-F_E^b, b-$r_BF_B^b$)	(0,0)	**(-b-αF_E^b, b-αF_B^b)**	(0,0)	(v-b-$r_{E2}F_E$, b-F_B)
④ (nd_1, nd_2)	≤0	≤0	**(α- r_B) F_B^b >0, αF_B> $r_BF_B^b$**		**(α- r_B) F_B^b <0, F_B^a >0**		**F_B^a <0, αF_B> $r_BF_B^b$**
SPE			{(bo, nd_1, nd_2), (do)}	{(nbo, nd_1, nd_2), (do)}	{(bo, nd_1, nd_2), (na_o)}	{(nbo, nd_1, nd_2), (na_o)}	{(bo, nd_1, nd_2), (a_o)}
			(-b-F_E^b, b-$r_BF_B^b$)	(0,0)	**(-b-αF_E^b, b-αF_B^b)**	(0,0)	**(v-b-αF_E, b-αF_B)**

Taking a brief glance of the two tables, we can find that two additional "successful corruption" situations (**④.b and ③.b**) in table 2 compared to table 1.

Leniency policy can be risky as they can backfire. Especially when E decides to give a bribe and B chooses not to award E a contract. Once the payoffs that E can get from denouncement (d_1) is smaller than that from de non-denouncement (nd_1) at node E_1, he will be discouraged from reporting a "non-credible" bureaucrat even with the proposition 1.2. That's because when the rebate on the ex-ante penalty for E is bigger that the probability of detection of criminal corruption, E will divert to not reporting when B reneges his promise. A high rebate means a low level of leniency, so we get:

Proposition 1.5 is complementary to proposition 1.2:
A low level of leniency policy (a high rebate rate on penalty) for a report of bribe-giver before the reciprocity will offset the effect of a lower ex-ante penalty on bribe-giver.

An illegal corrupt deal can be made in two steps: a bureaucrat can make a credible promise of approving a contract and most importantly, of not denouncing a bribe-giver; then an entrepreneur then threatens the bureaucrat to report the bribery if the latter does not keep his promise.

If there is a leniency for B, B can make a credible promise of approving a contract and not denouncing as long as b-$r_BF_B^b$ > b-αF_B, i.e. $r_BF_B^b$ > αF_B. When **$r_B = \alpha$,** it's difficult for B to keep his promise, and E will lose the trust on B. (Buccirossi and Spagnolo, 2005 and Lambsdorff and Nell, 2007.)

As mentioned before, a high leniency means a low reduced penalty, that is, a low value of r. Therefore, the level of leniency on the bureaucrat is negatively correlated with the probability of the detection of illegal bribe trades. In a country where the legislative institution is strong enough to detect the illegal corruption, or the media and the public are sensitive to the corrupt phenomenon, a low leniency on the bribe-takers is necessary. This is reasonable because the strict legislation on bureaucrat can

help the detection of the gross dereliction of duty of the bureaucrat, which can, in return, help build the trust of the public on an honest government. On the contrary, a high leniency on bureaucrat will create a crime shield- legislative, cultural, social…- for the opportunists, and the vicious circle will create irreversible consequences.

Proposition 1.6:

The level of leniency on bureaucrat is negatively correlated with the probability of the detection of corruption. The high leniency policy on the bribe-taker is only effective on anti-corruption in a country where the probability of detection is high, which includes honest and effective legislative institution, high level of transparence of medias, strong public supervision, high moral quality of citizens…

2) As for the leniency on entrepreneur,

When $r_{E1}=r_{E2}=r_E$:

E can threaten B to report if: $(\alpha- r_E)F_E^b > 0$ (d_1 on node E_1), or $(\alpha- r_E)F_E > 0$ (d_2 on node E_2). Suppose F_E^b and F_E are positive, we get $\alpha > r_E$. Which is shown as the situation ① (d_1, d_2) in the above table. Therefore, a high leniency for bribe-giver is recommended with a high punishment on him at the same time. While if B knows this, he will choose not to approve the contract (na_o) if $F_B^a \geq 0$. This result proves again the proposition 1.1.

Suppose F_E^b and F_E are negative, $\alpha < r_E$ is needed to divert E from cooperation to denunciation. A low leniency on E is accompanied with lower punishments on E. However, the question is it's difficult to distinguish the probability of detection of corruption from the reports (self-reports, whistle-blowers…). Furthermore, awards for self-reports of bribe-giver can be costly and may lead to frame-ups.

Table 3: The subgame perfect Nash equilibrium results for a one-shot bribe game with leniency					
The participation contraints : $b_{min} \leq b \leq b_{max}$, ou $v \geq \alpha(F_B + F_E)$					
When **F_E, F_B > 0.**					
			a	b	c
Dominant strategies	E_1/ E_2		*do*	*na_o*	*a_o*
	F_E^b ($\alpha- r_{E1}$)	$\alpha- r_{E2}$			
① **(d_1, d_2)**	≥0	≥0	**F_B^b >0, F_B> $r_BF_B^b$**	**F_B^a >0, F_B^b <0**	**F_B^a <0, F_B< $r_BF_B^b$**
SPE			{(*nbo*, d_1, d_2), (*do*)}	{(*nbo*, d_1, d_2), (na_o)}	{(*bo*, d_1, d_2), (a_o)}
			(0,0)	(0,0)	(v-b-$r_{E2}F_E$, b-F_B)
② **(d_1, nd_2)**	≥0	<0	**F_B^b >0, $r_BF_B^b$ < αF_B**	**F_B^b <0, F_B^b < αF_B**	**F_B^b > αF_B, $r_BF_B^b$ >αF_B**

SPE			{(*nbo*, d_1, nd_2), (*do*)}	{(*nbo*, d_1, nd_2), (na_o)}	{(*bo*, d_1, nd_2), (a_o)}
			(0,0)	(0,0)	**(v-b-αF_E, b-αF_B)**
③ (***nd*$_1$, or *d*$_2$**)	≤0	≥0	**(α- r_B) F_B^b >0, F_B> $r_B F_B^b$**	**(α- r_B) F_B^b <0, F_B>αF_B^b**	**F_B< $r_B F_B^b$, F_B<αF_B^b**
SPE			{(*nbo*, nd_1, d_2), (*do*)}	{(*nbo*, nd_1, d_2), (na_o)}	{(*bo*, nd_1, d_2), (a_o)}
			(0,0)	(0,0)	(v-b-$r_{E2}F_E$, b-F_B)
④ (***nd*$_1$, *nd*$_2$**)	<0	<0	**(α- r_B) F_B^b >0, αF_B> $r_B F_B^b$**	**(α- r_B) F_B^b <0, F_B^a >0**	**F_B^a <0, αF_B> $r_B F_B^b$**
SPE			{(*nbo*, nd_1, nd_2), (*do*)}	{(*nbo*, nd_1, nd_2), (na_o)}	{(*bo*, nd_1, nd_2), (a_o)}
			(0,0)	(0,0)	**(v-b-αF_E, b-αF_B)**

When F_B, F_E >0, $r_{E1} \neq r_{E2}$, the scenarios with leniency are shown in the above table.

The SPNEs seem to get extreme: either the corruption deal is successfully made, or the entrepreneur will denounce the bureaucrat after receiving the license. The good side is that a "non-credible" bureaucrat who reneges after receiving a bribe will no longer exist, which is reasonable because E will suffer less penalty in the situation with leniency.

The only two corrupt scenarios are ②**.c** and ④**.c** to be eliminated.
The condition for the four situations to be satisfied are

	$F_E^b \geq 0$		**$F_E^b < 0$**	
① (***d*$_1$, *d*$_2$**)	$\alpha \geq r_{E1}$	$\alpha \geq r_{E2}$	$\alpha \leq r_{E1}$	$\alpha \geq r_{E2}$
② (*d*$_1$, *nd*$_2$)	**$\alpha \geq r_{E1}$**	**$\alpha < r_{E2}$**	**$\alpha \leq r_{E1}$**	**$\alpha < r_{E2}$**
③ (***nd*$_1$, or *d*$_2$**)	$\alpha < r_{E1}$	$\alpha \geq r_{E2}$	$\alpha > r_{E1}$	$\alpha \geq r_{E2}$
④ (*nd*$_1$, *nd*$_2$)	**$\alpha < r_{E1}$**	**$\alpha < r_{E2}$**	**$\alpha > r_{E1}$**	**$\alpha < r_{E2}$**

On particulier, conditions for ② and ④ to exist are:

$\alpha \in [r_{E1}, r_{E2}]$ and **$\alpha < \min\{r_{E1}, r_{E2}\}$**

The two scenarios can be eliminated if **$r_{E1} \geq r_{E2}$**=0 or just **r_{E2}**=0.[2]

Proposition 1.7:

The leniency on bribe-giver after his reception of the contract is effective on elimination of the corruption trade. On the contrary, leniency on bribe-giver before the reciprocity is not necessary.

