COLLUSION IN CORRUPT SYSTEM: A GAME THEORETIC APPROACH

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Abstract

There is a growing literature on the issue of corruption. In particular, there is a large body of work that looks at policy instruments relating to punishment, incentive or monitoring schemes for the control of crime. In this context this paper considers, within a game theoretic framework, the different instruments that are available for the control of corruption or pilferage and considers as an example the voluntary disclosure of income scheme (VDIS) introduced by successive Indian governments for tax collection.

Introduction

The empirical literature dealing with the issue of corruption generally reported a negative correlation between economic growth and the level of corruption (Mendez and Sepulveda, 2000). In fact, prevalence of corruption at all levels of society marks a common feature for almost all developing nations. While some developing countries follow a hard approach to curb corruption , many others take resort to soft policies [see Jain (1998) for corruption and government]. Acceptance of corruption (in these latter countries) as a normal phenomenon by the general public makes its prevention all the more difficult. Bribery in particular is so pervasive that it is embedded in everyday life. The legal procedure being inefficient and unusually lengthy, it is hardly surprising that people do not view the potential threat of punishment seriously. Some people argue that privatization of certain activities can reduce the extent of corruption. While this may be true, all activities cannot be brought within the private sector. This paper focuses on two factors that are crucial in sustaining corruption in a developing nation. The first factor is that the probability of being held legally responsible for a crime is negligible. Secondly, the present value of the loss from a potential penalty itself contingent upon conviction is not significant. In India, the penetration of corruption into government departments in the form of bribery which leads to the evasion of tax[1] and other federal duties has proved rather costly to the economy [see Bardhan (1997 for a discussion on corruption and development][2].

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I am thankful to Sugata Marjit for creating an interest in this area.

This is not a phenomenon specific only to the Indian economy as quite a number of African countries (Rose- Ackerman,1999) and many countries of the erstwhile Soviet Union face the same problem. A study on Pakistan estimates that if the leakage caused by corruption and mismanagement could be reduced by 50%, the ratio of tax to gross domestic product would increase from 13.6 % to over 15% [Burki (1997)]. This note attempts to discuss a special case of India's tax collection policy, viz., the Voluntary Disclosure of Income Scheme (VDIS) and its effectiveness in combating corruption.

Successive Indian governments have, from time to time, introduced *voluntary disclosure of income schemes* for tax collection. The latest scheme, viz., VDIS'97 evoked a remarkably positive response. The provision of voluntary disclosure of income in VDIS'97, contained in Sections 62 to 78 of the act, had the objective of mobilizing tax revenue from previously undisclosed income and channeling it into priority sectors of the economy. The salient features of the last scheme, which commenced on July 1, 1997 and ended on December 31, 1998, were as follows (Economic Survey, Govt. of India, 1996).

First, it covered both corporate and non-corporate entities. The tax payable on the income declared under the scheme was 35% in the case of corporate entities and firms, and 30% in the case of all others. Secondly, according to the scheme a person could make a declaration in respect of any income chargeable to tax for any assessment year, up to 1997- 98. Thirdly, the scheme provides an assurance that all particulars contained in a declaration are to be treated as confidential. Furthermore, the contents of a declaration were not admissible evidence against the declarant for the purpose of penalty under the income tax or wealth tax act.

The scheme was a resounding success with a total number of disclosures of over .47 million, involving disclosure of income of Rs 330 billion (2.3% of GDP). The revenue collected under VDIS '97 accounted for about 7% of gross tax revenue and 20% of gross direct taxes (Economic Survey, Government of India). This is, however, not the only voluntary disclosure scheme that has been introduced so far. The following table depicts the particulars of earlier VDIS schemes:

The schemes	No. of cases	Tax collected (million)
VDS, 1951	20912	108.9
VDS, 1965	20001	308
VDS, 1965 (number 2)	114226	194.5
VD of income and wealth'76	245570(income) 13422(wealth)	247 & 7.7

Source: Economic Survey, Government of India, different issues

While such a policy can tap revenue that would otherwise escape the tax net of the government, it also raises some important questions. One of the stated objectives of introducing the VDI scheme is to 'offer an opportunity to the persons who have evaded tax in the past to declare their undisclosed income, pay a reasonable tax and in future adopt the path of rectitude and civil responsibility' (Economic Survey, Government of India). This objective is based on the assumption that individuals can be induced by suitable rewards to 'mend their ways' and return to the 'path of rectitude'. Because of such declared intentions of the scheme and its assumptions on human behavior, it would be interesting to subject the scheme to an economic analysis based on the usual assumptions of economic theory viz., the rational optimizing behavior of individuals.

Given this motivation, we begin with a general game theoretic framework and analyze the possibility of controlling embezzlements through various penalty/ reward schemes. Quite a number of papers in the existing literature deal with similar problems[3] .Our work differs from the previous contributions in its modeling of the bribery scheme in the presence of a special collusive agreement (see also Tirole,1986) and its treatment of information availability in the system (Marjit, Rajeev and Mukherjee, 2000). Based on our analysis we consider the VDI scheme as an example of a collusive agreement.

