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Persistence of Corruption: Some Theoretical Perspectives

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Summary. — The paper examines how pervasive corruption can be persistent. Despite the presence of anti-corruption measures and incentives, corruption has a strong tendency to persist. In the first part, we discuss how a high level of corruption or a low level of compliance can be an equilibrium outcome. In such a case, corruption becomes the social norm. In the second part of the paper, we use ides from evolutionary game theory to discuss how corrupt behavior can be immune to interventions and it can sustain itself against different individual behavioral norms.

Key words — corruption, incentives, persistence, evolution

1. INTRODUCTION

Is corruption simply a manifestation of deviant behavior from the norm or is it the norm itself? Corruption is commonly defined as "*behavior that deviates from formal duties because of private gains.*" Hence, the very definition of corruption would suggest that corrupt acts are deviations from implicit or explicit behavioral norms (with or without legal and ethical connotations). However, the widespread nature of corruption in some societies indicates that corrupt behavior is the norm itself—despite the fact that it is inefficient and generally condemned. In this paper, we try to examine the various factors that contribute to the persistence of such behavior.

Historically, many societies have endured long periods of widespread corruption. Huang (1974) examines how corruption emerged in China under the Ming dynasty in the 14th century and continued to spread during the Qing dynasty through to the 19th century. There were many attempts including large scale salary reforms to curb corruption but corruption grew unabated. Similarly, Waquet (1991) discusses how corrupt practices were widespread during the 17th century in Florence despite the presence of fairly repressive anti-corruption laws during this period. Many contemporary societies are also beset with similar problems. In the early 1960s, the Government of India viewed corruption as a top priority and appointed a high-powered committee to look into corruption. The committee, chaired by Santhanam, made a detailed study and made a number of recommendations. But the anti-corruption measures over the last decades have not met with any success and corruption has grown.

It is important to bear in mind that we are concerned with persistence of widespread corruption and not just the practice of corruption. The phenomenon of corruption is certainly very old. References to bribery and the punishments for bribery can be found in many ancient sources like The Code of Hammurabi, King of Babylon (22nd century BC), The Eddict of Harmhab, king of Egypt (14th century BC), and Kautilya's Arthasastra (14th century BC). Corruption is as old as the notion of kingdom itself and a corruption-free society is akin to an ideal state. [1]

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There are various ways to approach the persistence issue. Some scholars would argue that corruption persists because of the functional characteristics associated with it. Merton's (1968) fascinating study of American machine politics clearly sets out this intellectual tradition. Machine politics reached a peak at the turn of the century when corruption of various forms thrived. However, there was no systematic attempt to remove these because of the several latent functions they fulfilled. Even when there were serious attempts, as in the case of Waquet's study of Florence, "the laws were intended not only to control corruption but also render it tolerable." While there might be some merit in this view, we do not pursue it here. [2]

One could also argue that corruption persists because of inadequate initiatives and proper incentives. Bureaucratic corruption can be attributed to lack of sufficient political will and likewise, political corruption can be attributed to lack of adequate political competition. This is somewhat similar to the recent issue of corruption and competition. It is generally believed that greater competition in the form of privatization and deregulation would lead to substantially lower levels of corruption. But the recent experience of many countries (including some of the transition countries) shows that this may not indeed be the case. Corruption seems to be on the rise despite large scale privatization and deregulations. One can argue, along the same lines, that the reforms have not been proper or adequate and the right incentives are still not in place. [3] There may be some merit in this view, since some societies or organizations have managed to control corruption in a significant way. But it does not provide adequate explanation and can be tautological in many instances.

In this paper, we consider two complementary approaches to the problem of corruption. First we show that pervasiveness of corruption contributes to its persistence in a significant way. When there are many corrupt individuals in the society, it becomes optimal to be corrupt despite the presence of anti-corruption policies and incentives. This way corrupt behavior becomes the equilibrium behavior or the social norm.

