Bribe "Frequency" and Corruption in Economies[♣]

Vivekananda Mukherjee

Aparajita Roy*

Department of Economics, Jadavpur University, Kolkata 700032, India

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*Corresponding Author. E-mail: aparajita.roy1@gmail.com

Phone: +91-9831146381

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Abstract

The paper develops a theoretical model to study how size of corruption (defined as amount of revenue generated through bribes) varies with commonly obtained data on corruption for different economies that is “frequency” at which firms are asked for bribes. It accommodates both ‘high’ and ‘low’ levels of bureaucracies which are corruptible, and finds that bribe “frequency” negatively correlates with both the overall size of corruption and the size of ‘high’ level corruption present in the economy. Therefore the ranking of the economies based on “frequency” data may not reflect the same based on their overall size of corruption. The model not only explains the low level of development in economies with high “frequency” of bribery, also explains the observed independence of two levels of bureaucracies in these economies. It draws some important policy implications for economic development and control of corruption in economies.

Keywords: corruption, bureaucracy, bribe frequency, welfare, ‘kleptocracy’

JEL Classification: D61, D73, H11

1. Introduction

How do we measure "corruption" in an economy? A careful study of existing literature in economics reveals that it can be done at least in three different ways. While authors like Mookherjee and Png (1995) take it as frequency at which a bribe incidence occurs in an economy, Shleifer and Vishny (1993) take it as bribe rate. In a recent paper Zenger (2011) takes it as the amount of revenue generated through bribes. Unless all of them are positively correlated with each other, it seems reasonable that when we talk about overall size of "corruption" in economies we should take the size of bribe revenue as its measure. However due to illegal nature of bribe transactions, the data on bribe revenue is hardly available. The most frequently used data set on "corruption" the Corruption Perception Index (CPI) is prepared on the basis of responses from the people to the questions which ask them either about "prevalence" or "commonness" or "frequency" or "likelihood" of corruption[1]. Clearly CPI is based on the first measure described above. In some of the cases micro-data on both frequency and bribe rates are available like in Olken and Barron (2009) who collected data on bribes paid by the truck drivers on the way of transporting goods in Indonesia. They relate the bribe rate to frequency with which the bribes are asked at different checkpoints. But since they do not have the data on how the number of trucks varied with the variation of the bribe rate we are not able to relate the "bribe rate" and "frequency" with the total takes of bribe revenue; and thus with overall corruption of the economy. Do the data on "frequency" and "bribe rate" positively correlate with the overall size of corruption? In this paper we attempt to find a theoretical answer to this question.

We construct a model of an economy which has corruption both at the high and low levels of the bureaucracy. A 'high' level bureaucrat takes bribe from competing firms to award a monopoly license for operating in a particular industry to one of them. The firms rewarded with the licenses to operate in different industries have to bribe the 'low' level officials to access essential inputs required for production. A 'low' level official enjoys monopoly power to facilitate access to the essential inputs to

[1] See Lambsdorff (2007) for details of construction of CPI.

firms and charges a mark-up over the official price of the input. Thus the number of independent 'low' level officials stands for bribe "frequency" in our model[2]. The mark-up (the bribe rate) and the overall size of corruption (the bribe revenue) are endogenously determined from the model. We find that the "frequency" and the "bribe rate" positively correlate with each other as predicted by Shleifer and Vishny (1993) before and as empirically verified by Olken and Barron (2009) later. But, the overall size of corruption in the economy inversely varies with them. So we conclude all other things remaining the same, ranking of the economies according to bribe "frequency" as practiced by CPI may not reflect the ranking of the economies according to their overall size of corruption. Our model also predicts that the 'high' level corruption in an economy must be falling with bribe "frequency". We also show that in economies with higher "frequency" of bribes, lower overall size of corruption and lower welfare level coexist with each other.