The following section describes the general framework under consideration and examines various punishment and reward schemes for the control of crime. We next consider a possible collusion between a law enforcing supervisor and a potentially corrupt agent and the penultimate section uses the findings to re- interpret the VDI scheme. We also examine in this context the relevance of a personal transfer policy in controlling corruption. A concluding section sums up the findings.

The Model

The model under consideration is that of Marjit, Rajeev and Mukherjee (2000). Suppose the economy consists of 'n' potentially corrupt agents, who can be engaged in corrupt activities like tax evasion or an evasion of customs duties, etc. There is a supervisor who is in charge of detecting such embezzlements by the agents. We assume that the supervisor is dishonest in the sense that s/he is ready to take a bribe from the agents for not reporting the crime (to the higher authorities), after detection, when it is optimal for him/her to do so.

The agents are different from each other with respect to their *abilities to avoid detection* by the supervisor. In particular, the agents who have the lowest ability or synonymously having the least experience in the field would be notified as type 1 agents. Thus, a type t agent has lesser ability to avoid detection than a type t+1 agent. Finally, the type T agents form the upper bound by being the ones with the highest ability. To capture this feature, we would index the agents of different types through θ (a real number) belonging to the interval $[\theta_T, 1]$, where the type T agents would be indexed by θ_T and the type 1 agents by 1. In general, if θ_t is the index for a type t agent and θ_{t+1} for a type (t+1) agent and if the latter is more experienced, then $\theta_{t+1} < \theta_t$.

Thus, the supervisor's chance of detecting a crime depends on the type of the agent i.e., how experienced he is in concealing his crime or embezzlement. We assume that this chance or *probability* also gets influenced positively by a second factor, viz., the *effort* 'e' made by the supervisor for detecting a crime. Thus, if the supervisor puts an effort 'e' to detect an agent whose type is indexed by θ, the chance of the former being successful is denoted by θ p(e), which clearly decreases for the agents with a lower type index (or, equivalently higher ability to avoid detection). In other words, an agent with a higher ability to conceal his/her crime will be indexed by a smaller θ and hence will show a higher chance of getting detected. In particular, the probability of detecting a type T agent is θ_T p(e) and that of a type 1 agent is p(e) (=1.p(e)). This exertion or effort produces disutility to the supervisor, which we denote by d(e)>0 and make the following assumptions:

$$p'(e) > 0, \quad p''(e) < 0, \quad d'(e) > 0, \quad d''(e) > 0.$$

The first two conditions imply that the probability of detecting a crime increases with the increase in effort level given by the supervisor, however, it increases at a decreasing rate. The next two inequalities imply that disutility from putting the effort increases with the increase in the level of the effort, but if one goes on putting higher and higher level of effort, disutility can shoot up with such excessive effort and resulting exertion.

Penalty-Reward Scheme

If a corrupt agent is brought to the court of law s/he has to pay a penalty αx, $\alpha > 1$, where x is the net pay-off for the agent arising due to her/his corrupt activities and α is the penalty rate. The supervisor in turn gets a proportion λ of the penalty as a reward, given by $\lambda\alpha x$; $\lambda \leq 1$, such that reward can be financed by the penalty received . Alternatively, however, a corrupt agent for not reporting the crime can pay the supervisor an amount B (as a bribe)[4].

Given this basic framework let us now look at the strategies available for the supervisor and the agents. An agent can be honest (H) i.e., s/he is not involved in any corrupt activities, or can be dishonest (D), i.e., can be corrupt and ready to pay a bribe as and when necessary. The supervisor's strategies are either not to accept a bribe and opt to report (NA) or, to accept a bribe (A) for not reporting the crime after detection[5]. In this set-up if the supervisor knows the type of an agent as t and plays (NA, e), i.e., s/he does not accept a bribe and puts effort level 'e' for detection of a crime and the agent plays D, then the expected pay-off to the agent is:

$$x\{1-\theta_t\, p(e)\} + (x - \alpha x)\,\theta_t\, p(e)$$

$$= x\{1-\theta_t\, p(e)\} - x\,\beta\theta_t\, p(e) \quad \text{......................(1)}$$

where, $\theta_t \in [\theta_T, 1]$ is the index for the type t agents, $\beta = \alpha - 1$ and $p_t(e) = \theta_t\, p(e)$.

Thus with probability $p_t(e)$ the agent gets caught and pays a fine αx. Hence his/her net pay-off is $(x - \alpha x)$. On the other hand, with probability $1- p_t(e)$ s/he does not get caught and hence earns x which in turn gives us (1) as the expected pay-off for the agent.

The supervisor's pay-off is:

$$H(e) = \lambda\alpha x\ p_t(e) - d(e) \quad \text{............................(2)}$$

If the supervisor is successful in detecting the crime (which has a chance $p_t(e)$) s/he earns a reward $\lambda\alpha x$, but the effort creates disutility to the extent of d(e). Note that (2) is a concave function of e (fig 1).