This view is not new. Economists have shown that endemic corruption can be viewed as an equilibrium outcome in models with multiple equilibria. It has been noted that different societies with relatively same levels of development, judicial machinery, and politico-legal structures can exhibit varying degrees of "illegal (pre) occupation" like corruption, tax evasion, and other regulatory non-compliance. The explanation for this observation is that different societies can get caught in different equilibria. At a general level, this multiplicity arises due to various forms of externality. For example, if people expect more people to be corrupt, then the expected cost of being corrupt would be less (the probability of apprehension might be low or even the social sanction against corruption could be low) leading to more people being corrupt. [4] Like all models of multiple equilibria, these models cannot explain why some get caught in the bad equilibrium, but still aid to our understanding of the persistence of corruption in some societies.

We discuss a similar situation where both low compliance and high compliance can be equilibrium outcomes. The novelty of the analysis lies in the exact mechanism which gives rise to the multiplicity. Existing models of corruption tend to focus primarily on the cost and benefit of non-compliance, but we also look at the cost and benefit of compliance. It is often seen that in many of the corrupt societies, those who comply with the law or social standards often become victims of harassment, extortion, and alleged corrupt behavior. This means that the incentive to remain compliant declines leading to rise in the level of non-compliance. We are able to highlight the importance of several factors like the nature of information technology, the effectiveness of judicial redress, and compliance costs. We discuss how and when societies can avoid the low-compliance equilibrium. But guaranteeing these conditions become difficult when there is widespread corruption.

The second approach focuses on individual norms of behavior. The previous approach would suggest that people tend to be corrupt because there are many others who are corrupt or "being corrupt" is the social norm. This is different from saying that these individuals would be corrupt irrespective of the nature of the social surroundings. We wish to examine the extent to which corruption as an individual norm of behavior can sustain itself in the long run. We introduce some preliminary ideas from evolutionary game theory to discuss the persistence (and success) of these behavioral norms. It is shown that corrupt behavior can be self-sustaining and stable against other forms of behavior. Roughly speaking, this would mean that in the long run only corrupt people would survive in a population of corrupt and honest people. This is derived in a simple stylized model but it suggests that we should be asking the question "why don't we see corrupt behavior everywhere?" rather than the question "why do we see so much corruption?" This suggests that societies have over time tried to curb corrupt behavior in various ways and many of them would have to do with development of individual and social values.

The plan of the paper is as follows. In Section 2 we discuss how low compliance can be an equilibrium outcome. We present a model which admits two equilibria for certain parameter values. Section 3 discusses the evolutionary model of corrupt behavior. Section 4 concludes with a few comments.

2. CORRUPTION AND SOCIAL NORMS

We present a simple model of enforcement in this section. It is shown that corruption or non-compliant behavior can be the equilibrium outcome in some cases. In these situations, corruption is the norm rather than deviant behavior. For easy reading, we have omitted most of the technical aspects of the model. It is a general analysis of compliance—corruption being one such application. In the later subsection, we discuss how the ideas can be applied in an organizational context as well.

(a) *Multiple equilibria*

Consider a group of firms facing a certain pollution standard.[5] A firm can choose whether to comply with the prescribed standard or not. The gain from non-compliance g differs across firms and is distributed according to some distribution $F(g)$. It can be interpreted as abatement cost savings to the firm; hence, different abatement technologies would account for the difference in gains. Firms compare the expected cost of non-compliance with this gain while making their decisions. We shall assume that there is a regulatory body in place to enforce the pollution standard (assumed to be zero for convenience). Each firm expects to be inspected with a certain probability q by an officer. The officer can report the firm to the court or the higher authority as a polluter. We assume the court's technology to be perfect so that the firm's pollution level is revealed in the court with certainty. A firm found guilty by the court is charged a fine f and the officer receives a reward r. In the absence of any reward, the polluting firm can always bribe the officer and escape the stipulated fine. This does not mean that any reward will ensure honest reporting. But it can still act as deterrence since in most situations the bribe payments by the firm will be an increasing function of both the fine f and reward r. Let $b(f,r)$ be the bribe amount that the polluting firm (upon discovery) has to pay to the officer to escape reporting. If bribery is not feasible, a firm with gain g will engage in pollution if and only if $g > qf$. On the other hand, if bribery is feasible, a firm with gain g will pollute if and only if $g > qb(f,r)$. This resembles the standard incentive mechanism that would be suggested to ensure honest reporting by the officer and compliance by the firm.