[2] In the original model, Nell et al. come to an extreme conclusion that r_{E2}=0 and r_{E1}=1.

The article provides a basic general bribe game to study the effects of asymmetric penalties and leniency on anti-corruption, leaving many questions to be asked:

- What if it's not the entrepreneur who offers a bribe in the first step but the bureaucrat who extorts the entrepreneur?
- What if there is a cost for a bureaucrat to provide a public service (for instance, approve a public contract in this article) and a cost for whistle-blowers to report?
- What if the bribe amount is refunded after the self-report of a bribe-giver?
- What if the penalties for who self-report is lower than when his bribery crime is detected?

2.2 Basu's proposition and Harassment bribe

2.2.1 A modified one-shot harassment bribe game - a complementary study on the legalizing bribe giving game of Giancarlo Spagnolo et al. in 2012

It is a simple model based on the Basu's proposal and Drèze's critics. According to the definition of a harassment bribe by Basu, a citizen pays a harassment bribe just once, for example, for demanding a driver license. It seems unseasonable to describe a harassment bribe in form of a repeated game. In the next part, we will briefly review the one-shot time bribe game proposed by Spagnolo et al. and then a repeated non-harassment bribe in a repeated game.[3]

The harassment bribe game is similar with the first model. When an entrepreneur (***E***) demands for a public service (valued at ***v*** for E) which he is entitled to, for example, a driving licence after passing all the examines. A public servant (***S***) demands a petty bribe or a harassment bribe (valued at ***b***).

Suppose that no corruption crime will be convicted except when there are reports. Once the crime is reported/convicted, the penalties on E and on S will be F_E and F_S separately. And $F_E, F_S > v > b > 0$, $b > |c|$.

Personally speaking, the model of Spagnolo approaches more to a non-harassment bribe as the bureaucrat can deny the entrepreneur's demand for a license even after paring the bribe, and the game can take places in a repeated form. To get closer to the scenario of a harassment bribe, I make a little change in the assumptions. As a result, two assumption are added, one sub game is cut off, and the game occurs just one time.

At the beginning of the game design, there are several important necessary prerequisites:

- A1. It's a harassment bribe, so the entrepreneur deserves what he demands (a license, a public service, a permission…), and the fairness quality has not been changed by the bribery. When the public service is competitive or exclusive, for example, two citizens are in an interview for a professor position, and a citizen who pays a gift or uses some relationship gets the position finally. Even if the citizen who pays bribe is qualified for the position, this bribery is a

[3] Most of the literature take the harassment bribe game as a one-shot game while the non-harassment as a one-shot or repeated game.

collusive corruption rather than a harassment bribe. That's why the briber can keep the value of the license (v) after the reporting of bribery.

- A2. It's not rational for an entrepreneur to report a civil servant when it comes to a harassment bribe, neither rational to change to other civil servants. For example, when you demand a business visa for un urgent abroad business trip, the servant working in the embassy demands a little "extra fee" to give it to you. The act of blowing the whistle can be costly in time and efforts. The rational choice is to pay a little bribe to catch up with his business travel. What's more, there is no competitions between civil servants. As the documents for demanding a travel vis are already submitted, it's also costly to change a agent or sometimes a citizen cannot choose the public service freely as he does in the market.[4]

- A3. There is a cost (c) for a civil servant to provide the public service (to issue a licence in this model). The cost is positive for the costs (time, efforts…) to provide a public service; and is negative as it's risky for the dereliction of a civil servant.[5]

- A4. The civil servant is in dominant position in a harassment bribe. When a civil servant accepts a bribe, he may not give the licence at the same time but use it to a second "blackmail" to get an "optimal" bribe amount. But once they have an agreement on the bribe amount, and E pays the demanded bribe. Again, it is coherent to the definition and characteristics of a harassment bribe.[6]

- A5. When a civil servant accepts a bribe, he gives the licence at the same time, which means no "hold-up" problem and no chance for a civil servant to renege. (Spagnolo et al. in 2015, Basu 2016) In the harassment bribe, as the entrepreneur deserves the licence that he demands, a civil servant can bargain with the entrepreneur by the time delays, but he has no right to hold back what is entitled to the entrepreneur once he receives the bribe.

- A6. The corruption crime can be convicted as long as one of the players reports. Once there is whistle-blowing, a "top-down" investigation will be launched. In such a mechanism, a bribe-giver can use reporting as a threaten weapon to get a license, but no chance to a frame-up as report is not used as an evidence in non-harassment bribe. In harassment bribe, this mechanism can effectively encourage the whistle-blowing.[7]

The game tree of a harassment bribe with standard law enforcement (symmetric punishment) is described in the figure 3.

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[4] See Rose-Ackermans in 1996, Di Tella, R.in 1999, AHMAD in 2004 and Serra in 2013.

5 This is a debatable point in different literatures. In some models (Spagnolo in 2015, Oak 2013), authors think it takes effects for a civil servant to provide a public servant, and he can use it as a "bargain chip" in the corruption crime. For example, a public servant can delay the delivery of a license to ask for a bribe before the corrupt bribe transaction, he can approve a "more lucrative" project to a higher bribe payer, and he can even revenge the bribe payer after the corruption in a repeated game. Others **(**Basu 2014) assume it costless to deliver a license considering the specific function of a government official.

6 The original model includes this situation, which from my point of view is not reasonable.

[7] To learn more about this, see more in the articles of D. Serra (2009), Schikora (2011) and Spagnolo (2017).

The strategies in the game tree:

- E can agree to pay a bribe (B) or not (┐B);
- When E refuses to pay a bribe, S can issue a license (L) or not (┐L);
- S may refuse the bribe but still issue the license (┐AL);
- If S accepts the bribe, he must issue the license, and the illicit corrupt trade is done, then S and E can choose to self-report or not the corrupt crime.

Here I eliminate the situation when S doesn't accept the bribe but issue the license as it's contrary to the fourth prerequisite (A4). And the situation when S neither accepts the bribe nor issues a license doesn't any more (according to the last prerequisite). Some may argue that S has the bargaining power and he wants to get a higher bribe amount. However, S can totally achieve his objective by a time delay or by asking extra documents, which can be realized by the first step of not fiving a license without bribe amount.

Suppose the cost for reporting (C) is null, the corruption crime will be convicted if and only if when one of the players reports, which means a random audit has no effect on harassment bribe. This assumption is released in the following studies.

Under the symmetric punishment, after the illegal corrupt trade, the dominant strategies for E and S are both reports because the payoff after reports are reduced by the penalties. And the bribe will be confiscated by relevant institutions.

When $c \geq o$, the only SPE is that the corrupt crime is committed without reporting. When $c<0$, the unique SPE is that an entrepreneur gets his license issued without paying any bribe.

In the case of harassment bribe, the former is more frequent. The civil servant will ask a bribe by threatening the entrepreneur when the risk of being caught and being fired by his boss is small. Or even worse, the harassment bribe in this department becomes a "common practice". Basu's proposition aims at mostly the first situation when $c>0$.

Now consider the modified games taking different constraints into consideration: the Basu's Proposal (BP), Costly reporting, moral cost, probability of conviction. (See figure 4)

1) With Basu's Proposal:

In this model, Basu's proposal is interpreted as a double penalty on bribe-taker and the bribe is refunded to the bribe-giver.

The dominant strategy for S doesn't change, and E's payoff is better when he reports. The equilibrium:

- When $c \geq 0$, the SPE is that *S doesn't* accept the bribe but issue the licence.
- When $c<0$, the SPE is that *S* issues the licence without bribe, or that S doesn't accept the bribe but issue the licence.
  As a result, Basu's proposal changes effectively the situation to the optimum situation.

2) With Basu's Proposal and a cost of reporting:
There is a cost for E to report unless S reports.
If b < C, the SPF is the same with the standard law enforcement.

If b ≥ C, same with the BP situation.

- When c≥0, the SPE is that *S doesn't* accept the bribe but issues the licence.
- When c<0, the SPE is that *S* issues the licence without bribe, or that S doesn't accept the bribe but issues the licence.