An agent would play D only if it gives him/her some positive returns, i.e., his/her expected pay-off derived in (1) above were positive. Thus solving (1) > 0 we get[6]:

$$p_t(e) = \theta_t\, p(e) \le 1/(\beta+1) = 1/\alpha \quad \text{................(3)}$$

Thus, if the supervisor puts a very high effort level (in particular from (3) above we get if $e > p_t^{-1}(1/\alpha)$), the agent would not try to be engaged in any corruptive activities.

The supervisor would try to maximize his/her pay-off by appropriately choosing the effort level and hence his/her (unconditional) optimal effort level would be derived from maximizing his/her pay-off with respect to the effort level

$$\text{Max}_e\ \{\lambda\alpha x\, p_t(e) - d(e)\}$$

$$= \lambda\alpha x\, p_t(e_{max}) - d(e_{max}) = H(e_{max}), \text{ say,} \quad \text{.........(4)}$$

where, $p_t(e_{max}) = \theta_t\, p(e_{max})$.

However, if $e_{max} > p_t^{-1}(1/\alpha)$ [fig1], a type t agent will play H (see (3)) and hence the resulting pay-off for the supervisor would be 0. In other words a high enough effort level on the part of the supervisor will make the agent to be honest. As a result it will not be possible for the supervisor to collect any reward since there was no crime committed.

Therefore, the optimal effort for the supervisor, if s/he wants to report and earn reward would be, min (e_{max} , $p_t^{-1}(1/\alpha)$)= e*, say.

On the other hand if the agent plays D i.e., opts to be corrupt and the supervisor opts for A (accept a bribe), a possibility of a bribe (B) emerges[7]. Computing the agents' pay-off in a fashion similar to that of (1) we arrive at the following condition:

$$x(1-\theta_t\, p(e)) + (x - B)\,\theta_t\, p(e) > 0$$

$$p_t(e) = \theta_t\, p(e) \le x/B \quad \text{.............................(5)}$$

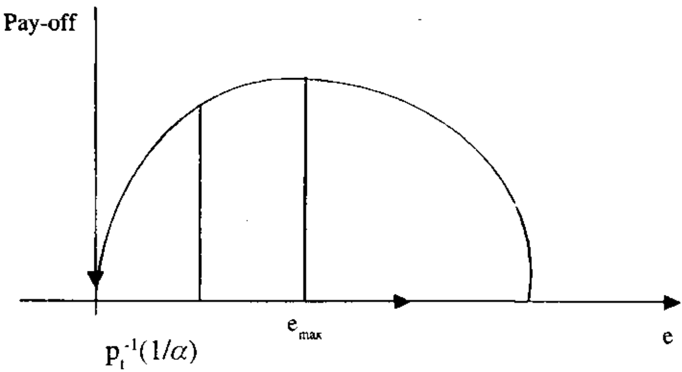


Fig.1

We further *assume* that there is a probability 'q' that the corrupt supervisor is successfully *penalized* for taking a bribe, in which case s/he incurs a loss 'L', where, 'L' is the discounted value of the loss from a potential penalty. It is assumed that q and L are *exogenously determined* which essentially depend on the social consciousness as well as alertness and honesty of the reporting and judiciary system. Hence, whenever the supervisor takes a bribe B, there is always a chance of getting caught later and incur an expected loss qL. Thus his/her net pay-off from such an activity would be $B- qL$. However, all these will happen only if the supervisor can detect a corrupt agent which has probability $\theta_t\, p(e)$ and an effort put will always cause some amount of disutility captured by $d(e)$. Thus the supervisor chooses his/her effort level so as to maximize his/her expected pay-off:

$$\text{Max}_e \{ B - qL\}\, \theta_t\, p(e) - d(e)$$

$$= (B- qL)\, \theta_t\, p(e^{B}_{max}) - d(e^{B}_{max}) = G(e^{B}_{max}), \text{ say.}$$

As argued above, if the supervisor puts very high effort (i.e., a very strict supervisor) the agent would not be engaged in any corruptive activities and the supervisor in turn will earn 0 return. Hence s/he has to select her/his effort level optimally so that the crime gets committed and s/he also gets the maximum possible return.

As before, the supervisor's optimal effort would be $\min(e^{B}_{max}, p_t^{-1}(x/B)) = e^{**}$, say.

Thus, $G(e^{**})= (B- qL)\, \theta_t\, p(e^{**}) - d(e^{**})$.

We assume a general form for B as $B= \delta\, \alpha\, x$, $\delta < 1$.

If $\delta =1$, we assume that the agent would be ready to pay a fine rather than a bribe.

Remark 1: In this set-up, if we assume that a supervisor is in charge of a particular locality for a long enough time to have *complete information* about the agents' types and can develop a reputation regarding her/his *strictness* in detecting an embezzlement, then s/he can *commit* differentiated effort level for every agent s/he confronts. It can be easily shown under this assumption that crime on the part of the agents cannot be controlled, even though it may be possible to prevent the bribery solution by announcing an appropriate λ (i.e. (NA ,D):(supervisor, agent) would be a solution).