We shall be looking at a case where information is soft. Soft information refers to a situation where information can be manipulated easily. Hard information, on the other hand, can be suppressed but not manipulated.[6] In the present case, hard information would imply that the officer after detecting evidence of pollution can suppress it and report lack of sufficient evidence. But the officer cannot distort it and report a polluting firm as non-polluting. The analysis of enforcement when information is soft has attracted attention recently.[7] The nature of soft information implies that the officer can report a non-polluting firm as well. In that case, the firm is eventually acquitted by the court, but it incurs a cost c. To discourage the officer from such misreporting, we suppose that the officer, in such cases, incurs a cost d. Note that if the officer knows that the firm is non-polluting, then any positive d will be sufficient to stop such over-reporting. We shall assume that d is bounded above by some value D. A high value of d would mean that the officer would not report a firm whenever he has slightest doubt about the firm's pollution level. We want to avoid such situations and assume that d is not very large. The exact nature of this upper bound will be discussed later. The reward and penalty structure is given and satisfies the following assumption:

$$r < f, \quad c < f, \quad \text{and} \quad d < D.$$

Inspection in itself does not reveal anything, it all depends on whether the officer has put in the necessary effort or not. Effort can be given a very broad interpretation to include investments by the officer in learning, human capital development, or skill acquisition. It is a measure of the competence of the officer. Competence may have several connotations, but in our model context it implies that a competent officer is able to differentiate the polluting firms from the non-polluting firms upon inspection. [8] To avoid confusion, such officers (who have put in the required effort) will be called *informed*. We also assume that firms can observe the level of e chosen by the officer. [9] This is however non-verifiable, and hence non-contractible. So the authority cannot force the officer to choose a particular level of e.

We can summarize the situation as a two stage process. In the first stage, each firm chooses whether to pollute (p) or not (np). Its decision is given by a where $a \in \{p, np\}$. The officer chooses effort e, $e \in \{0,1\}$. Effort is costly, whenever $e = 1$, it costs the officer an amount E. The second stage is a simple bribe game. If the firm and the officer agree on a bribe (including a bribe of zero), the firm is not reported. Otherwise, the firm is reported. The firms and the officer work out the expected payoffs in this stage while making decisions in the first stage.

Firm's gain g is not observable to anyone other than the firm, though the distribution is known to all. Neither the officer nor the other firms can observe a particular firm's choice of a. As discussed earlier, a firm will choose to pollute if and only if its private gain g exceeds some threshold level g^*. This threshold level will depend on the officer's choice of effort and the nature of the bribe game. The fraction of non-polluting firms will be given by $\pi = F(g^*)$. The officer has some belief about the level of g^* and consequently π. The officer's choice of effort and reporting strategy would be a function of this level of g^*. In equilibrium, this level turns out to be the actual level and the strategies chosen by the officer and the firms are optimal. [10]

We shall skip the analysis concerning the actual bribing process. [11] Note that we can have two types of situations. Depending on the choice of the officer, the firms might be facing an informed or uniformed officer. Whenever, $e = 1$, the firm faces an informed officer who knows the pollution level of the firm. It seems reasonable to suppose that the non-polluting firms would prefer an informed officer to an uninformed one. The exact opposite preference is expected for the polluting firms. In fact, under some conditions it does turn out to be the case. The informed officer would never like to report the non-polluting firm because of the cost d. But with an uninformed officer, the non-polluting firm gets reported with positive probability (it is increasing in the reward r) and will incur some cost. Let the expected payments by the firm from choosing a be $U(a)$, $a = p, np$. A firm with private gain g will choose to pollute ($a = p$) if and only if $g > U(p) - U(np)$. As the previous discussion suggests the expected payment will depend on the officer's choice of effort. $U_I(a)$ and $U_{UI}(a)$ denote the expected payments under the informed and uninformed cases, respectively. Hence, depending on the effort choice of the officer we can have two threshold values g_I^* and g_{UI}^*. It is clear that $g_{UI}^* < g_I^*$ since

$$U_I(np) > U_{UI}(np) \quad \text{and} \quad U_I(p) \leqslant U_{UI}(p).$$

Hence, when the officer is uninformed, even firms with lower gain g will choose to pollute.