2) With moral costs and exogenous conviction:

Bribers not only bears a moral cost of committing a crime and being caught at any moment, but also of "stabbing the bribe-takers in the back as they blow the whistle after the event" (Jean Drèze, 2011).[8] What's more, there may be a third part who can report the corrupt crime, or the legislative institution finds it out.

The probability of being detected by others (α, $0 < \alpha < 1$) when there are no self-reports is added in this situation. The moral cost for bribe-givers is M.

The Nash equilibrium for the matrix is "not Report" for both players.
As implied by the participation constraints, $b-c-\alpha(b+F_S)\geq 0$.

When $c\geq 0$, then $b-\alpha(b+F_S) \geq c \geq 0$, the SPE is that the corrupt crime is committed without reporting.

When c<0,

- If $b\geq\alpha(b+F_S)$, the SPE is that *S* issues the licence without bribe.
- If $b<\alpha(b+F_S)$, the SPE is that *S* issues the licence without bribe, and *S doesn't* accept the bribe but issues the licence.

4) With BP, moral costs and exogenous conviction

When C<b, the Nash equilibrium for the matrix is "Report" for E and "not Report" for S.

- When c≥0, the SPE is that *S refuses* the bribe but issues the licence.
- When c<0, the SPE is that *S* issues the licence without bribe, and *S doesn't* accept the bribe but issue the licence.

When C ≥ b, the Nash equilibrium for the matrix is "not Report" for both players.
$b-c-\alpha(b+F_S)\geq 0$ is implied by the participation constraints.

When $c\geq 0$, then $b-\alpha(b+F_S) \geq c \geq 0$, the SPE is that the corrupt crime is committed without reporting.

When c<0,

If $b\geq\alpha(b+F_S)$, the SPE is that *S* issues the licence without bribe.

If $b<\alpha(b+F_S)$, the SPE is that *S* issues the licence without bribe, and *S doesn't* accept the bribe but issues the licence.

8 Some may argue that in a harassment bribe context, the briber is a victim. However, from the ethical point of view, Drèze thinks that a briber may have externality on other citizens who wants to "resist the harassment" in other ways other than bribes.

5) With leniency, moral costs and exogenous conviction

Here, Spagnolo proposes a modified BP:

The immunity is only for the player who reports the corruption **first**[9]. If E self-reports first, there is no fine and the bribe amount will be refunded. However, considering the harassment bribe and the specific function of civil servant, there is no leniency for a public servant.

Apply that idea to the game in Figure 4. That is, if *E* chooses *R* then, in the corresponding row, remove *b* and F_E.

> If b>α(b+2F_S), SPE is the same with the standard law enforcement;
> If b<α(b+2F_S), SPE is ③ when c>0 and ② ③ when c<0.

The summary of SPEs and payoff sets in different scenarios are in the following table:

		0) Standard law enforcement	1) BP	2) BP & C	
The Matrix (report or not)	Equilibrium	(┐R, ┐R); (v-b, b-c)	(R, ┐R); (v, -c-2F_S)	C ≥ b	C < b
	Payoffs			(┐R, ┐R); (v-b, b-c)	(R, ┐R); (v-C, -c-2F_S)
SPE (Equilibrium and payoffs)	c≥0	{(B, ┐R), (┐L, AL, ┐R)}; (v-b, b-c) ④	{(B, R), (┐L, ┐AL, ┐R)}; (v, -c) ③	{(B, ┐R), (┐L, AL, ┐R)}; (v-b, b-c) ④	{(B, R), (┐L, ┐AL, ┐R)}; (v, -c) ③
	c<0	{(┐B, ┐R), (L, ┐R)}; (v, -c) ②	{(┐B, R), (L, ┐AL, ┐R)} & {(B, R), (L, ┐AL, ┐R)}; (v, -c) & (v, -c) ② ③	{(┐B, ┐R), (L, ┐R)} (v, -c) ②	{(┐B, R), (L, ┐AL, ┐R)} & {(B, R), (L, ┐AL, ┐R)}; (v, -c) & (v, -c) ② ③
		3) Moral cost and exogenous conviction		4) BP, moral cost and exogenous conviction	
The Matrix (report or not)	Equilibrium	(┐R, ┐R); [v-b -αF_S- M, b-c- α(b+ F_S)]		C ≥ b	C < b
	Payoffs			(┐R, ┐R) [v-b, b-c- α(b+ 2F_S)]	(R, ┐R); (v-C, -c-2F_S)
SPE (Equilibrium and payoffs)	c≥0	{(B, ┐R), (┐L, AL, ┐R)}; [v-b -αF_S- M, b-c- α(b+ F_S)] ④		{(B, ┐R), (┐L, AL, ┐R)}; [v-b, b-c- α(b+ 2F_S)] ④	{(B, R), (┐L, ┐AL, ┐R)}; (v, -c)

[9] Generally, it's interpreted as that the entrepreneur reports (first) since there is no reason that a civil servant who accepts a bribe will self-report in a harassment bribe situation.

						③
	c<0	b≥α(b+ F_S)	{(┐B, ┐R), (L, ┐R)}; (v, -c) ②	b≥α(b+2F_S)	{(B, ┐R), (┐L, AL, ┐R)}; [v-b, b-c-α(b+2F_S)] ②	{(┐B, R), (L, ┐AL, ┐R)} & {(B, R), (L, ┐AL, ┐R)}; (v, -c) & (v, -c) ② ③
		b<α(b+ F_S)	{(┐B, ┐R), (L, ┐AL, ┐R)} & {(B, ┐R), (L, ┐AL, ┐R)}; (v, -c) & (v, -c) ② ③	b<α(b+2F_S)	{(┐B, ┐R), (L, ┐AL, ┐R)} & {(B, ┐R), (L, ┐AL, ┐R)}; (v, -c) & (v, -c) ② ③	

With a little modification of the original model, the results change a lot.

In the modified harassment bribe game, we can see that there isn't any obvious change when c<0. That's coherent with the assumption A3 at the beginning of the game. When the cost of providing a public service is positive, it means that the public servant has a responsibility and can get a sense of achievement from their job. On the contrary, the negative cost for a civil servant to deliver a license implies that he is an opportunist who just want to take advantage of his job. The latter is just the situation where the harassment bribery happens the most.

Proposition 2.1:
In a one-shot harassment bribe game, when the public servant has no right to hold back the license, Basu's proposal (BP) can successfully encourage the self-report of the bribers as soon as the cost of reporting doesn't exceed the bribe amount.

The leniency policy only works when b<α(b+2F_S), i.e. Fs>(1- α)/2αb. So, here comes the second proposition:

Proposition 2.2:
Leniency policy on the bribe-giver when he reports first the corruption, can only work with a high penalty on bribe-taker in the meantime.

To sum up, Basu's proposal of more punishment on the civil servant and leniency on a whistle-blowing briber is only effective on anti-corruption when the cost of self-report of briber is low enough, and the penalty on the public servant is high enough, in a harassment bribe situation with the strict prerequisites mentioned in the beginning.

Then how the asymmetric punishment and leniency policy affect the corruption behavior if the bribe is not a harassment bribe?

2.2.2 A bribe game when bribe types are exogenous

In the paper of Oak in 2013, he designed a game which included both two types of bribes and used microeconomic analysis to study the applications of Basu's proposal as well as its social effects.

2.2.2.1 The design of the model

An entrepreneur (E) needs the bureaucrat (B) to approve his project of building a plant. B may demand a bribe, which is defined as a harassment bribe if E's project is compliant (CP) and is a non-harassment bribe if the project is non-compliant (NCP). The type of the project is only known to the two parts. So, it's risky and costly for a third part to report a bribe. Things can get trickier when the standards of getting a CP is subjective or professional. How can the evidence that B takes E's bribe for a NCP be proved? An opportunist B will even try to change CP to NCP. Thus, BP may increase the difficulty of demanding an approve.

The value of the project is $v \geq 0$ for E. The cost for CP is $c > 0$, $(c + x)$ for NCP where x is an extra cost. CP has good social externality, but NCP has bad social externality (e.g. air pollution.). Let $\lambda \in (0; 1)$ denote the probability that the bureaucrat is corrupt (B^C), which charges bribes *bn* and *bc* for NCP and CP. On the contrary, an honest bureaucrat (B^H) will just approve CP.

Suppose there is no legal enforcement, i.e. no third party to detect (either the bribery or the projects types). The timing of the game is:E decides whether to do the project. If he decides to do the project, he decides whether to be compliant. B observes the project type and decides whether to approve it. E can appeal if B refuse CP and can also report the bribery if he is demanded. The credibility of B's threat to delay CP depends on E's appealing cost L (time, money, efforts, hassles…).
The payoffs for E are the expectation value of the net profits when he meets with two bureaucrats; the payoffs for B is the expectation value of bribes with different project types.