Failure to control crime in this set-up is due to the fact that the supervisor gets a reward only if crime exists and s/he therefore, ensures the occurrence of the same by choosing an appropriate effort level for each agent.

Remark 2: An *alternative, lump sum reward scheme* therefore, can be conceived. Consider a situation where the supervisor's reward, instead of being conditional on the fine collected, depends on the contrary on some *exogenous* assessment of his/her performance. For example, if the supervisor is in charge of pollution control, s/he is given a reward 'R' if, after a scientific testing of air quality, pollution level is found to be within a specific limit.

The scheme has the following noteworthy features:

(i) Here the government's earning through fines is close to zero, as ideally the supervisor's effort level will be high enough to ensure honesty on the part of the agents.

(ii) However, the government has to finance a large reward R to the supervisor, to compensate for his/her potential earnings through bribery.

(iii) Applicability of the scheme is limited to cases where such an exogenous assessment is feasible.

Apart from the example of controlling pollution, one alternative situation where such an exogenous assessment is feasible is *tax collection*. Here the supervisor can be given a reward if s/he collects taxes up to a pre-specified amount. However, from (i) and (ii) above, it is clear that this type of scheme, rather than enhancing the revenue of the government, would raise its cost.

Alternatively, a supervisor may be *punished* if the external assessment suggests that the work is not accomplished successfully. If the punishment is a 'salary cut', one has to then compare the financial gain to a supervisor arising out of taking a bribe with the financial loss due to a salary cut. If the punishment can be made very stringent, for example, loss of employment, things might work. In countries like Singapore very stringent punishment is able to control corruption to a great extent. However, such actions may not be politically viable in many other developing countries. A World Bank study of 72 countries indicated that corrupt officials are seldom penalized (Mendez and Sepulveda, 2000).

Remark 3: Consider a situation where the supervisor cannot individually identify the type of each agent *(incomplete information)*, while s/he has an idea about the *distribution* of agents according to their types. This can happen if the supervisor is in charge of a particular locality for a shorter period of time, which is not enough to gather personalized information about each agent. It has been shown in Marjit , Rajeev and Mukherjee (2000) that in such a situation, the optimal choice problem of the supervisor would restrict him/her to choose a *uniform effort level* say, $\underline{e}$, for all the agents (since he/she cannot distinguish between different types of the agents). Depending on λ, this uniform effort level can be high enough for the relatively inexperienced agents, inducing them to opt for the strategy '*honest*' and thereby making crime at least *partially controllable*.

Note 1: If the supervisor is in charge of a particular locality for a long enough time s/he will know each and every agent quite well. This will give rise to a situation of complete information. His/her effort levels would be chosen for each and every agent separately and appropriately. As our result indicates, in such a case it will not be possible to control corruption.

Incomplete information on the part of the supervisor can arise if s/he is in charge of a particular locality not for a long enough time. This can happen if a person is transferred from one locality within a regular interval of time. From Marjit, Rajeev et al. (2000) (and from Remark 3) it is clear that it will be possible to at least partially control corruption under incomplete information on the part of the supervisor and his effort to detect corruption *increases* with the level of reward. Such a result supports the *personal transfer policy* of the government where by, an employee is posted in a particular location for a limited period of time, which in turn may prevent him/her from acquiring complete information about the agents.

A Possibility of an Agent-Supervisor Collusion

The works of Basu et al (1992), Marjit and Shi (1998) and Marjit, Rajeev and Mukherjee (2000) however, do not consider a further possibility of collusion between the agents and the supervisor, which is presumably common in many developing countries including India. This note examines the implications of this possibility theoretically.

Suppose an agent resorts to the following strategy in his/her confrontation with a supervisor. S/he does not wait for the supervisor to detect her/his embezzlement. *Prior to the detection of his/her crime,* a criminal agent confesses his/her guilt to the supervisor and offers a bribe $\mathfrak{Z}=bx$ ($b<1$ (take it or leave it)) for settlement. The supervisor then has two possible strategies viz., to accept the bribe which relieves him/her from putting an effort for detection of a crime or alternatively, (as in the previous section) to detect the crime and consider the option of reporting for a reward $\lambda\alpha x$. At this stage again the supervisor can take a bribe for not reporting (after detecting). However, we ignore this case due to the following lemma:

Lemma 1: There exists a $\lambda \leq 1$, such that reporting is optimal after detection.

Proof: We recall that the supervisor's pay off if s/he opts to report is

$H(e^*) = \lambda\, \alpha\, x\, p_t(e^*) - d(e^*)$

Alternatively, her/his pay off if s/he decides to take a bribe is

$G(e^{**}) = (\delta\alpha\, x - qL)\, p_t(e^{**}) - d(e^{**}),\ \delta < 1.$

We fix a $\lambda = \lambda^*$ s.t. $\lambda^* \geq \delta$.