For the officer, let his payoffs from the bribe game be V_I and V_{UI} in the informed and uninformed cases, respectively. The difference will depend on the belief π and information cost E (in addition to the incentive parameters r, f, and d). For a given E, it can be shown that $V_I > V_{UI}$ and the officer will choose to be informed ($e = 1$) if π is relatively high. [12]

When the officer is expected to be uninformed, more firms would choose to be on the wrong side of the law than when the officer is informed. This, in turn, can make the officer's decision to choose $e = 0$ optimal. So we might see a greater degree of violations of law with an uninformed officer. Similarly, when firms expect the officer to be informed, fewer firms would choose to pollute and π is likely to be high and this, in turn, makes the officer's decision to choose $e = 1$ an optimal one. This would suggest that for certain parameter values, there exist two equilibria. There is a high-compliance equilibrium with fewer firms choosing to pollute (π is high) and the officer remains informed. The other is the low-compliance equilibrium where the officer is uninformed and a greater fraction of the firms chooses to pollute.

(b) *An example*

To fix ideas, consider the following simple example. Suppose there are only four types of firms; $g \in \{5, 10, 15, 25\}$. Each type is equally likely. Each firm is going to be inspected with probability 1/2 by a corruptible inspector. A polluting firm faces a penalty of 50 if reported.

For limited liability reasons, this is the maximum penalty that can be imposed. A non-polluting firm will not have to pay this penalty but will have to incur a cost of 30 if reported. We assume that the inspector has a high commission rate and gets 48 as reward if the reported firm is found to have polluted. However, in the absence of any mechanism to discover bribery, this does not guarantee honest reporting. But this means that the minimum bribe that a polluting firm can offer is 48. This in itself will act as deterrence. The cost of being informed E is 9 and the penalty for over-reporting is 20. Now we can have a situation where the officer chooses $e = 0$ and reports the firm with probability one unless the firm offers a bribe of 48 or more. [13] This means the polluting firm can get away by paying a bribe of 48; hence, their expected cost from non-compliance is 24. The non-polluting firms also have an expected cost of 15. All firms with gains exceeding 9 will choose to pollute. Hence, 75% of all firms will pollute. Given that only a quarter of the firms choose to comply, the officer's expected cost from reporting is 20/4 which is less than the cost of being informed. On the other hand, we can also have a situation where $e = 1$ and only 25% of all firms choose to pollute. Given that there are many non-polluting firms the officer will prefer to be informed. The expected cost of reporting a firm without being informed is 15, which is higher than the cost of being informed.

The above analysis does not apply to the case of hard information because the officer cannot report anyone without hard evidence. [14] This would require choosing $e = 1$ or being informed. The officer's choice of $e = 0$ would fetch zero payoff. On the other hand, a choice of $e = 1$ would fetch a net expected payoff of three. Hence, the only equilibrium outcome would be the high-compliance outcome.

Similarly, a lower value of c would mean that judicial remedies are not very costly and the incentive to remain compliant would be high. It can be checked that if $c \leqslant 26$, the officer will always choose $e = 1$. When $e = 0$, any firm with a gain exceeding 11 will choose to pollute (it can be checked that the officer still follows the strategy of reporting a firm unless offered a bribe of 48). That means half the firms would be polluting. But this would make the expected cost of reporting a firm without being informed high compared to the cost of being informed. Hence, the low-compliance outcome is not an equilibrium outcome. This would also be the case for lower values of E and higher values of d. If the cost of being informed is low, say $E \leqslant 5$, then in the original example the only equilibrium outcome would be the high-compliance outcome. Similar arguments apply when penalty for over-reporting is high; $d \geqslant 40$. The officer would always prefer to be informed to avoid the cost of wrongly reporting a non-polluting firm.

The preceding exercises suggest that the low-compliance outcome can be affected by suitable choice of c, E, and d. However, the social planner might have limited control over these variables. For example, while in principle it is possible to choose a high d, such a high penalty is unlikely to be seen in practice if the verification technology is not perfect. In that case even an honest and informed inspector might not be interested in reporting which would defeat the purpose of enforcement. Similarly, E might be determined to a large extent by the available technological capabilities and practice. Regarding the other remaining variable, it is always optimal to have a lower cost c. But if the higher authority or the court also has corrupt agents who would like a share in the rent, this cost is likely to be higher and not lower. In a situation of pervasive corruption, this is the most likely outcome.

