

Corruption: Informal Remarks and Models

Mukul Majumdar

[With Athreya, Lambert- Mogiliansky, Radner,
Yoo...]

JDE, IJET, RED

Interest in corruption (abuse of *public* office for *private* gains) is not of recent origin. In *Arthashastra*, Kautilya was concerned, among other themes, in designing an effective public administration, and we have some incisive comments:

"Just as it is impossible not to taste honey or poison that one may find at the tip of one's tongue, so it is impossible for one dealing with government funds not to taste, at least a little bit of the King's wealth."

"Just as it is impossible to know when a fish moving in water is drinking it, so it is impossible to find out when government servants in charge of undertakings misappropriate money."

"Those officials who do not eat up the King's wealth but increase in just ways are loyally devoted to him shall be made permanent in service."

Interestingly enough, Kautilya was invoking and contesting *even earlier* prescriptions on deterring corruption.

Despite the difficulties in developing any systematic analysis of illegal activities based on reliable empirical foundations, there is a voluminous (and ever expanding) literature on many facts of corruption and remedial policies.

I follow the useful stylized framework proposed in Elliott (1997) which classifies the individuals in a particular economy in three groups: "citizens" , "non-elected" officials (bureaucrats/members of the judiciary), and "elected" officials (legislative/administrative/judicial branches).

Three types of "corruption" are portrayed in this framework:

- **"grand" corruption** typically occurs at the highest levels of government, usually involving all three groups;
- **"influence peddling"** describes corruption that arises out of the interaction between elected or recently retired officials, or bureaucrats going through "revolving doors" (promise to promote special interests in order to generate campaign contributions, arrangements to lure public sector employees into lobbying,...)
- **"petty"** corruption occurs when private citizens (and owners/managers of businesses,...) interact with lower level non-elected officials on approval of privileges (driving license, passports,...) or business requirements

(registration of a firm, confirming that it meets the laws/regulations on public safety, minimum wages....) or government benefits (pensions, loans, jobs,..). "Pet-tiness" refers to "the size of each transaction and not to its total impact on government income or policy" (Scott,1972, p.6)

Klitgaard (1988): Ingredients of corruption:

- (government) monopoly (on granting specific privileges),
- discretion enjoyed by bureaucrats on interpreting "laws" / "procedures" / "proper" documentation / "eligibility"
- lack of direct accountability to the citizens / lack of transparency and appeal procedure

Much has been written on the role of the "license/permit Raj" in India during the period of national economic planning.

- bureaucracy inherited from the colonial days [Indian civil service/ British Indian army]

"these services ran India....dedicated to maintaining things as they were. Their disbelief in Indian capacity was pronounced, distrust of India claims profound, and opposition to Indian encroachment in higher services determined. The (civil) service was at once the strength and the weakness of the British Raj in India, for while it served the needs of a static society to admiration, it was temperamentally unsuited to adapt itself to the demands of a changing society." {Percival Spear (1965.p.218: History of India).

- assumed special importance in the allocation of resources from the Second Five Year Plan [program of industrialization/micro management of the economy by the state)

- multiple verifications of documents without a time frame for decision making: "a series of substantially meaningless scrutinies for which no rational economic criteria have ever been defined or at least discovered" [Bhagwati:1973]
- verifications and design of procedures generated "rent seeking" activities

It has been argued that the overall growth of bureaucracy (in its 2002 Report Transparency International estimates that there are ~19.5 million bureaucrats spread over 200,000 establishments) and the maze of regulatory procedure have hurt development efforts and attempts to attract direct foreign investments, after the liberalization policy announced in 1991. A sharp statement from Roy (2003), who has served at the highest level in policy making:

"I highlighted that the administrative procedures associated with trade are probably the most primitive in the world. Even just to export, we require 258 signatures, 118 copies of the same document... This involves dealing with a multitude of Government of India agencies separately. This evokes hardly a protest from established exporters who have mastered the knack of getting around the system and having prompt clearance by paying bribes. But for new global players this is posing as a major irritant."

"A single window policy"

"The Japanese envoy compliments the intent of the industry minister. But he gets upset over India's much talked about "single window" for Foreign Direct Investment. "The joke is that India has forty "single windows" for one investor...It is not easy to be working here."