Then $\lambda^*\alpha\, x\, p_t(e) - d(e) > (\delta\, \alpha\, x - qL)\ p_t(e) - d(e)$, for all e.

In particular, $\lambda^*\alpha\, x\, p_t(e^{**}) - d(e^{**}) > (\delta\, \alpha\, x - qL)\ p_t(e^{**}) - d(e^{**})$

Thus, $\lambda^*\alpha x\, p_t(e^*) - d(e^*) > \lambda^*\alpha x\, p_t(e^{**}) - d(e^{**}) > (\delta\,\alpha x - qL)\, p_t(e^{**}) - d(e^{**})$. QED.

Therefore, if the government fixes such a $\lambda = \lambda^*$, no bribery will take place after the detection of the crime. In other words, reporting would always be optimal after detection. Suppose such a $\lambda = \lambda^*$ has been fixed to avoid the bribery solution. Then "bribe" would refer to a bribe offered prior to the detection of a crime. We therefore continue to consider two possible strategies for the supervisor:

A: accept the bribe,
NA: not accept the bribe;

while the agents' strategies also remain the same: H (honest) and D (dishonest).

Note 2: Question may arise whether random monitoring by an external agency can give a credible threat to the supervisor and compel him/her to be honest. One has to then find out conditions under which such an agency cannot be bribed.[8] If the external agency is assumed to be honest (by definition) one has to recalculate the value of bribe, etc., to incorporate this additional risk of getting caught by an external agency, which is beyond the scope of the paper.

Let us first consider the **complete information case**. If the supervisor chooses A, his/her pay-off would be :

$$bx - qL\ldots\ldots\ldots\ldots\ldots(7)$$

where, $b \leq 1$ and q and L are as defined above.

If s/he chooses NA and opts to report, her/his pay-off (for any given e) would be

$F(e) = \lambda\,\alpha x\, p_t(e) - d(e)$. We have from section 2 that his/her optimal effort e^* would be s.t. , $p_t(e^*) = \min(1/\alpha,\ p_t(e_{max})) \leq 1/\alpha$.

Hence inserting the minimum value $p_t(e^*)$ we get

$$\therefore\ \lambda\,\alpha x\, p_t(e^*) - d(e^*) \geq \lambda x - d(e^*),\ \ \lambda \leq 1\ldots\ldots\ldots\ldots\ldots(8)$$

Comparing (7) with (8), it is observed that if qL is not sufficiently significant, i.e., reporting or judiciary system or for that matter society at large do not give a big threat to a supervisor who is engaged in taking a bribe, then there would always exist a

$$b < 1 \text{ s.t. } bx - qL > \lambda x - d(e)\ldots\ldots\ldots\ldots\ldots(9).$$

A sufficient condition for (9) to hold is $qL < d(e^*)$[9]. Note that (9) implies that the net pay-off from taking a bribe dominates the one from reporting.

Now let us consider the agents' problem.

Case 1: If $\min(1/\alpha, p_t(e_{max})) = 1/\alpha$

Then the agent's pay-off is (close to) zero (see end note 6) if s/he does not pay a bribe. But s/he can choose to pay a bribe $b < 1$, such that (9) holds whereby, both the agent and the supervisor can gain. Therefore in this case it is not possible to rule out the bribery solution.

Case 2: If $\min(1/\alpha, p_t(e_{max})) = p_t(e_{max}) = p_t(e^*)$

Then the agent's pay-off , if s/he does not bribe is

$p_t(e^*)(x - \alpha x) + (1 - p_t(e^*))x = x(1 - \alpha\, p_t(e^*)) > 0$

If the agent opts to bribe, his/her pay off would be $(1-b)\,x$.

Suppose $d(e^*) - qL = \varepsilon > 0$

We fix a bribe $\beta(=bx)$, $b = \alpha\, p_t(e^*) - \varepsilon / (ax)$,
where $a>1$ is s.t. $\alpha\ p_t(e^*) > \varepsilon / (ax)$

The supervisor's pay off under strategy A would then be

$\alpha x\, p_t(e^*) - \varepsilon / a\ - qL\, p_t(e^*)$

It would be optimal for him/her to take a bribe if

$\alpha x\, p_t(e^*) - \varepsilon / a\ - qL\, p_t(e^*) > \lambda\, \alpha\, x\, p_t(e^*) - d(e^*)$

$\Rightarrow \alpha\, x\, p_t(e^*) - \varepsilon / a\ - qL\, p_t(e^*) > \alpha\, x\, p_t(e^*) - d(e^*)$, (assuming the maximum possible value of λ which is, $\lambda = 1$).

$\Rightarrow -\ \varepsilon / a\ + d(e^*) - qL\, p_t(e^*) > 0$, which is true.

For the agent , $b < \alpha\, p_t(e^*) \Rightarrow 1-b > 1 - \alpha\ pt(e^*)$

Thus there exists a 'b' s.t. both parties could gain.[10] Therefore, under this case also the agent will pay a bribe and the supervisor will accept.