The equilibrium is when:

B decides the set of bribes amount (bn; bc) to maximize his payoffs; given the value of the project and B's bribe amount, E decides whether to appeal B's denial, whether to pay the bribe, or whether to report.

If E's appeal succeeds, B will be punished with a fine of T^B (>0). With symmetric penalties, E will not report the bribery since he will also get punished with a fine of T^E (>0).

With a high cost of appealing and a punishment for E, he will not report the harassment bribe.

2.2.2.2 Basu's proposal

Let $T^B > 0$ but $T^E \in [-b; 0)$, i.e. E is awarded for reporting. Assume that the project can't go on if it's proved NCP after report.

Authors find that E will report the bribery if and only if when the project type is CP. B will not demand a bribe for CP if the penalty on him exceeds the bribe amount. B will demand bribe only on NCP considering the payoff function when project type in the model is exogenous. Hence, Basu's proposal will just be effective on harassment bribe but not non-harassment bribe.

B has two strategies:

Strategy 1: He will demand zero bribe for CP, and set an optimal bribe amount for NCP to maximize his payoffs;

Strategy 2: He tries his best to hinder the approval of CP (by time delay, complicated processes, hassles…), to induce E to take a NCP by a shot-cut - bribery.

Proposition 2.3:
Comparing the strategies of the bureaucrat in different situations, authors come out with the proposition that the bribe amount for non-complaint projects (non-harassment bribe) under the first strategy becomes higher with Basu's proposal. What's worse is that more inefficient projects (non-compliant projects) are approved in the latter situation.

Proposition 2.4:
Furthermore, under the second strategy, the payoff of the bureaucrat is positively corelated with the cost of appealing for the entrepreneur. That is, when it's costly for an entrepreneur to report or appeal, the bribery is harder to be detected as the project type is endogenous. So, B will use the first strategy when the report cost is low; the second one when the report cost is high.

In summary, Basu's propose can deter the harassment bribe but it may backfire by the strategic behavior of the bureaucrat.[10] The dominant position of the bureaucrat makes the endogenous project type possible. The bureaucrat can make the complaint project non-complaint, which is that, changes a harassment to a non-harassment. Maybe it seems the harassment bribery decrease, but in fact, the bribe amount increases, and the social welfare is reduced as more non-complaint projects are approved.

2.3 When bribe size and the detection rates are exogenous

A modified model of Chandan Kumar Jha, which combines the assumption of Spagnolo et al. (2012) and the structure of game of Abbink et al. (2002), analyses the situation when the conviction is not definite even after the reports and adds the probability of detection after the reciprocity of the bribery. This model draws the conclusion that Basu's proposal (double punishment on bureaucrat, and immunity on bribe-giver with bribe refunded) only works when the cost of reporting is less that the bribe amount. Moreover, the modified leniency proposed by Spagnolo (leniency only when the briber reports first) is more effective that Basu's proposal. However, when the bribe is not returned to the reporter, is conditionally effective when the difference between the proportion of the two probabilities of detection (with self-report and

[10] Another scenario that Basu's proposal can backfire is when the "credible threat" of the bribers in the non-harassment bribe situation discussed in the first model of Nell (Buccirossi and Spagnolo, 2005). With Basu's proposal, if an entrepreneur with a non-complaint project doesn't get an approval, he may use denouncement as a threat (at d_1) to force the bureaucrat to give the approval.

without self-report), and the ratio of the punishment on briber to the bribe is less that one.

That is, the mechanism of punishment and leniency program should be well designed according to the probabilities of detection under two scenarios (report or not) and also the amount of the bribe. Here, the probability of detection is equal to the probability of conviction, which is questionable. Furthermore, according to other relative literatures (e.g. Barr and Serra 2008) point out that if a mechanism is used to enforce the conviction (more details are in the part III on experimental studies).

Basu also constructs a model using microeconomic analyses to study the effects of asymmetric punishment. It's a bargaining game of harassment without "hold-up" problem.

An entrepreneur (E) who is supposed to get a license valued at L (>0) is likely to be demanded a bribe (B) by the official (O). The payoff without bribe for E and O are Uo and $U_E \in [0, L]$ respectively. If they can't get an agreement on the bribe amount, the payoffs are Do < Uo and $D_E \in [0, L]$. if they make a deal after the bargaining, there is still a possibility of being detected, i.e. $p \in [0, 1]$. If detected and convicted, $F_E \geqq 0$ for E and $F_O \geqq 0$ for O will be imposed, and O is supposed to refund a fraction $\beta \in [0; 1]$ of the bribe paid.

A "Perfectly symmetric punishment" (SP) is defined as $F_E = F_O$ and $\beta = 0$, and a "perfectly asymmetric punishment" (AP) as $F_E = 0$ and $\beta = 1$. Assume the fine on O (F_O) exceeds the fine on E (F_E) in the case of harassment bribes (Assumption 1/A1). *The relationship between bribe amount, punishment and the probability of detection:* A Nash bargaining on optimal bribe amount is when the surplus of utility (payoff of corruption minus payoff without bribe) for E from a license and of O from bribe is maximal at the same time. A bribe will be demanded if the value of the license is attained to some degree (or precisely, profitable enough).

Under the Nash equilibrium harassment bribe amount, the bribe size is positively corelated with the fine on O, the fraction of the bribe amount refunded, and negatively corelated with the fine on E. In the harassment bribe scenario, the bribers are kind of protected by the asymmetric penalties and leniency, and the bribe takers are in greater risk, so they need more guarantee in form of a bigger bribe size.

Proposition 2.5:
One important lesson drawn in this article is that the symmetric penalties have nothing to do with the corruption when there is no whistle-blowing. The core of the elimination of bribery is to prevent the agreement of the bargaining of the optimal bribe amount. Once the agreement is made, symmetric punishment and leniency can only change the surplus of the payoffs they spare and the risk balance between them. Moreover, the bribe size is positively correlated with the probability of detection of the bribery. Under asymmetric punishment, the higher the probability of detection, the higher bribe amount B demands. [11]

[11] See also a microeconomic analysis on relationships of bribe size and fines in a working paper of Popov, S. V. in 2017.

It's a paradox because B can hardly keep it with a high refund rate. However, a high probability of detection doesn't a high probability of conviction. From this point of view, if B has a way to get ride of the persecution, he can transfer his illegal assets abroad, or he can as well launder his illegal bribe assets. Therefore, a well-designed mechanism, for instance, a mechanism combined "from top to down audit" and "from bottom to up" whistle blowing mechanism can enforce the effects of Basu's proposition and leniency policy (Serra 2011).

Basu's proposal will be effective only when the cost of reports is trivial, and the probability of detection is high enough. Only with high probability of detection, can a whistle-blower det more refunds; however, in this case, the surplus of utility for both parts is nearly zero. As a result, bribery agreement is hard to be made.
On the contrary, if the probability of detection and conviction is low, even with a trivial cost of reports, bribery and whistle-blowing coexist under asymmetric penalties.

	$L < L^*$	$L \geq L^*$
$k < k_l$	No bribe	Bribe and whistle-blowing
$k \in [kl, k_h]$	Bribe without whistle-blowing	(Both situations are possible)
$k > k_h$	Bribe without whistle-blowing	
k = probability of report/whistle-blowing. kl = low k; k_h = high k. L*= equilibrium value of license which is profitable enough for E to report.		

Proposition 2.6
Asymmetric punishment is only effective when the cost of whistle-blowing is trivial, and the value of the license is not profitable enough for the bribers to pay a bribe.

2.4 Evolutionary game, parochial corruption, framing and culture

Verma and Sengupta (2015) design an evolutionary game to analyze the effectiveness of asymmetric and leniency (Basu's Proposal) on bribery. They use a game tree similar to the Abbink's in 2013 (see Figure 8).

They study the transition of the structures in the population (honest officials, corrupt officials; honest citizens who refuse to pay a bribe, citizens who pay a bribe silently and citizens who pay a bribe and report.). They find that under symmetric punishment mechanism, the elimination of bribery relies on a high punishment, a large possibility of prosecution, a small bribe size and a small report cost. High punishment and possibility of persecution can deter the bribery under asymmetric punishment mechanism even without the refund. Allowing to return the bribe back or a refund will definitely help encouraging whistle-blowing. In this case, an over optimum bribe amount can also lead to the breakdown of the negotiation, while a small bribe amount can't attract the honest officials enough.