The Financial Express , November 28, 2001.

In defense of windows

A careful assessment of an investment project might indeed require appraisal of a number of special experts: proposals involving construction activities need to be looked at by a civil engineer; environmental concerns on disposal of waste ought to be examined by an environmental engineer familiar with the location; financial aspects/viability of loans must be examined by appropriate accountants, benefits to workers...

A visit to a 'track" of independent bureaucrats [windows] might be natural. In addition, specialization/division of labor among the bureaucrats is expected to have a positive influence on their productivity and efficiency. Over time, a well-designed system of windows might develop the right combination of skills/technology ensuring that a project is "in order".

But it means a major break with the past.

An Informal statement of a Formal Model and some Conclusions [Details: A Note on Closing the Windows by Athreya and Majumdar , Int J Econ Theory, 1, 73-81]

We focus on the efficiency of approval systems [not worrying about bribes at the moment]

Two alternative designs for approval systems: two types of applicants:

1) two windows (servers in the language of queuing theory, each a sole authority one verifying and granting a specific approval (e.g., first dealing with "real" aspects, second dealing with "financial" aspects)

2) both windows are allowed to examine both aspects and grant approvals); the applicants go to the first available window.

Arrivals of both types of applicants are Poisson processes, independent of each other, with a common positive rate, λ .

The service processes are also Poisson, independent of each other as well as the arrival of arrival processes, with a common positive rate μ .

To study the stochastic process of queue size write $\rho = \lambda/\mu$.

A stochastic equilibrium (invariant distribution or steady state) $\pi^* = (\pi_n^*)$ of the queue size exists when $\rho < 1$. It is given by

$$\pi_n^* = Prob[X = n] = (1 - \rho)\rho^n$$

where X is the number of applicants in a given queue. Note that given the structure of the process, π^* is approximately the distribution of the queue size for large t . More precisely,

$$\pi_n^* = \lim_{t \rightarrow \infty} P[X(t) = n]$$

where $X(t)$ is the number of applicants in one queue at time t . Hence, the expected number of applicants in a queue in equilibrium is:

$$EX = (1 - \rho) \sum_{n=0}^{\infty} n\rho^n = \rho/[(1 - \rho)]$$

In the second system with an arrival rate of all customers being 2λ , IF the service rate of both servers can be maintained at μ , the steady state distribution of the number of customers, Y , in the queue is given by:

$$\begin{aligned} \text{Prob}[Y = 0] &= \eta_0 = 1/[1 + \{2\rho/(1 - \rho)\}] \\ \text{Prob}[Y = n] &= 2\eta_0 \cdot \rho^{n-1}. \end{aligned} \quad (1)$$

Hence,

$$EY = [2\rho\eta_0]/(1 - \rho)^2$$

This leads to

$$2EX/EY = 1 + \rho$$

This ratio of the expected queue size in the two systems can be taken as a numerical measure of efficiency.

In the "heavy traffic" case (ρ close to 1), the second system of "competing windows" serving both types of customers is roughly twice as efficient as the first.

A few clarifications are in order:

- while λ and μ can be interpreted capturing the demand and supply sides of the approval process, their ratio ρ turns out to be the key element in the expressions of invariant distributions and measurement of efficiency. Therefore, a policy designed to raise λ ought to be supplemented by another aiming to raise μ .
- since both windows remain active, the improvement in efficiency is not necessarily in conflict with employment generation.

- whether the same service rate μ can be maintained when are redesigned to compete is basically an empirical question that will depend on the context. An increase in the supporting staff of servers might be needed, but an increase in the use of computers may lead to downsizing the workforce. Even when there is some increase in μ , there may be an increase in the efficiency measure. [A & M explore some generalizations, subsequent paper by Athreya and x in Economic Theory]

Early effort on jumping queue through bribery by Liu:

Introduce variation of μ to send signals /propose bribes

Windows: Game Theoretic Models

The literature on game theoretic analysis is rather limited. A fundamental difficulty is the multiplicity of equilibria in dynamic games.

An Informal Sketch of L-M-R model.