Thus we have the following result:

Proposition 1: If qL is not sufficiently high ($qL < d(e^*)$), in a complete information case, it would not be possible to prevent corruption on the part of *both the agents as well as the supervisor* and the *bribery* solution (i.e., (A,D): (supervisor, agent)) would prevail.

Let us now consider the *incomplete information case* (i.e., the supervisor cannot individually identify each agent's type but has an idea about the distribution of the agents according to their types) and in view of **Remark 2** ask whether a lack of agent specific knowledge on the part of the supervisor can help reducing crime.

Suppose the distribution of the agents according to their types is denoted by $f(\theta)$ where, $_{\theta T}\int^{1} f(\theta)\, d\theta = 1$ and N is the total number of agents (we recall that θ_T and 1 are the indices for the most experienced and the least experienced agents, respectively, and hence the boundary values for θ) . The supervisor chooses his/her optimal effort level by maximizing his/her expected pay-off function w.r.t 'e'.

$$\text{Max}_e\, \Phi(e) = \text{Max}_e \{N\lambda\alpha x\, _{\theta T}\int^{\theta(e)} (\theta p(e))\, f(\theta)\, d\theta - Nd(e)\}$$
$$= \Phi(\underline{e}), \text{ say}......................(10)$$

Note that in a complete information case a supervisor individually identifies each agent and hence can commit appropriate effort levels for each one. In an incomplete information situation however, the supervisor needs to choose a uniform effort level for all agents and hence s/he needs to maximize a general function like (10). Maximization of (10) with respect to 'e' will give us an optimal effort level for the supervisor which will be uniform for all agents since now s/he does not have agent specific information. This uniform effort level '$\underline{e}$' (say) can be high enough for the less experienced agents leading them to choose H, because the less experienced agents by definition have higher chances of getting detected if the supervisor is strict.

Thus, in the absence of any prior collusion between the agent and the supervisor (and given Lemma 1), e would give us a measure of the extent of corruption if the supervisor opts to report crime. Using (1) above we get that all agents for whom $x\{1- \theta_t\ p(\underline{e})\}- x\, \beta\, \theta_t\ p(\underline{e}) < 0$, would not indulge in embezzlements. Hence the range of integration runs from θ_T to $\theta\,(\underline{e})$, where, $\theta\,(\underline{e})$ represents the largest type index of the subset of agents who would play D at $\underline{e}$. Let us now go back to our model with collaboration between the agent and the supervisor prior to the detection of a crime. Consider an agent who is deciding to bribe a supervisor prior to the detection of the crime. Then we get the following lemma.

Lemma 2: A bribe $\Im(=bx)$ fixed at a level $\Im=x\alpha\ (p_T(\underline{e}))$ would ensure that it would be offered by all agents.

Proof: If an agent does not collude with a supervisor prior to the detection of a crime s/he can alternatively wait for detection and pay the fine. To choose his/her strategy an agent would compare his/her pay-off between these two options.

Thus, for a type t agent, who does not opt for bribery, the alternative pay-off is

$$(x-\alpha\, x)\ p_t(\underline{e}) + (1- p_t(\underline{e}))x = x(1-\alpha\ \ p_t(\underline{e}))........................(11)$$

where, $\underline{e}$ is the optimal uniform effort level for the supervisor (see (10)).

If the agent goes for bribery s/he would get x-bx . Therefore, bribery would be better only if

$$x\text{-}bx > x(1-\alpha\ p_t(\underline{e})) \Rightarrow \Im = bx \ \leq \alpha\, x\, p_t(e) \ldots\ldots\ldots\ldots\ldots(12)$$

Since the effort level is uniform, we have, $\alpha \times p_t(\underline{e}) \leq \alpha \times p_{t-1}(\underline{e})$. Therefore, all agents would opt for bribery if $\Im \leq \mathrm{Min}_t \ (\alpha \times p_t(\underline{e}))$, i.e.,

$\Im \ \leq x\alpha\, (p_T(e))$.

Note 3: The above Lemma shows that if the types of the agents are known , one can extract higher levels of bribe (for per rupee embezzled) from the agents with lesser experience.

Proposition 2 : The bribery solution cannot be ruled out even with incomplete information.

Proof: Suppose the bribe taken by the supervisor is $\Im = \ \alpha \times p_T(\underline{e})$. In that case all agents would pay the bribe. The supervisor's total pay-off would be

$$(N\, \alpha \times p_T(\underline{e}) - \ qL\ ) \ldots\ldots\ldots\ldots\ldots\ldots\ldots(13)$$

Alternatively suppose that the supervisor wants to report (i.e., plays NA). Then *his/her pay-off would be, from (10) above*

$$\Phi(\underline{e}) = N\lambda\alpha x \ {}_{\theta T}\!\int^{\theta(\underline{e})} (\theta p(\underline{e}))\, f(\theta\,)\, d\theta - Nd(\underline{e})$$

Therefore, assuming $\lambda = 1$ and qL insignificant, the supervisor would accept bribe if

$$N\alpha x\, p(\underline{e}) \ {}_{\theta T}\!\int^{\theta(\underline{e})} \ \theta\, f(\theta)\, d\theta - Nd(\underline{e}) < N\alpha x p_T(\underline{e})$$[11] ....(14)

From (14) it is clear that if d ($\underline{e}$) is sufficiently high it may not be possible to violate the inequality. Thus, it is clear that the bribery solution cannot be ruled out even with incomplete information. QED.