Another interesting game theoretical analyzing the impact of the social structure on corruption is made by Kingston (2007), especially the effectiveness of asymmetric punishment on parochial corruption[12].

He extends the one-shot game to a social exchange game, where denouncement is beneficial in a short term for an individual, but in the long term, cooperation is the best choice for the entire social group where he belongs to. For example, the "solidarity networks" in developing countries where the insurance system is not sound. As assumed by most of the literature, the official is always in dominant position and a citizen as victim. Kingston points out that the web of social relationship that the briber represents also exerts pressure on the official. "Social capital", i.e. social networks, relational ties… will enforce the corruption transaction by liking one-shot games. He also affirms that it's the official that should be fully punished according to this one-shot model and give immunity can encourage the whistleblowers.

[12] The corruption like nepotism when the officials use relationships (kinship, caste…) to profit his power. (Scott 1972, Kingston 2007)

III Experimental studies

3.1 The experiments analyses on asymmetric punishments and leniency policy

3.1.1 Is asymmetric punishment more effective for deterring bribery?

The earliest and most important contribution on experimental bribe game is done by Abbink et al. in 2002 (see Figure 9).

Based on the three special characteristics of corruption: reciprocity feature, negative social externalities and inherent risky, they introduce three treatments: a pure reciprocity treatment (PRT), a negative externality treatment (NET, the payoffs are reduced for both parts if they choose to bribery) and a sudden death treatment (SDT, the detection of bribery is taken as an exogenous lottery and both parts are extruded from the game.)[13]

They find that the trust and reciprocity are essential to build a corrupt deal. The negative social externality barely has any influence on the corruption deal.[14]The threat of interrupting the corruption with penalty is significantly effective in deterring corruption.

They conducted another experiment on collusive bribery (non-harassment bribery) in 2013 at Xiamen University in China. Contrary to Basu's proposal, authors suggest allowing the public servants to self-report in collusive bribery. It's usually the citizens who initially propose a bribe to the officials to get a public service which is not entitled to them. In this case, it's reasonable to offer an opportunity for the honest officials to a leniency policy. The game happens when an importer tries to bribe an officer to jump the customs inspections, supposing there is no audit or third-part reporting and it's a repeated game. Reports are possible only when the bribe is accepted, and the reciprocity is offered.

The results show that allowing the public servants to self-reports in collusive bribery/non-harassment bribery has limited effects in deterring bribery. Whereas, encouraging only the citizens or entrepreneurs to report in a non-harassment bribery is not effective. The rewards mechanism only works in discouraging the bribery when the game is just one-shot.

3.1.2 Are asymmetric punishment and leniency policy effective for deterring harassment bribe?

The first experimental study on Basu's proposal and harassment bribe is Abbink et al. in 2013.

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[13] Abbink, K., Irlenbusch, B. and Renner, E., 2002. An experimental bribery game. Journal of Law, economics, and organization, 18(2), pp.428-454.

[14] Maybe that's because in a country where corruption is conspicuous, citizens are not fully aware dot informed of the negative social externality that the bribery can have. It's called "Visible or Invisible Externalities" by Spagnolo in 2017. See more Büchner, Freytag, González, and Güth (2008), Barr and Serra (2007).

It's a sequential decision game: an official may or may not demand a bribe from a citizen for a license which is entitled to him. When a citizen encounters a corrupt official, he can refuse to pay but with a vast cost.[15] He can either pay with or without bribe. There is always a possibility of being discovered even after the reporting.[16] (see figure 5 in annex)

Four mechanisms of punishment are introduced:

- *Symmetric punishment (SP)*: the Nash equilibrium is that a citizen always pays bribe but not report it afterwards, and the official always demands a maximal bribe amount.
- *Asymmetric punishment (ASP)*: according to Basu's proposal, when there is no fine on citizen and the bribe is returned, the equilibrium of the game will be "pay and report" for a citizen.[17]

- *With retaliation (WR)*: when the official has the right to revenge a citizen if the report doesn't succeed (the official is not convicted even after the report of the citizen), as the citizen has not got his license yet, he will face with the hassles of the same official.[18] However, the cost of retaliation is costly[19], so the effects of leniency policy may be reduced rather than totally disappeared.

- *With bribe amount not refunded (NR) and retaliation*: As returning the bribe amount is not realistic (How to verify the bribe amount declared by the citizen or when the money is laundered? What if the bribe is paid by antiques, jewelry, houses which are easily resold?), the leniency policy can be lee effective when there is no money refunded. When it comes to the classic problem of whether monetary motivation will crowd out the intrinsic motivation, it depends also on whether the citizen is fully informed of the social externality of his actions (bribe and reporting), the moral cost, the sense of responsibility, the social judgement…[20] In this situation the equilibrium of the game is not determinate.

The experiment took place in a university in Hyderabad (India) among the students, over half of whom have paid a bribe to get some public service.

The percentage of citizens who don't pay a bribe doesn't change too much across the four different mechanisms. Compared to the standard symmetric punishment mechanism, people who pay a bribe and report afterwards augment most significantly under asymmetric punishment mechanism, less significantly under retaliation mechanism and least significantly under no-refund mechanism.

There are some interest findings about the bribe size. They find that people tend to report more when the bribe amount is large, even when the cost pf reporting is huge in

[15] Here, different from the zero payoff in the theoretic analyses, authors try to take into consideration the negative social externality of bribery. They use the reduced payoff (from 500 to 40 for the citizen) to express the diminution of social efficiency. Nevertheless, the action of "pay quietly" sounds more harmful to the whole society, which isn't presented in the payoff sets.
[16] Which implies that the probability of detection is not equal to the probability of conviction.
[17] This equilibrium outcome is achieved only when the bribe amount is less than the imposed fine (B<F) in this game design.
[18] The revenge from the officials can be alleviated by the mechanism of "staff rotation" policies (Abbink et al. 2004).
[19] See, for example, experiments of Gächter et al. in 2008 and Abbink et al. in 2010.
[20] To learn more about the impact of (non-) monetary incentives and social judgment on whistleblowing, see Spagnolo in 2017, Schmole and Utikal in 2006, Dufwenberh and Selten in 2007, Bigoni et al. in 2012, etc.

symmetric treatment. Huge bribe demanded seems unfair for most citizens; little amount of bribe, in contrast, may bring more benefits for citizens then is tolerable. The bribe amount demanded by the official also drops in the asymmetric punishment mechanisms. As the average bribe amount doesn't change, this decline comes from the diminution of the trade. It's a result consistent with the theoretic conclusion of Basu in the part 2.3 that asymmetric punishment may encourage the reporting but also result in a huger bribe size. However, the causality between the bribe size and whistleblowing is confusing.

On the contrary, the deduction in the theories that the officials will demand higher bribe to compensate for higher risk in the asymmetric punishment mechanism is not testified in this experiment.

Regarding the officials, more officials demand bribes in retaliation and no-refund mechanisms than the (a)symmetric punishment mechanism. Their behaviours across the four mechanisms don't have too much change, whose optimal strategy is always to charge as more bribe as possible.

Two other interesting findings:

The no-refund monetary mechanism seems have not changed the whistleblowing behaviour.[21]

People who pay bribe and report it tend to charge bribe when the roles are changed.

3.2 The feasibility of asymmetric punishment and leniency policy in China

3.2.1 The relative experimental results

1) An experiment of non-harassment bribe in China

The game is designed as follows:

A payer (P) decides whether or not to pay a bribe (b) to receiver (R) to demand a favour (valued at v). Their payoff without bribe are e_P and e_R. R can either refuse the offer, accept it and give a favour, or accept but not return the favour. The bribery can be detected and convicted with a probability of α. When the bribery is detected, both will be punished by p_P and p_R, and the bribe is confiscated. If R returns no favor, E can report him.

But this bribe game excludes harassment bribes, social externalities, bargaining for the bribe amount, self-reporting after reciprocity by the receiver, and external detection.

The experiments are conduced in two universities in Bonn (Germany) and Shanghai (China).

[21] Same with the point of view of Spagnolo in 2015 about whistleblowing and motivation.

The results of the experiment show:

- More self-reporting from the bribers under asymmetric punishment in both cities;
- More rejections of returning a favor under asymmetric punishment;
- The threat of more self-reports under asymmetric punishment leads to more favors granted if the bribe is accepted;
- More bribe attempts are made by payers under asymmetric punishment.

They also found some interesting cases:

- the probability of detection has no big effect on bribers;
- proposers are retrospective and prospective: they tend to resist bribe offers once they have been detected before, and if they have revenged before;
- risk aversion has no impact on rejection decisions.