A sequence of entrepreneurs (EPs) may apply to a track of two or more bureaucrats (windows BUs) in a prescribed order for approval of their projects. Each EP 's project has a specific (expected discounted?) value that will be realized if the project is approved. This value is known to the entrepreneurs but not to the bureaucrats. However, its probability distribution is common knowledge. The EP must apply in the specific order, and the project is approved if and only if every BU approves. A BU demands a bribe as a condition for approval. At any step the EP may not apply, or, may leave the process, the value of the project is not realized, and she loses all the application cost and bribes paid up to that point.

If the project is approved by the entire track, the EP receives the value minus the application costs and the bribes paid. The pay off to a BU in that period is the amount of bribe collected, if any, and, his total payoff in the game is the expected sum of discounted bribes he receives.

Roughly, we make the following assumptions about the information that the players have about the actions of the other players:

- Players remember their own actions and those of the players they transact with;
- Within a single period, no bureaucrat knows the bribes demanded by the other bureaucrats.
- Every player learns about the actions of other players in previous periods, perhaps with some delay.

These specifications are important in the repeated game, and I shall only talk about that game informally!

A one stage Game

An *EP* may apply to a "track" of two or more N bureaucrats (*BUs*) [arranged in a specific sequence] for approvals [in that order] of their projects. If the project is rejected by any *BU*, the game ends: *EP* does not proceed farther in the track [losing the total amount of bribes and costs up to that point].

It is important to distinguish between two types of interventions by *BUs*. Suppose that each project must meet some "requirements" . A *BU* may *reject* a qualified project if a bribe is not paid. On the other hand, a *BU* may *approve* an unqualified project if a bribe is paid. The LMR paper in JDE assumes for expository ease that all projects are qualified. The more general model is in IJET. The RED paper introduces intermediaries. I shall follow the JDE exposition first.

Let V be the project's potential (expected present) value, which is uniformly distributed over $[0,1]$ (relaxed in Yoo, Economic Theory article). The probability distribution is common knowledge, but the realized value of V is known only to EP.

If and when EP applies to BU_n she has an application cost $c > 0$. The cost is known to all players. If EP applies to BU_n let $b_n \geq 0$ be the bribe demanded as a take-it-or-leave-it basis: if EP does not pay, the game ends. It is assumed that the BUs do not observe the bribes demanded by other BUs .

Let $a_n = 1$ or 0 as EP does or does not apply. If she does, she incurs the cost c and then learns the magnitude of b_n . Let $p_n = 1$ or 0 as EP does or does not pay the bribe. Of course, if $a_n = 0$, or $p_n = 0$, then the game is over. Thus, if $a_n = 0$, we have $p_n = 0$, and, consequently, $a_m = 0$ for all $m > n$.

Call the part of the game in which EP faces BU_n the n -th step ($n = 1, 2, \dots, N$) of the game. The action taken

by EP in the n -th step is (a_n, p_n) . The action taken by BU_n in step n is, of course, b_n .

For $n \geq 1$, let H_n denote the history of the game through step n , *i.e.*, the sequence of actions taken by all players through step n . A strategy for EP is a sequence of functions $\alpha = \{A_1, P_1, \dots, A_N, P_n\}$ which determine EP 's actions according to:

$$\begin{aligned} a_n &= A_n(V, H_{n-1}) \\ p_n &= P_n(V, a_n, b_n) \end{aligned} \tag{2}$$

Since BU_n does not know the magnitude of any previously demanded bribes, his strategy for the game is the magnitude of the bribe he demands:

$$b_n \geq 0$$

To complete the description of the game, we describe the pay-off functions. The pay-off for BU_n is the bribe he demands, if paid,

$$U_n = p_n b_n$$

The pay-off for EP is the value of the project if approved, less the sum of the application costs and bribes (whether or not the project is completely approved). Thus, EP 's pay-off is

$$U_n = p_N \cdot V - \sum_{1 \leq n \leq N} (a_n c + p_n b_n)$$

Finally, $0 < Nc < 1$.

As usual, a Bayes-Nash equilibrium of the game is a profile of strategies such that no player can increase his or her expected pay off by unilaterally changing his strategy. A strategy is weakly undominated if there is no other strategy that yields the player as high a pay-off for all strategy profiles of other players, and a strictly higher pay-off for some strategy profile of other players.