To proceed one step further. Suppose, the inequality in (14) is reversed *because d(e) is not sufficiently high.*

Thus a bribe fixed at a level $\alpha x p_T$ will not be acceptable to the supervisor. Let $\underline{t}$ be the smallest type such that

$$(1-p_t\,(\underline{e}))\, x + (x-\alpha\, x)\, p_t\,(\underline{e}) > 0 \Rightarrow (1-\alpha\ \ p_t\,(\underline{e}))x > 0$$

Fix a bribe $\Im = \alpha\, p_t\,(\underline{e})\, x$. Then all the agents whose type is smaller than t would opt to bribe (otherwise they are forced to choose H which gives them zero pay-off).

The rest of the more experienced agents would choose to play D and take the risk of getting reported by the supervisor. In this partial bribery solution the supervisor gains (compared to the corresponding no bribe situation where s/he plays NA for all agents) because s/he is earning an additional income through bribes from the less experienced agents who would have played H in the absence of this prior collusion with the supervisor. Thus, we have proved that there exists at least one $\mathfrak{S}$ which makes all agents to opt D:

Proposition 3: Even with incomplete information crime cannot be controlled.

Note 4: Incomplete information however may be successful in reducing the extent of bribery.

Remark 4: The kind of collusion that is described in this section shows that even incomplete information does not help to control corruption. Thus, it appears that transfer policy of the government may not be effective in combating embezzlements (see Note 1).

VDIS: An Example

If we now compare the bribery solution of the above section and the voluntary income disclosure scheme (VDIS) discussed in the introduction section, we observe several similarities.

(i) It is a situation of incomplete information.

(ii) An agent confesses beforehand that s/he had been corrupt.

(iii) There is no effort on the part of the enforcement authority (supervisor) to detect corruption.

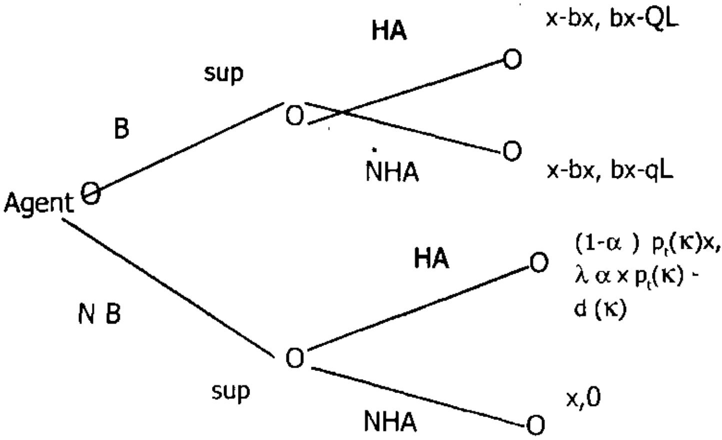
(iv) An agent has to pay a percentage of his/her disclosed income as tax which can be interpreted as a bribe for not reporting the crime for punishment. For example, in VDIS '97 , b=35% in the case of corporate entities and 30% for others.

(v) Once that is paid, the agent is allowed to go scot-free as the terms of the scheme says that all information contained in a declaration are to be treated confidential. Furthermore, the contents of the declaration are not admissible evidence against the declarant for the purpose of penalty under the income tax or wealth tax act.

Thus , this paper theoretically establishes that in nature VDIS is equivalent to the bribery case where the government itself is playing the role of a supervisor. While the scheme checks directly unproductive but privately profitable activities (Bhagawati, Brecher, Srinivasan ,1984) and raises resources (at least in principle) for the productive purposes, *it virtually amounts to legalizing bribery*. Our results therefore raise the question of efficacy of the schemes like VDIS for checking corruption by providing an opportunity to make up for a past crime (see the first section). Thus, when a government takes recourse to such soft approaches, the only alternative for a developing nation is to have an honest and efficient reporting and judiciary system together with socially alert citizens which can make 'qL' high enough to remove corruption from the grass root level.[12]

However, the success of the VDIS raises a natural question. If a tax payer could hitherto evade taxes through bribery -why should s/he declare it under the VDIS. This would depend on the kind of future threat a tax evader would perceive. However, the *personal transfer policy* of the government may have played a role in making such a scheme successful. For, if one needs to bribe only once to evade paying a tax, it makes sense not to disclose the income. However, if one needs to pay the bribe to each new officer transferred to the locality, then the expected lifetime (bribe) payment may be higher than what one needs to pay through the VDIS. Let us now look at the problem through a game tree.