In China, more bribe deals are made under asymmetric punishment; while in Germany this case is not significant.

2) An empirical assessment in China

The most recent but also an initial empirical assessment of the impacts of asymmetric punishment, leniency on bribery is affected by Spagnolo et al. in 2017.

His methodology is base on the theoretical model on criminal collusion cartel behaviour of Mill (2009).[22] According to the model, if a policy is effective on detection of criminal activities, the detective cases will **increase** right after the implementation of the policies because of the booming of the underlying criminal cases, and then it will **decrease** gradually due to the subsequent readjustment.[23] They focus on the reform of the legislations on bribery in China in 1997.

The first legislation who defines the bribery as a crime was in the legislation of anti-bribery in 1952 in China. And bribery didn't become an independent crime until 1979 in the criminal law, in which the most severe punishment is 15 years of sentence in prison. In the "complementary decision on severely punishing criminals who undermine the economy" in 1982, the modification noted that the serious bribe takers will be sentenced to life imprisonment or death penalty. The complementary decision on punishing bribery crimes in 1988 set 2000 yuan as the filling standard of bribery crime. The standard went up to 5000 yuan in 1997.[24] The asymmetric sanctions on harassment bribe and leniency policy was strengthened in the legislation of 1997, especially for the bribe-takers. The leniency is always applicable for bribers who report before the investigation.

The data is chosen from the statistics on the cases on suspect corruption, arrests, trials and prosecutions of bribery before and after 1998. Therefore, the corruption detected and reported are mixed together. [25] The bribery and the other corruption forms (such as embezzlement, nepotism…) are not separated neither.

[22] We can't know the diminution of corruption cases are because of the elimination of corruption, or due to the "successful" collusion of the bribers and bribes without whistlblowing.

[23] Miller, N. H. (2009) "Strategic leniency and cartel enforcement", Page 11.

[24] Source: http://s.yingle.com/l/xf/105466.html

[25] It's hard to distinguish the two situations as the "bottom-up" and "top-down" mechanisms of corruption detection are always together.

However, contrary to the theory of Mill, their analysis shows that even though there is an obvious decrease in the number of corruption cases, there is not a "spike" from the data, which is a sign of deterioration of the situation.

Authors argue that the "slump-without-spike" changes in the database may because of the difference of cartels and corruption.[26]

Once again, less harassment bribery case and larger average bribe amount after the reform are observed in the data.[27]

They attribute this also to the exonerations of the bribers in the harassment bribery. Nevertheless, after a deeper analysis between 1986 and 2010 by separating bribers and bribees, they point out that the decrease of harassment bribe come more from the bribees rather than the bribers. This may be related to the fact that the bribees can get leniency even after the whistleblowing of the bribers. As pointed by Abbink (2002) and Li (2012), the leniency for bribees allow them to retaliate the bribers, especially in the harassment bribe where the crime and punishment is much less severe. Even the bribe game is one-shot, the group of interests in the official will defender their "credibility" or "reputation" by discouraging the whistle-blowers or even the new demanders of public service.

They find also that more serious bribery case occurring, implied by the higher level of officials involved in the bribery case. This finding proves the previous theoretical inferences of Oak in 2013. In countries like China, the officials who have absolute discretional power can change easily a complaint project to a non-complaint project, especially when the criteria are subjective.

The only positive and tenable argument, to explain the effectiveness of the policies, is that the enforcement is not strict enough. Together with an increased latency (the time between the corrupt deal and the time of detection) in the data, which means more time to discover the crimes, these may lead to a mild instead of a sharp increase of cases.

3.2.2 The Legislative Recommendations and their practices in China

China is called "celestial empire" (Tianchao) ironically by the young cyber users in recent years. Even with the rapid economic development, the autocratic dictatorship since over 2000 years haven't decreased at all in the long history. The central control of the media and press are imposed to ignore the uprating serious social problems as the pollution, gender and regional discrimination, the uneven distribution of social resources[28], the corruption…

[26] Which is not a persuasive argument and not consistent with other articles of Spagnolo.

[27] The larger bribe amount finding is consistent with the previous theoretical deduction, and it's also coherent with the economic reform and development after 1979. As for the fewer harassment bribe cases, there are may be other reasons except the legislative reform on bribery.

[28] For example, a documentary made by a Japanese director NHK http://www.nhk.or.jp/docudocu/program/92409/2409304/ .

There are three groups involved in the “guanxi” (social network) in china: “hong er dai” (the Red second generation), who are the descendants of people help creating the people’s republic of china in the 49s; “guan er dai” (“the officiallings”), which means the descendants of the officials; “fu er dai “(the second-generation riches), meaning the descendants of the rich people. The red generation concentrates in politically central cities like Beijing, the two others are decentralized in different regions. What’s in common is that they have the most political power and economic influence. The power-and-money transaction is uncommon in the whole world, but it can never be so conspicuous in a country as china.

The corruption especially accompanied with the social network or the nepotism is conspicuous in china. The collusive corruption and the harassment bribe can be seen almost everywhere, from getting a public position to getting a visa. The bribery becomes more like a shortcut for citizens. When you get “relationships” in the public function, you get privilege to everything. So, the rich business collude with the bureaucrat to get profits and the poor people suffers the harassment from the bureaucrat. Sometimes people even pay a bribe to get rid of the harassment from the bureaucrat. The only situations when a citizen blows a whistle is either because of the uneven carve-up of benefits after the negotiation, either because of the internal political power struggles.

The cost of whistle-blowing is superhigh when the society is surrounded by the corrupt bureaucratical groups. Revenge from the bureaucrat is also the usual case, the punishment on some officials can be very light and even not imposed on reality. With the censorship of mass medias, it’s getting harder to expose the bad side of the society such as corruption as it’s inconsistent with “the core values of the socialism”.

IV Conclusion

Theoretically, asymmetric punishment is effective on anti-corruption, especially on harassment bribes. Nevertheless, the mechanism needs to be well-designed to guarantee a low cost of whistle-blowing for citizens, a high probability of conviction after whistling-blowing, a low possibility of revenge from the bureaucrat, an ensured honesty of the legislative institutions.

Once one of the conditions is not fulfilled, Basu's proposal will backfire: an honest citizen may become an dishonest citizen by threatening the bureaucrat to get what doesn't belong to them; the bureaucrat will change a non-harassment bribe into a harassment bribe; a whistle-blower will get retaliated from the bureaucrat or his complice after reporting. Even when all conditions fulfilled and Basu'a proposal works, it may increase the bribe amount or the bribe payers.

Things can get more complicated when the policies are implemented in real life. For example, how can we identify a harassment bribe from non-harassment bribe when the criterion is subject and flexible? What if a dishonest citizen blackmails a bureaucrat by frame up in this situation? There may be also irreversible externalities which has been done to the society after the transaction of the bribe. When the bribe trade is finished, it's always too late. So why not encourage the citizen to report the extortion from the bureaucrat before the bribe-giving?

The experiments are more realistic as they reflect the psychological, social cultural, ethical influence on bribe game. Unfortunately, the experimental studies on well-designed bribe game in China is limited in recent years.

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Appendices

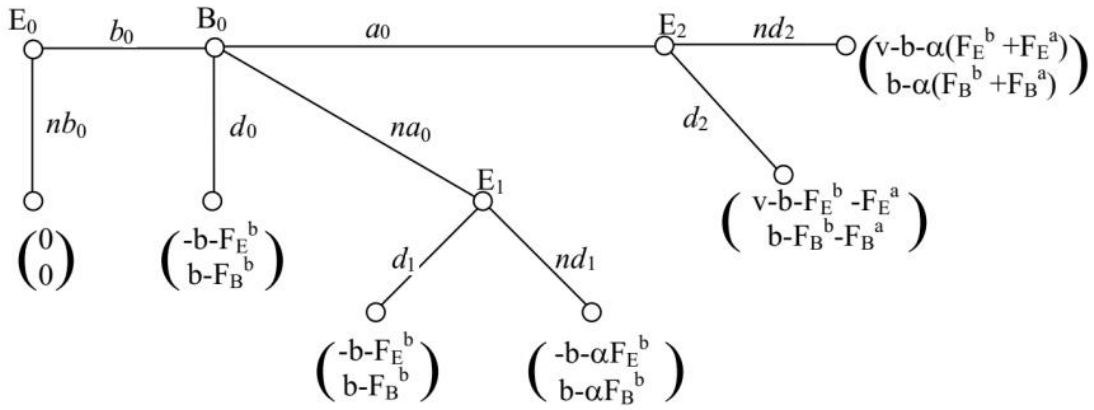

Figure 1: One-Shot Game with Asymmetric Penalties (Lambsdorff and Nell, 2007). (Here I have made a footnote as 0 or 1 or 2 to separate the different strategies.)