(c) *Corruption in organizations*

The above analysis can be applied to hierarchical organizations to explain why corruption might spread within an organization. Consider a group of officers being monitored by dishonest superior officers. If honest officers find that they are not free from charges of bribery and corruption and corrupt officers find that they can avoid penalty by bribing the superior, we are likely to see depletion in the bench of honest officers. It creates an atmosphere of mistrust and every one is believed to be corrupt which prompts many individuals to be actually corrupt. [15]

The role of a dishonest superior is quite important in this context. [16] As we saw in our earlier discussion, low-compliance outcome is unlikely in the case of the honest officer (superior officer). However, dishonest superiors can also be viewed as a consequence of pervasive corruption. We can consider a dynamic version of the model and assume that an officer gets promoted to be a superior officer with some probability. If there are many corrupt officers, then the probability that the superior officer would be also corrupt is high. A corrupt superior in turn would induce corrupt behavior by other officers. This way pervasive corruption would sustain itself.

3. CORRUPTION AND EVOLUTIONARY DYNAMICS

In this section, we look at some of the ideas from evolutionary theories to see whether the persistence issue can be addressed in such a framework. There are at least three motivations for focusing on an evolutionary approach. First, recent work on evolutionary game theory has shown that evolutionary stability can address the issue of equilibrium selection to some extent. Since corruption happens in one such equilibrium, we can ask what kind of social dynamics would select such an outcome (equilibrium). Second, we also need to look at individual norms of behavior and not just social norms.[17] The analysis of the previous section showed that we could have different compliance levels as different equilibria or (social) norms. But then these do not explain the presence of certain social norms. In the present section, we shall be primarily concerned with individual norms of behavior. Last, we want to see whether corruption persists because of imperfect information, underlying beliefs, and the ease of collusion or it persists because corruption has a self-replicating nature in a very basic and primitive way. Suppose we have a set of honest (non-corrupt) individuals. Clearly, the analysis of Section 2 would suggest that there cannot be any corruption in equilibrium. Suppose we introduce some corrupt individuals into this population. Do we still have the equilibrium with no corruption? This question is at the heart of evolutionary game theory.[18]

(a) *Evolutionary stability*

Suppose individuals are programmed to play certain strategies (act in certain manner) in some strategic situation under consideration. Unlike standard decision theory or game theory, there are no rational calculations involved. We consider a case where a large population plays the following symmetric three-person distribution game.[19] We shall assume that one unit of resource is to be distributed between three randomly matched individuals. Individuals are either collusive (C) or non-collusive (H). Alternatively, C stands for corrupt behavior. A collusive individual always colludes with similar agents to further his or her share in the distribution process. On the other hand, a non-collusive individual never colludes (this represents honest behavior). Players meet randomly and play the game. Each individual has an outside option—not to participate in the game and receive z, $z \geqslant 0$, and small.

One can use various modeling strategies to analyze the payoffs from this distribution game. We could model the situation as a strategic bargaining process with disagreement leading to payoff of zero for everyone. Alternatively, we could assume that with equal probability one person is authorized to distribute the resource. Rather than describe the details of the distribution process we shall suppose that the following outcomes (payoff distributions) result when different C or H types are matched. We shall denote the payoff to strategy X when it is matched with Y and Z as $g(X, Y, Z)$.

—(**H, H, H**): When three **H** types are matched, each gets an equal share and $g(\mathbf{H,H,H}) = 1/3$.

—(**H, H, C**): Again each gets 1/3. The presence of one **C** does not make a difference because **C** cannot collude with anyone.

—(**H, C, C**): **H** gets z, and **C** gets $(1 - z)/2$ since the two **C** types collude. Hence, $g(\mathbf{H;C,C}) = z$ and $g(\mathbf{C;C,H}) = (1 - z)/2$.

—(**C, C, C**): Each gets $(1 - d)/3$. This reflects the fact that collusion formation is competitive and wasteful here, $d > 0$.