The results we have outlined above crucially depend on the assumption that the independent 'low' level bureaucrats exist in economies and they behave like monopolies over the supply of respective essential inputs. How realistic is this assumption? Given the fact that the monopoly behavior of the independent 'low' level officials reduce the bribe revenue collected by the 'high' level official, does not the 'high' level official try to strike a coalition with the 'low' level officials such that they are adequately compensated for behaving competitively? Earlier Kahana and Nitzan (2002) solved an organizational design problem under similar situation and concluded that the optimum bureaucratic friction at the 'low' level should reduce to zero. In this paper we consider a mechanism similar to the conjecture by Moe (1984) through which a high level "career" bureaucrat attempts to control its subordinates and finds that such a mechanism fails to take off. This explains why we observe both 'high' and 'low' level bureaucrats, who are bribe-seeking, in a large number of economies. In support of existence of independent 'low' level bureaucrats in reality De Soto (2000) reports obtaining legal authorization to build houses in Peru requires the completion of 207 bureaucratic procedures involving 52 government offices. In Egypt and Philippines

[2] Since the 'high' level official himself could supply the essential inputs besides rewarding the licenses, the presence of 'low' level officials here can be termed as "bureaucratic decentralization".

the number of agencies involved is 31 and 53 respectively in similar situations. The fact that all these economies with high number of ‘low’ level bureaucrats are typically of ‘low’ income type is also consistent with the model’s prediction. This also explains the absence of real life examples of ‘Kleptocracy’ defined by Grossman (1995) as the economies where coalition between the ‘high’ and ‘low’ level officials forms.

To summarize the contributions of the paper: first, the paper argues that the ranking of the economies as reported by CPI may not reflect the ranking of the economies according to their overall size of corruption; second, it points out that higher bribe “frequency” in an economy as reflected in CPI is an indicator of lower size of ‘high’ level corruption in the economy; third, it explains why a stable coalition between the ‘high’ and ‘low’ level bureaucrats does not form and therefore it explains why we typically observe high ‘low’ level bribe frequency as we observe it in the low income economies. The results imply that the well known policy rhetoric like controlling bribe ‘frequency’ or controlling power of ‘low’ level bureaucrats may indeed bring about economic development but may fail to control the overall size of corruption in economies.

Section 2 of the paper describes the model. Section 3 discusses the results. The section following concludes.

2. The Model

We assume there are k number of industries in an economy. Each industry has inverse demand function

$$P(Y) = a - Y.$$

In each of these industries a license is to be awarded to one of the $m \geq 2$ number of firms[3]. If the *l*th firm is able to enter the *i*th industry, it expects to earn profit π_{il}. It is known that both the 'high' and 'low' levels of corruption independently exist in the economy. The implication of the existence of 'high' level corruption is the following: the 'high' level bureaucrat responsible for making choice among the *m* competing firms accepts bribe to determine the winner. The larger is the amount of bribe paid by the *l*th firm, the higher is the probability z_{il} of winning the contest for that firm in the *i*th industry. However, the firm that wins the contest then passes through the hierarchy of independent low level officials to access the essential government services at the production stage. The existence of 'low' level corruption implies the low-level officials demand bribe for supplying the services over and above the official price set by the government. Hence, the *l*th firm in the *i*th industry ends up paying bribe at two stages: first, at the 'high' level it pays R_{il} to win the contest with probability z_{il} and second, at the 'low' level pays p_j $(\forall\, j = 1,2,\dots,n)$ per unit for each of the *n* different complementary inputs supplied by *n* different low-level officials which are above their official price c_j $(\forall\, j = 1,2,\dots,n)$[4]. We assume the production technology is such that production of one unit of each product requires one unit of each of the *n* inputs where $n \geq 2$. Therefore, unit cost of production of the *l*th firm becomes $(p_1 + p_2 + \cdots + p_n)$. Since the production is fixed coefficient, the cost of production of Y_{il} units of output turns out to be $(p_1 + p_2 + \cdots + p_n)Y_{il}$. Hence, the *l*th firm's expected profit is written as:

$$\pi_{il} = z_{il}[(a - Y_{il}) - (p_1 + p_2 + \cdots + p_n)]Y_{il} - R_{il}, \quad \forall\, i = 1,2,\dots,k; \;\; \forall\, l = 1,2,\dots,m \tag{1}$$

[3] The number of firms *m* is finite in our model for two different reasons. First, as Lambsdorff (2001) argues, an act of corruption is illegal and secretive in nature and therefore, by definition it cannot involve too many players. Otherwise, the information becomes available in public domain and corruption does not sustain. Second, the firms in our model participate in rent-seeking contest at the high-level, in which only one of the firms wins but the other firms lose their entire amount paid as bribe. So, by definition the firms have to be large enough to absorb the loss. Not too many firms can satisfy this criterion. See Bliss and Di Tella (1997) for an endogenous determination of number of firms in a rent-seeking model.