Theorem 1. *There is no equilibrium in which the project is approved with positive probability.* ■

[for $N \geq 2$, the result is valid even when $c = 0$]

On the other hand, there *is* an equilibrium in which the bribes demanded are so high that the entrepreneurs does not apply, no matter what the value of the project.

A particular *Null Strategy Profile (NSP)* is characterized by N parameters b'_1, b'_2, \dots, b'_N . The parameter b'_n is the bribe that *EP* expects BU_n to demand.

These parameters satisfy

$$0 < b'_n < 1 \text{ for each } n; \max\{1 - c, 1/2\}$$

EP's strategy: apply only if the value of the project is as large as the sum of the expected cost of completing the track, whereas she pays the actual bribe demanded only if the value of the project is as large as the sum of this actual bribe and the cost of completing the track if the remaining *BUs* demand their planned bribes.

BU'_n 's strategy is: if *EP* applies demand b'_n .

▲ *Skipping* an issue involving credibility which has to be taken care of by examining the equilibrium definition closely ▼

Theorem 2. *Suppose that*

$$0 < b'_n < 1 \text{ for each } n; \max\{1 - c, 1/2\}$$

The corresponding NSP is an ▲ equilibrium, and for every value of V , EP does not apply to BU_1 . ■

Observe that in a *NSP* equilibrium each player has a zero pay-off. This property of a *NSP* equilibrium is important in the repeated game framework, where the threat of reverting to a *NSP*, under certain conditions, deter a *BU* from deviating from "cooperative-like" behavior.

A "repeated" game with a sequence of entrepreneurs

Suppose that the one-stage game is repeated in an infinite sequence of periods, with a succession of *EPs* with i.i.d. project values, but the same track of bureaucrats. The method of analysis and attainable results for this supergame are similar to those of a repeated game.

▲▲ very informal to avoid complicated notation.▼▼

** The game has many equilibria , which differ in the bribes demanded**

**There is $\delta^* < 1$, such that if the common discount factor δ of the *BUs* satisfies $\delta \geq \delta^*$, there is a family of equilibria for which there is a positive probability that *EPs* will apply to the *BUs*, pay the bribes demanded and retain a positive surplus.

** If there were no bribes , then all projects with $V > Nc$ will be approved. Call this the economically efficient outcome. While there is no equilibrium with such a property, as $\delta \rightarrow 1$, one can find a sequence of equilibria that approaches economic efficiency.

** given the multiplicity of equilibria one cannot assert that "single window" policy is necessarily better. [for a class of second best equilibria it does: see LMR for a precise description and analysis of this issue].

Influence Peddling

"Vote for cash" or "Vote for vote" may be a challenge to democracy and social justice.

"Revolving doors" has been the subject of intense scrutiny . The term refers to "post-government" employment opportunities that open up for senior bureaucrats with special expertise.

Significant number of transitions from the public to private sector appointments has been documented.

Concern: a public servant (a 'regulator') may be negligent in enforcing the rule of law or representing public interests for possible *future personal gains* (lucrative employment in a private firm that s/he interacted with, compensation as a lobbyist,..)

Laws on restrictions : a "cooling off " period on the passage from the public or private sector have been enacted in many countries.

M_Yoo (2011) is a formal model with two regulators and two firms that captures two distinct elements in understanding revolving doors: "human capital transfer" and "collusion building".

- It may be in the interest of the firm to acquire expertise in the (possibly complex) laws that are binding given the scope of a firm's activities. High quality bureaucrats, in turn, may choose to send appropriate signals to strengthen their case. Thus employing a former civil servant is a part of the process of enriching the human capital of the firm. Thus, the revolving door may be a part of allocation mechanism that enhances the mobility of labor with specialized skills.
- On the other hand, firms and regulators may seek to build a collusion: leniency in the enforcement enhances the prospects for a future association.

A one stage game: each regulator is either "qualified" or "unqualified". The firm knows only the probability of qualification. There are complex details to capture the interactions in the model. The case with no PGEO is contrasted with the one where the bureaucrat has PGEO. It is shown that in the latter case the qualified bureaucrat regulates more stringently to signal his ability.

A class of equilibria is identified in a repeated game framework. In this case, the qualified bureaucrat chooses to regulate the colluding firm leniently and the non-regulating firm stringently. For this class, however, the "cooling off" policy does not seem to have any effect.