Definition. Let A be the set of pure strategies and S be the set of mixed strategies. A strategy X is evolutionary stable (ESS) if there exists δ^* such that for all $\delta \in (0\ \delta^*]$ and for all Y

$$g(X, (1-\delta)X + \delta Y) > g(Y, (1-\delta)X + \delta Y).$$

This captures the basic idea that if everyone in the population plays X and there is a small invasion of mutants (playing Y), then population of X is immune to such invasion. In biological contexts, payoffs represent fitness and ability to replicate. In the above definition, X is an evolutionary stable strategy because the payoff from playing X in a population where everyone plays X except a small (δ) fraction of mutants is higher. Since the mutants do not do very well (payoff is smaller), they are not able to replicate and overrun the X population. In our case, replication can be interpreted as imitation or adoption of the successful strategies. So we could think of a scenario where individuals look at their own payoff as well the payoffs of other individuals. Individuals can switch to some other strategy which gives a higher payoff. This way a successful strategy gets replicated. This is called the replication or imitation dynamics.

In the present context, we have assumed that success is measured purely in terms of monetary payoffs. This is where the social value system comes into play. It is quite possible that individuals might continue with their honest strategy despite the corrupt strategy yielding higher economic payoff. The latter might yield less prestige or social esteem. Clearly the underlying value system is a major determinant of the imitation dynamics. [20]

For the three-person case, we can reinterpret $g(X,(1-\delta)X+\delta Y)$ as payoff to X when all other opponents are playing a mixed strategy with randomization probabilities given by $(1-\delta)$ and δ. It can be shown that the non-collusive strategy **H** is an ESS if $\delta(d/3)+z-1/3>0$. [21] This inequality is not likely to be satisfied, and hence, **H** is not immune to invasion by **C**. On the other hand, **C** is an ESS if $(1-\delta)^2[(1-d)/3-z]+2(1-\delta)\delta[(1-z)/2-1/3]>0$. This is likely to be true. Clearly collusive behavior is immune to the invasion by **H** (a few good individuals cannot help!). This would suggest that corruption is not a deviation but it is the norm itself. However, it is easy to check that it is an inefficient situation. Societies which can establish **H** behavior as the norm would do much better.

(b) *Extensions*

We have assumed that collusion formation is instantaneous and costless, but collusion formation is likely to be a costly process. Moreover different societies and cultures will have different costs. When and how people can collude depends on a variety of factors. First, collusion might be difficult if there is sufficient informational asymmetry between the colluding parties. [22] Second, collusion in most instances involves bribery and by its very nature a bribe transaction is a personalized transaction. [23] Hence, customs, practices, and attitudes also determine the environment in which collusion takes place. These are similar to what Rose-Ackerman (1999) calls "cultural factors" affecting corruption. [24]

We can extend the previous analysis in a few directions. First, recall that we have a static distribution game. Consider a situation where agents have to invest some effort in the production of the output before distribution. In that case, one can devote effort to forming collusion or to raising output. This would make the cost of collusion very high (high d) because collusive behavior implies lost growth opportunities. In such a case, a population of **C** types would rather do badly. This suggests that the process of development itself can bring about changes in whether corruption can persist or not. Second, in a similar vein, one could ask what would lead to high values of z, the outside option. A high z would imply that the **H** type's share does not depend so much on the nature of matched opponents. This suggests that more market oriented societies would be better suited to sustain non-collusive behavior over the long run.

A third way would be to consider sets of behavior rules and not just one. [25] For example, the **H** type could imply a collection of behavior—never collude and always divide equally, leave the game rather than accept anything that is not fair. Now when the **H** type meets two of the **C** types, the **H** type could leave the game resulting in payoffs of z to everyone. This may not be a gain to the **H** type, but the mutant **C** types are not going to do very well. Given that they do not do very well against their own types, they will not be able to replicate. Hence, the **H** type could be immune to invasion by the **C** types. A society develops (has to develop) such behavioral rules and norms over time to sustain the honest and more efficient mode of behavior.

4. CONCLUSION

The aim of the paper is rather modest. The paper discusses two different approaches to study the issue of persistence. In the first case, using a static framework, it is shown how pervasive corruption becomes the social norm. In the second case, we have shown how corrupt behavior by individuals can survive and succeed in the long run in an evolutionary setting.

The first half of the paper shows that it is possible to have a situation of low-compliance and pervasive corruption as an equilibrium outcome. If individuals expect to bear substantial cost from compliance and hope to get away cheaply by non-compliance, then the society is driven toward the equilibrium with very low levels of compliance. In such a situation, there is a general belief in the society that everybody engages in non-compliant behavior. This belief becomes self-fulfilling. In addition to the standard incentive structure, one has to address the issues of information technology, harassment, and redress to get rid of the low-compliance outcome.