[4] We assume the firms face no punishment for bribery either in the country of origin or in the country where they pursue their business venture. This closely approximates the reality despite OECD's 'Convention on Combating Bribery of Foreign Public Officials in International Business Transactions' in place since 1999 (see Celentani, Ganuza and Peydro (2004) for details).

We represent the sequence of events in *each* of the industries in the following timeline:

t = 1	t = 2	t = 3	
firms participate in rent-seeking contest for the license ['high' level corruption]	firm that wins the contest pays bribe to access essential services; 'low' level officials decide about the bribe rates ['low' level corruption]	firm decides about its scale of production	payoffs are realized

In our model the frequency of bribe payment is represented by the size of the 'low' level bureaucracy n. The subjective perception indices like Corruption Perception Index (CPI) published by Transparency International records this data for different economies[5]. The results of the model are derived as we observe what happens if n changes. We also explain the existence of independent 'low' level officials in an economy.

The model is solved in backward induction method starting at $t = 3$.

<u>Firm's Output Decision</u>

The lth firm maximizes π_{il} as in (1) by choosing its scale of output Y_{il}.The firm's choice $Y_{il}^* > 0$ must satisfy the following equation

$$a - 2Y_{il}^* - (p_1 + p_2 + \cdots + p_2) = 0, \forall\ i = 1,2,\ldots,k;\ \forall\ l = 1,2,\ldots,m \tag{2}$$

Since, firms are symmetric, it must be

[5] See Lambsdorff (2007).

$Y_{il}^* = Y^*, \forall\, i = 1,2,\ldots,k;\ \forall\, l = 1,2,\ldots,m$

Therefore, each firm's choice is given by:

$$Y^* = \frac{1}{2}[a - (p_1 + p_2 + \cdots + p_n)] \quad (3)$$

<u>'Low' Level Corruption</u>

We assume the corruption that exists at the 'low' level is *without theft*. Each official pays to the government its per unit due c_j for the provision of the input[6]. Since each of the *k* firms that have won the rent-seeking competition at $t = 1$ demand one unit of input from each of the *n* number of heterogeneous government officials, the amount of input demanded from the *j*th official is given by $x_j = kY^*, \forall\, j = 1,2,\ldots,n$. Therefore the payoff function of the *j*th official is:

$$\emptyset_j = (p_j - c_j)kY^*, \quad \forall\, j = 1,2,\ldots,n \quad (4)$$

where, $\emptyset_j$: payoff of the *j*th official.

Substituting Y^* from equation (3) in equation (4) the payoff of the *j*th official can be written as:

$$\emptyset_j(p_1,\ldots,p_n) = \frac{k}{2}(p_j - c_j)[a - p_j - (p_1 + \cdots + p_{j-1} + p_{j+1} + \cdots + p_n)], \forall\, j = 1,2,\ldots,n \quad (5)$$

Each official maximizes his own profit by choosing p_j^*. Assuming that an interior solution exists, p_j^* must satisfy the following equation

$$\left[a - p_j^* - \textstyle\sum_{j\neq h} p_h\right] - (p_j^* - c_j) = 0,\ \forall\, j = 1,2,\ldots,n \quad (6)$$

The system of equation (6) represents the reaction function of the *j*th official with respect to the price charged by all other officials. The Nash equilibrium prices $(p_1^*,\ldots,p_j^*,\ldots,p_n^*)$ must satisfy the *n* equations