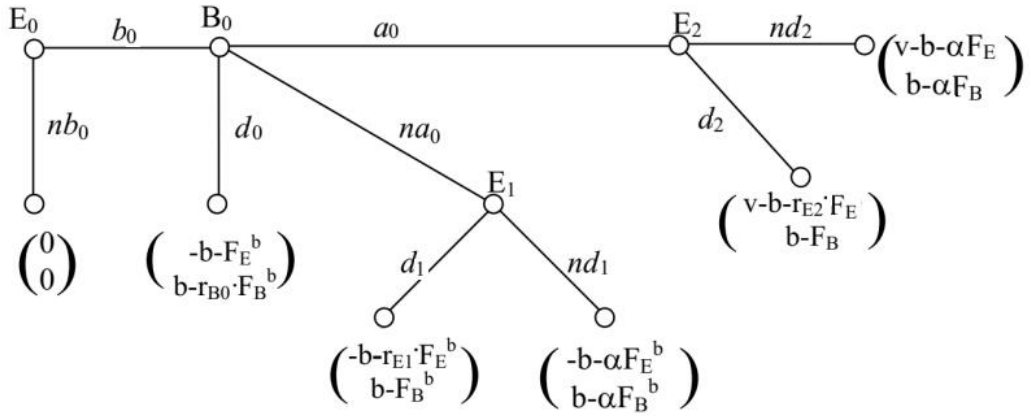

Figure 2: One-Shot Game with Leniency (Lambsdorff and Nell, 2007).

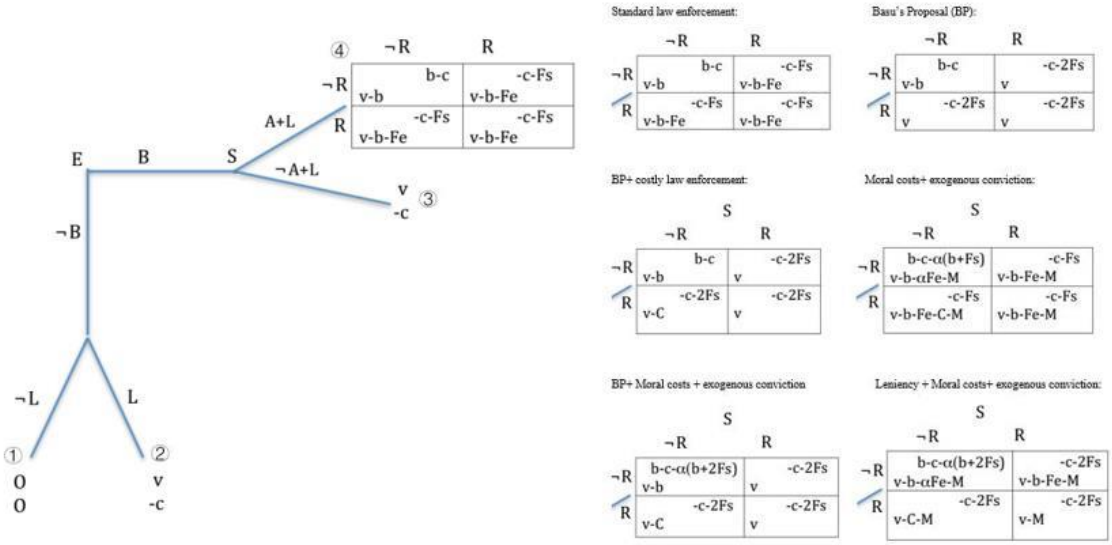

Figure 3 (left): A harassment bribe game with standard law enforcement (Modified by elimination the situation when S neither accept nor issues a license when he accepts the bribe.)
Figure 4 (right): A harassment bribe with other constraints.

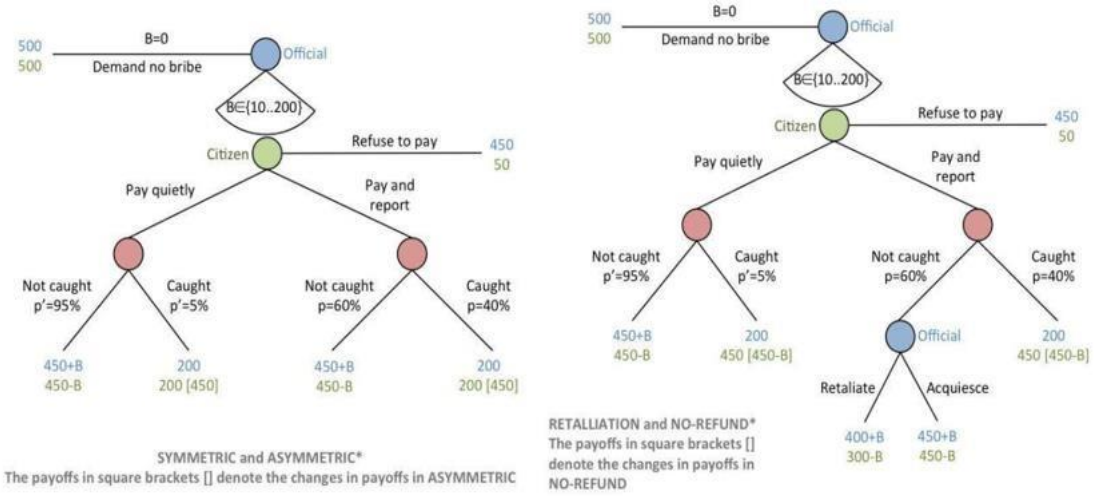

Figure 5: The game tree of Abbink 2013 "letting the briber go free" (Left: treatments without retaliation; Right: Treatments with retaliation)

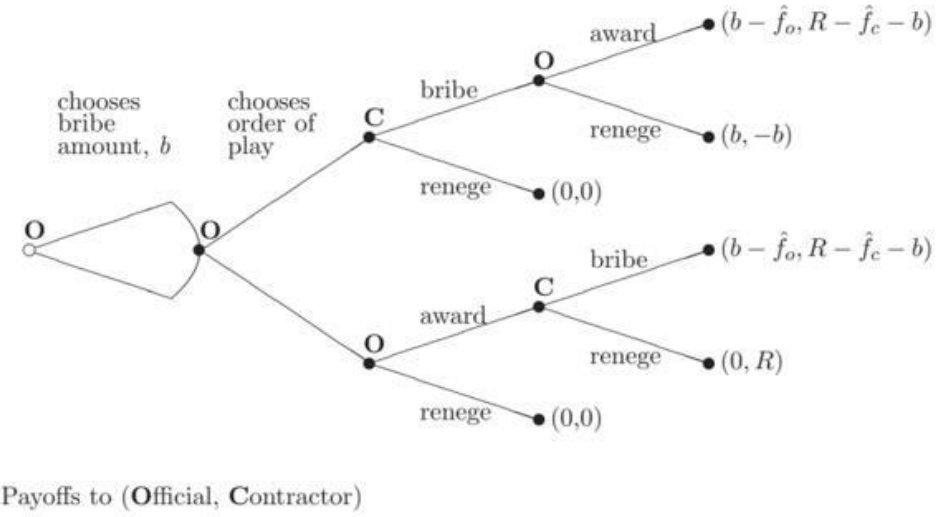

Figure 6: One-shot bribery game of Kingston (2007)