The second half of the paper has been rather exploratory. We have tried to pose the persistence of corruption issue in an evolutionary setting. This provides us with a framework in which we can analyze how non-corrupt behavior can survive over the long run. The analysis has been somewhat speculative and rudimentary, a detailed development is left for future research.

NOTES

1. Moreover, it might be optimal to tolerate some amount of corruption.

2. This view is shared by many who view corruption as necessary to "grease the wheels of commerce." See Mishra (2005a) for an appraisal of this viewpoint.

3. See Dutta and Mishra (2003) for the references and an extended discussion of this issue.

4. Andvig and Moene (1990) showed how "corruption may corrupt" others and lead to a situation of widespread corruption. Likewise, Lui (1986), Sah (1991), and Tirole (1996) focus on this multiple equilibria phenomenon to throw light on the persistence of crime and corruption. See also the survey by Bardhan (1997).

5. We could reinterpret the situation as corruption deterrence, where the officer is to be monitored by other officers. In the present section, we make no distinction between corruption and any other criminal activity.

6. See Tirole (1992) for a discussion on the implications of this.

7. This gives rise to extortion possibilities. See Polinsky and Shavell (2001), Hindriks, Keen, and Muthoo (1999), and Mishra (2005b).

8. To give an example, tax inspectors often spend considerable time and effort researching on related areas before they do the true assessments.

9. Strictly speaking this assumption can be avoided. The firms can form belief about e in the first stage and in equilibrium this belief is justified. But one has to restrict these beliefs to end points only and all firms have same beliefs.

10. Alternatively, we can suppose that the officer observes some imperfect aggregate signal (total pollution or past pollution levels) and infers about the level of g^*. Collective reputation, such as an aggregate imperfect measure, plays an important role in Tirole (1996).

11. Mishra (1998) contains a discussion of similar bribe games.

12. When π is high, the officer expects to incur the cost (d) with greater probability and would rather choose to be informed.

13. The actual outcome is a bit more complicated. The non-polluting firm does not offer any bribe, and the polluting firm randomizes between offering nothing and 48. Whenever zero bribe is offered, the officer reports with probability 48/50. So the non-polluting firm's expected cost is slightly lower than 15.

14. This result would also be obtained when the officer is honest. In that case, honest reporting is possible only when $e = 1$. The honest officer would choose $e = 1$ and would always report the polluting firms irrespective of the rewards, provided his net payoff from doing so is positive.

15. Myrdal (1968) narrates an interesting case where the honest policeman would not approach the taxi driver for traffic violation because the driver would complain of harassment and extortion which will be readily believed even if the policeman had no such intention.

16. Much of the corruption literature normally assumes that there is an honest agency which is supposed to enforce the penalties and rewards stipulated by the incentive structure. However, there are some attempts to see how a single corrupt act is likely to be backed by the possibility of several layers of collusion. See Basu, Bhattacharya, and Mishra (1992), Bac (1996), Carrilo (1995), and Mishra (2002).

17. "Flashing headlights to let another vehicle pass" is part of a social norm and drivers may not follow it in all societies in the same way. But "driving carefully when people are crossing the road" is a norm which the driver may follow irrespective of the society he lives in.

18. Pioneering work by biologists Maynard Smith and Price (1973) has led to a substantial literature. See surveys by Kandori (1996), Vega-Redondo (1996), and Weibull (1995).

19. It is normal to compare strategies in a pairwise fashion; hence, it is normal to consider two-person games. Here also we shall compare two strategies but to motivate the idea of collusion/corruption we are using an example of three-person matching.

20. This can be related to Huntington's modernization and corruption hypothesis (1968). Modernization brings a different social dynamics to an otherwise traditional society.

21. It follows from $(1-\delta)^2 g(\mathrm{H,H,H}) + 2(1-\delta)\delta g(\mathrm{H,H,C}) + \delta^2 g(\mathrm{H,C,C}) > (1-\delta)^2 g(\mathrm{C,H,H}) + 2(1-\delta)\delta g(\mathrm{C,H,C}) + \delta^2 g(\mathrm{C,C,C})$.