[6] See Shleifer and Vishny (1993) for the definition of 'corruption without theft' and 'corruption with theft'. In the case of 'corruption with theft' essentially we have $c_j = 0$. However, all the results of the present paper go through for the case $c_j = 0$.

given in (6). Defining $P^* = \sum_{j=1}^{n} p_j^*$, we can calculate P^* by summing up the n equations given in (6) to obtain:

$$P^* = \frac{na + \sum_{j=1}^{n} c_j}{n+1}$$

Substituting the value of P^* in equation (3) we obtain

$$Y^* = \frac{a - \sum_{j=1}^{n} c_j}{2(n+1)}$$

Assumption 1: $c(n) = \sum_{j=1}^{n} c_j$, $c^{'}(n) \geq 0$.

The government may reduce the number of ‘low level’ officials either by discontinuing some of the services it provides or by clubbing them under less number of officials. In the first case, since the services are essential, the firms cannot do away with them and must purchase them from the market. We assume the market for these services are competitively supplied and consequently the total cost payable by a firm for these services either remains the same or falls. In the second case, even if the number of officials falls, since the services are clubbed under the new department, the cost of each of the redefined service increases. Therefore, we assume the total cost payable by a firm either remains the same or falls.

Following assumption 1, the values of P^* and Y^* can be written as:

$$P^* = \frac{na + c(n)}{n+1} \qquad (7)$$

$$Y^* = \frac{a - c(n)}{2(n+1)} \qquad (8)$$

Assumption 2: $a > c(n)$

Assumption 2 ensures that $Y^* > 0$. Otherwise, $Y^* = 0$.

The total amount of bribe collected by all the *n* number of ‘low’ level officials is:

$B^* = \sum_{j=1}^{n} \emptyset_j^* = kY^* \sum_{j=1}^{n} (p_j^* - c_j)$.

By summing over all *n* officials from equation (4) and substituting the values of P^* and Y^* we get

$$B^* = \frac{1}{2} kn \left[\frac{a - c(n)}{n+1}\right]^2$$

Using the expression of Y^* from (8) B^* can be written as:

$$B^* = 2kn(Y^*)^2 \qquad (9)$$

<u>‘High’ Level Corruption</u>

Substituting the values of P^* and Y^* into (1), expected payoff level of the firm that wins the competition for entering the industry is calculated as

$$\pi_{il}^* = z_{il}(Y^*)^2 - R_{il}, \forall\, i = 1,2,\ldots,k; l = 1,2,\ldots,m \qquad (10)$$

Since each firm pays R_{il} as bribe to the high-level official; the ‘contest success function’ suggests that it must be

$$z_{il} = R_{il}[R_{il} + (R_{i1} + \cdots + R_{il-1} + R_{il+2} + \cdots + R_{im})]^{-1}, \forall\, i = 1,2,\ldots k; l = 1,2,\ldots,m$$

So each firm ends up maximizing

$$\pi_{il}^* = R_{il}[R_{il} + (R_{i1} + \cdots + R_{1l-1} + \cdots + R_{il+1} + \cdots + R_{im})]^{-1}(Y^*)^2 - R_{il},$$
$$\forall\, i = 1,2,\ldots,k; l = 1,2,\ldots,m$$

by choosing an appropriate value of R_{il}^*.

Since the participating firms in the rent-seeking game are symmetric it must be $R_{il}^* = R_i^*, \forall\, l = 1,2,\ldots,m; i = 1,2,\ldots k$. The symmetric Nash equilibrium must satisfy the following equation:

$$[R_i^* + (m-1)R_i^*]^{-1}(Y^*)^2 - R_i^*[R_i^* + (m-1)R_i^*]^{-2}(Y^*)^2 = 1, \forall\, i = 1,2,\ldots,k$$