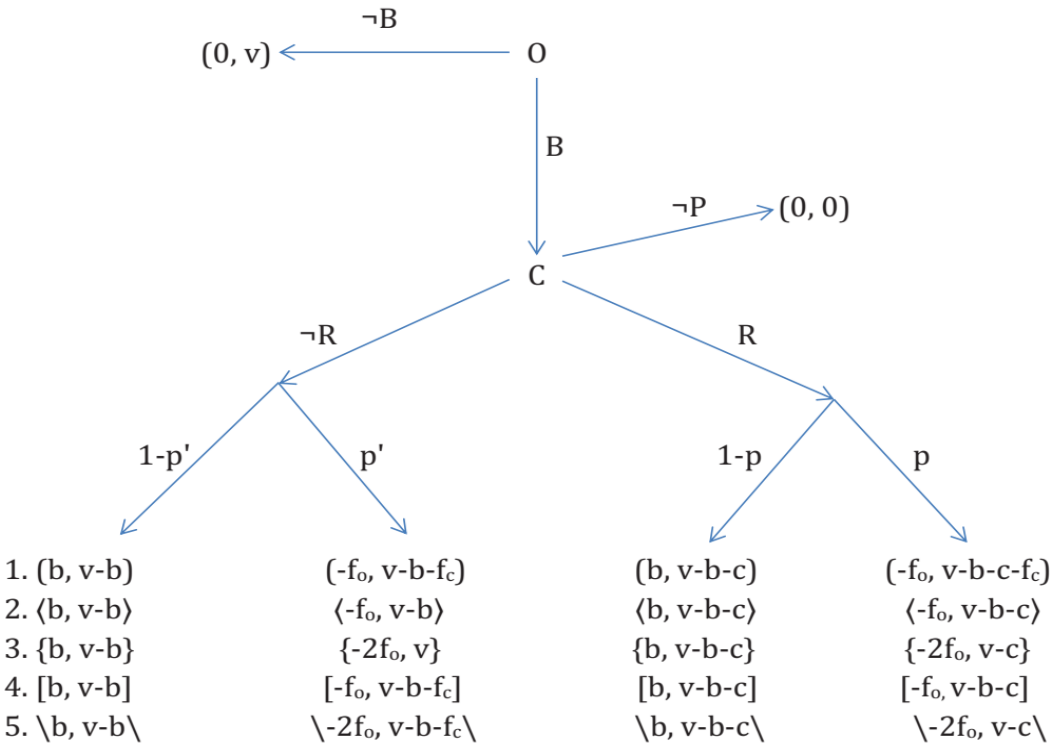

Figure 7: A bribe game when the probability of detection and conviction are endogenous (a modified game based on the paper of Spagnolo in 2012 by Chandan Kumar Jha in 2015)

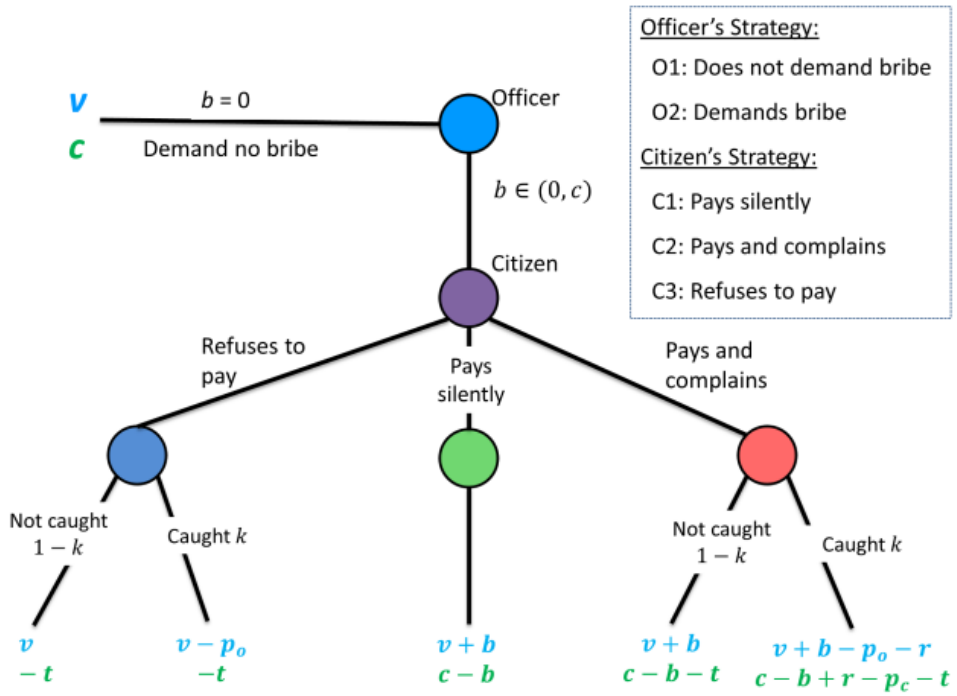

Figure 8: Game tree of an evolutionary bribery game by Verma and Sengupta (2015).

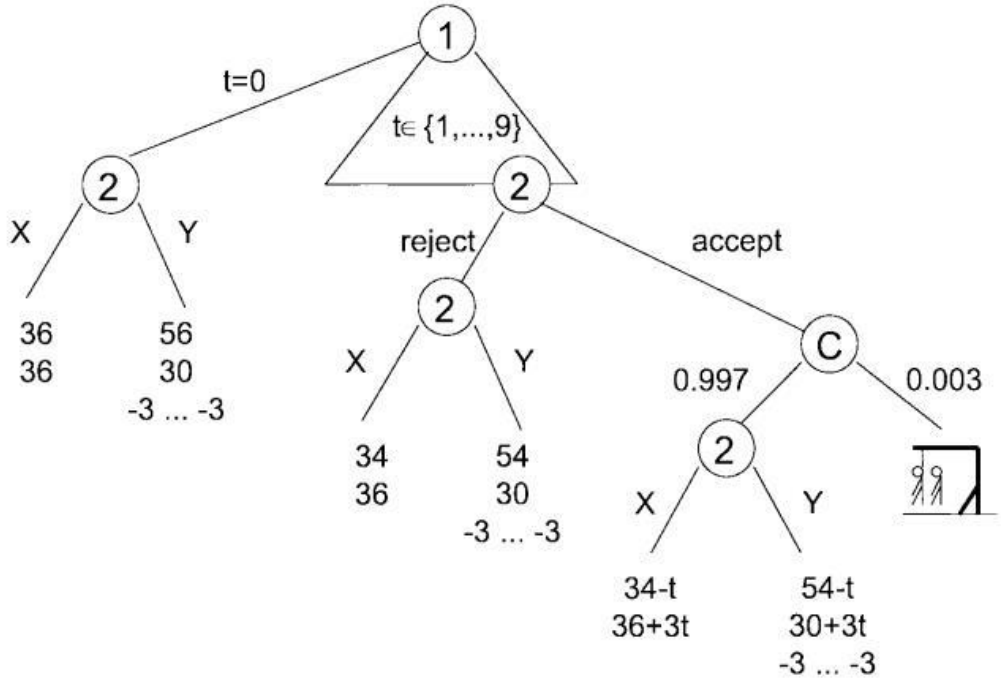

Figure 9: A incomplete game tree in a collusive bribe game by Abbink, al in 2002

Table 2.1: The subgame perfect equilibrium results for a one-shot bribe game with leniency (r_E=r_B=0)					
The participation contraints :			$b_{min} \leq b \leq b_{max}$, ou $v \geq \alpha(F_B + F_E)$		
			a	b	c
Dominant strategies	E_1/ E_2		*do*	na_o	a_o
	F_E^b	F_E			
① (*d1* , *d2*)	> 0	> 0	F_B^b >0, F_B>0	F_B^a >0, F_B^b <0	F_B^a <0, F_B<0
SPE			{(*nbo*, d_1, d_2), (*do*, na_o)}		{(*bo*, d_1, d_2), (a_o)}
			(0,0)		(v-b-F_E, b-F_B)
② (*d1* or *nd2*)	> 0	≤ 0	F_B^b >0, F_B>0	F_B^b <0, F_B^b < αF_B	F_B^b > αF_B, F_B<0
					{(*bo*, d_1, nd_2), (a_o)}
					(v-b-αF_E, b-αF_B)
③ (*nd1* or *d2*)	≤ 0	> 0	F_B^b >0, F_B>0	F_B^b <0, F_B>αF_B^b	F_B<0, F_B<αF_B^b
SPE			{(*nbo*, nd_1, d_2), (*do*)}	{(*nbo*, nd_1, d_2), (na_o)}	{(*bo*, nd_1, d_2), (a_o)}
			(0,0)	(0,0)	(v-b-F_E, b-F_B)
④ (*nd1* or *nd2*)	≤ 0	≤ 0	F_B^b >0, F_B>0	F_B^b<0, F_B^b<F_B	F_B<0, F_B>α F_B^b
SPE			{(*nbo*, nd_1, nd_2), (*do*)}	{(*nbo*, nd_1, nd_2), (na_o)}	{(*bo*, nd_1, nd_2), (a_o)}
			(0,0)	(0,0)	**(v-b-αF_E, b-αF_B)**
2 SPE			$F_E^b \leq$ -b	{(*bo*, *d1*, *nd2*), (*do*, na_o)}	(-b- F_E^b, b-F_B^b) & (-b- F_E^b, b-F_B^b)
			-b < $F_E^b \leq 0$	{(*bo*, d_1, d_2), (a_o)}	