22. This is of relevance in designing the delivery mode of public services. For example, in the context of decentralization of public service delivery, Bardhan and Mookherjee (2000) argue that such collusion formation (capture) is easier at the local level because of familiarity and lack of information asymmetries. This also has a bearing on the placement and transfer policy of personnel in many public offices.

23. Anthropologists would argue that the "self" is involved in such transactions. Market transactions are atomistic and does not involve the individual self (characteristics and attributes).

24. In some societies, even the so-called market transactions are not necessarily impersonal. One could cite several examples. One frequents a shop not because of any obvious clientele benefits but because of personal links. Similarly, it is often reported that people might vote for someone because he or she had visited them in the past—akin to pretence of personal knowledge. As Basu (2000) points out, in India, you have the right to ask a stranger traveling with you about various personal details like age, salary, family life, etc., because getting to know the person is a done thing. In many other societies it would be considered rude.

25. This is similar to the analysis of "rationality limiting norms" in Basu (2000).

REFERENCES

Andvig, J. C., & Moene, K. (1990). How corruption may corrupt. *Journal of Economic Behavior and Organization, 13*(1), 63–76.

Bac, M. (1996). Corruption and supervision costs in hierarchies. *Journal of Comparative Economics, 22*(2), 99–118.

Bardhan, P. (1997). Corruption and development: a review of issues. *Journal of Economic Literature, 35*(3), 1320–1346.

Bardhan, P., & Mookherjee, D. (2000). Corruption and decentralization of infrastructure delivery in developing countries, mimeo, Boston University.

Basu, K. (2000). *Prelude to political economy*. Oxford: Oxford University Press.

Basu, K., Bhattacharya, S., & Mishra, A. (1992). Notes on bribery and control of corruption. *Journal of Public Economics, 48*(3), 349–359.

Carrilo, J. D. (1995). Corruption in hierarchies, mimeo, GREMAQ, Universite de Toulouse.

Dutta, I., & Mishra, A. (2003). Corruption and competition in the presence of inequality and market imperfections. University of Dundee DP 152.

Hindriks, J., Keen, M., & Muthoo, A. (1999). Corruption, extortion and evasion. *Journal of Public Economics, 74*(3), 395–430.

Huang, R. (1974). *Taxation and government finance in sixteenth century Ming China*. Cambridge: Cambridge University Press.

Huntington, S. (1968). *Political order in changing societies*. New Haven: Yale University Press.

Kandori, M. (1996). *Evolutionary game theory in economics*. University of Tokyo, DP.

Lui, F. (1986). A dynamic model of corruption deterrence. *Journal of Public Economics, 31*(2), 1–22.

Maynard Smith, J., & Price, G. R. (1973). The logic of animal conflict. *Nature, 246*, 15–18.

Merton, R. K. (1968). *Social theory and social structure*. New York: The Free Press.

Mishra, A. (1998). An analysis of non-compliance based on information acquisition. University of Dundee, DP 98.

Mishra, A. (2002). Hierarchies, incentives and collusion. *Journal of Economic Behavior & Organization, 47*(2), 165–178.

Mishra, A. (2005a). Corruption: an overview. In *Economics of corruption*. New Delhi: Oxford University Press.

Mishra, A. (2005b). Optimal enforcement policies under the threat of collusion and extortion. Mimeo. University of Dundee.

Myrdal, G. (1968). *Asian Drama*. New York: Priority Press.

Polinsky, A. M., & Shavell, S. (2001). Corruption and optimal law enforcement. *Journal of Public Economics, 81*(1), 1–24.

Rose-Ackerman, S. (1999). *Corruption and government*. Cambridge: Cambridge University Press.

Sah, R. (1991). Social osmosis and patterns of crime. *Journal of Political Economy, 99*(6), 1272–1295.

Tirole, J. (1992). Collusion and the theory of organizations. In Laffont (Ed.), *Advances in economic theory*. Cambridge: Cambridge University Press.

Tirole, J. (1996). A theory of collective reputations. *The Review of Economic Studies, 63*(1), 1–22.

Vega-Redondo, F. (1996). *Evolution, games and economic behavior*. Oxford: Oxford University Press.

Waquet, J.-C. (1991). *Corruption: Ethics and power in florence, 1600–1770*. Cambridge: Polity Press.

Weibull, J. (1995). *Evolutionary game theory*. Cambridge: MIT Press.