This solves for

$$R_i^* = \frac{m-1}{m^2}(Y^*)^2, \forall\, i = 1,2,\dots,k$$

Hence, the total amount of 'high' level bribe given by all the *m* firms in the *i*th industry will be

$$\overline{R_i^*} = mR_i^* = \frac{m-1}{m}(Y^*)^2 \quad (11)$$

Since all the industries are identical,

$$\overline{R_i^*} = R^*, \forall\, i = 1,2,\dots,k$$

And hence, the size of 'high' level corruption in the economy is:

$$H^* = kR^* = k\frac{m-1}{m}(Y^*)^2 \quad (12)$$

Definition 1. *The overall level of corruption* (T^*) *in an economy* is the sum of the amounts of bribe paid by all the firms both at the 'high' as well as the 'low' levels in all the industries that belong to the economy, i.e.

$$T^* = H^* + B^*. \quad (13)$$

Definition 2. *The welfare of the economy* is defined as:

$$W = w(kY^*) \quad \text{where} \quad w' > 0.$$

Note that since the bribe payments are transfers from firms to the officials within the economy they do not enter the welfare calculation. Also note that definition 2 deals only with the static efficiency of the economy. But the distribution of rent from the firms which are productive agents to the bureaucrats who are unproductive agents creates dynamic inefficiency for the economy, too.

In the next section we use this model to find out the effect of rise in size of ‘low’ level bureaucracy (equivalent to frequency of bribe payment) on the size of the ‘high’ level corruption in an economy. We also derive the effect of the same on the size of overall corruption and the welfare of the economy. Then we explore the condition under which a coalition between the ‘high’ and ‘low’ level officials forms. We compare the overall corruption level of an economy where such a coalition forms against the overall corruption of an economy where such a coalition does not form.

3. Results

Observation 1: $\frac{dY^*}{dn} < 0$.

Proof: From (8)

$$\frac{dY^*}{dn} = -\frac{1}{2(n+1)^2}\left[a - c(n) + (n+1)c'(n)\right] \tag{14}$$

The statement of the observation follows from application of assumptions 1 and 2 of the model. □

Note from (7), $\frac{dP^*}{dn} = \frac{(a-c(n))+(n+1)c'(n)}{(n+1)^2}$. By assumptions 1 and 2, $\frac{dP^*}{dn} > 0$. So as the number of ‘low’ level officials increases, the marginal cost of production P^* for each of the firm increases. Hence, output of each of them falls, causing a fall in the aggregate output. The opposite happens when the number of ‘low’ level officials falls. The aggregate output expands.

Proposition 1: *As the frequency of bribery increases (decreases), the size of ‘high’ level corruption falls (rises).*

Proof: The frequency of bribery increases as *n* increases. From (12) we get:

$$\frac{dH^*}{dn} = 2kY^*\frac{m-1}{m}\frac{dY^*}{dn}$$

Since $m \geq 2$, with the help of observation 1we observe:

$$\frac{dH^*}{dn} < 0 \quad (15)$$

Therefore, the statement of proposition follows. □

As the number of 'low' level officials increases, marginal cost of each firm increases. Consequently, their operating profit falls. This reduces the obtainable rent from the *k* th industry. So the total amount of bribe paid by firms in competing to enter *k* th industry falls. As all the industries are identical, the total amount paid at the 'high' level falls.

Proposition 2: *As the frequency of bribery increases (decreases), the size of overall corruption of an economy falls (rises); the welfare of the economy also falls (rises).*

Proof: The frequency of bribery increases as *n* increases. From Definition 1, it follows:

$$\frac{dT^*}{dn} = \frac{dH^*}{dn} + \frac{dB^*}{dn}. \quad (16)$$

From (15) we know: $\frac{dH^*}{dn} < 0$. From (9) we derive:

$$\frac{dB^*}{dn} = 2k(Y^*)^2 + 4knY^* \frac{dY^*}{dn}$$

By substituting from equations (8) and (14) in the expression of $\frac{dB^*}{dn}$ we obtain:

$$\frac{dB^*}{dn} = -\frac{kY^*}{(n+1)^2}\left[(n-1)\big(a - c(n)\big) + 2n(n+1)c'(n)\right]$$

Given assumptions 1and 2, and the fact that $n \geq 2$, $\frac{dB^*}{dn} < 0$. Hence from (16) the statement of the first part of the proposition follows.