Suppose that a supervisor threatens an agent to expose a past act of embezzlement - i.e., the supervisor gives a threat to harass (HA) the agent. The agent in turn can offer a bribe to stop an inquiry (B-pay bribe) or, alternatively face the risk of exposure (NB-pay no bribe). The supervisor on the other hand can decide independently, for whatever reason, not to harass (NHA) the agent for a past crime. In such a case the agent need not pay a bribe. (In other words his/her bribe equals 0).



The above game tree reveals different strategy combinations for the agent and the supervisor and the resulting pay-off for the both. First, the two possible strategies of the agent are shown as B (opt to bribe) and NB (pay no bribe to the supervisor).

Suppose that an agent pays a bribe, bx. If the supervisor does not harass, his/her pay-off would be $bx - qL$ and the agent gets $x-bx$. Recall that x is the gain for the agent from his/her corruptive activities out of which she now pays bx as bribe. We further assume that if a supervisor harasses an agent after accepting a bribe, the former faces a much higher chance 'Q' of being penalized for the act of bribery, i.e., $Q >> q$. Thus in the case where the agent is paying a bribe (B) even after which the supervisor is harassing, the supervisor gets $bx - QL$ and the agent gets $x-bx$. On the other hand, if an agent declines to bribe, the supervisor in turn can try to detect the embezzlement with an optimal effort level, say, (and report for a reward). Then the payoffs for the agent and the supervisor would be similar to the ones described by equations (1) and (2) where 'κ' is the optimal effort level. Finally if there is no bribe and no harassment either, the agent gets x and the supervisor gets 0. From the payoffs of this game it is clear that the supervisor can give a credible threat to the agent to harass unless s/he bribes. Thus,

Proposition 4: The supervisor's strategy is to commit not to harass if the agent bribes and play HA otherwise, while an agent plays B, form a sub game perfect Nash equilibrium.

If an agent needs to bribe repeatedly, his/her expected discounted lifetime (bribe) payment would be:

$bx + \rho bx + \rho^2 bx + \dots\dots\dots = bx/(1-\rho)$, where, ρ is the discount factor.

Suppose the tax rate under the VDIS is τ. It would then be optimal for an agent to pay a tax ($= \tau x$) under the VDIS provided $b/(1-\rho) > \tau$.

Note 4: In the absence of a transfer scheme however, extracting a bribe repeatedly through threats of exposure may not be feasible as it can in turn incriminate the supervisor for the bribe that s/he has already received.

Conclusion

In this short exercise we have shown the limitations of various punishment and reward schemes in the presence of a collusive agreement between a supervisor and the agents. We then drew similarities between this collusive agreement and the agreements of the VDIS to show formally how the scheme amounts to legalizing bribery. While there appears to be no other alternative to stop such (unproductive) corrupt activities, schemes like the VDIS (though they raise resources for productive purposes) do not seem to be the appropriate solution. The exercise shows the futility of punishment/ reward schemes, whereas the factor qL seems to be the most crucial element in controlling corruption. This means, unless the institutions of civil society (like print media or judiciary) impose stringent norms of behavior on the political and administrative authorities— norms whose violation brings with it a high risk of exposure and punishment-corruption would continue to remain a festering sore on the bodies of developing societies.

Notes

1. Several authors deal with corruption in tax administration: c.f.Chander and Wilde (1992), Goswami et al (1991), Basely and Mclaren (1993), Toye, J and M Moore (1998), Kumar (1999).

2. Gupta (1992) estimated the size of the black economy in India to be 42% of GDP for 1980-81 and Kumar and Sen (1993) estimated it to be 30% of GDP for '87-'88.

3. c.f Kofman & Lawaree (1996), Marjit & Shi (1996), Basu et al (1992), Mookherjee and Png (1994)

4. This is surely not the only possible—reward scheme. One can conceive of a scheme where a supervisor may be punished and evalute the implications.

5. In section 3 however, we would consider a different bribery scheme.

6. $x\{1-p_t(e)\} + (x - \alpha x)\, p_t(e) = 0 \Rightarrow x - x\, p_t(e) + x\, p_t(e) - \alpha\, x\, p_t(e) = 0 \Rightarrow x - \alpha\, x\, p_t(e) = 0 \Rightarrow 1/\alpha = p_t(e)$. Thus when $1/\alpha = P_t(e)$, the agent's pay-off is zero.

7. *Monitoring or investigation of crime* [see Mookerjee and Png (1993)] may not be effective in such cases as hierarchical bribery network can exist.

8. There is a body of literature dealing with hierarchical bribery network, see for example Gangopadhyay et al (1991) .

9. Note that if qL is significantly high the supervisor would always choose to report.

10. Here we get a similar result as that of Mookherjee & Png (1994) viz., an increase in the penalty rate raises the level of a bribe.

11. If the supervisor is risk averse , s/he will be satisfied with even lower 'certain income'.

12. There is literature that argues in this context that redesign of tax system and specifically their simplification can reduce corrupt leakages , see Toye and Moore (1998). Of late the Indian government has been trying to resort to this strategy.

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