For the second part of the proposition we use Definition 2. Since $\frac{dY^*}{dn} < 0$, clearly $\frac{dW}{dn} = w'\left(k\frac{dY^*}{dn}\right) < 0$. □

In a recent paper, which exclusively deals with 'low' level corruption, Zenger (2011) has shown that $\frac{dB^*}{dn} < 0$ and $\frac{dW}{dn} < 0$. Our paper shows that similar result holds even if we consider the scope of 'high' level corruption in an economy. It turns out that the higher frequency of 'low' level bribes acts as a check on the overall level of corruption in an economy. The size of 'low' level corruption itself falls as the demand for the 'low' level officials' services falls as the firms scale down their operation. As the expected operating profit of the firms falls, demand for licenses of these industries falls as well. Consequently, the high level corruption falls. But as the total output of the economy falls, the welfare level of the economy also falls. So proposition 2 points out that in economies where we observe independent 'low' level bureaucrats the overall size of corruption and its welfare level can go hand in hand.

Proposition 2 also explains the way the CPI ranking is based on the data on 'frequency' of bribery in different economies may be misleading in comparison of overall corruption level of the economies. The economies with higher frequency of bribery must be having lower overall level of corruption.

One natural question that arises from the above results is that since the presence of 'low' level officials reduces the bribe revenue of the high level officials in each of the industries, why not these officials try to strike out a coalition with the 'low' level officials. Such a coalition by eliminating the double marginalization effect that each one of the 'low' level officials imposes on the other would have reduced the marginal cost of production of the firms. The higher output produced by the firms could increase payoff of the high level officials. Would the 'low' level officials agree to participate in such a coalition? Note that from participating in such a coalition the 'low' level officials would lose the bribe-rent they were enjoying without the coalition. Therefore such a coalition would form if the high level officials with their higher payoff could compensate the loss of the 'low' level officials from participating in it. The analysis below explains the possibility of coalition formation in details.

The coalition between the 'high' level official in the *i*th industry and the 'low' level officials would form if all the 'low' level officials agree to charge the respective official prices for the services they provide to the firm which wins the license to operate in *i*th industry and thus avoids the double marginalization. So in case of coalition between 'high' and 'low' level officials the *j*th 'low' level official ($\forall\, j = 1,2, \dots, n$) charges:

$$p_j = c_j .$$

Now, the profit of the *l* th firm that wins the license to operate in the *i*th industry can be written as:

$$\pi_{il} = z_{il}[(a - Y_{il})Y_{il} - (c_1 + c_2 + \cdots + c_n)Y_{il}] - R_{il} \tag{17}$$

The profit maximizing choice of output level $Y_{il}^{'} > 0$ must satisfy the following equation:

$$a - 2Y_{il}^{'} - (c_1 + c_2 + \cdots + c_n) = 0$$

Since due to symmetry $Y_{il}^{'} = Y^{'}, \forall\, i = 1,2, \dots, k;\ \forall\, l = 1,2, \dots, m.$

$$Y^{'} = \frac{1}{2}\left[a - \sum_{j=1}^{n} c_j\right].$$

From assumption 1 the value of $Y^{'}$ can be rewritten as

$$Y^{'} = \frac{1}{2}[a - c(n)] \tag{18}$$

Using (18), from (17) the expected payoff of the *l*th firm that participates in the contest to take entry in the *i*th industry can be written as:

$$\pi_{il}^{'} = z_{il}(Y^{'})^2 - R_{il}, \forall\, i = 1,2, \dots, k; \forall\, l = 1,2, \dots, m$$

where R_{il} is the bribe to the 'high' level official responsible for awarding license in the *i*th industry and z_{il} is the 'contest success function'. Substituting the value of z_{il} in the expression of $\pi_{il}^{'}$ we obtain: $\pi_{il}^{'} = R_{il}[R_{il} + (R_{i1} + \cdots + R_{il-1} + R_{il+1} + \cdots + R_{im})]^{-1}(Y^{'})^2 - R_{il}, \forall\ i = 1,2, \ldots, k;$

$$\forall\ l = 1,2, \ldots, m.$$

Suppose $R_{il}^{'}$ maximizes $\pi_{il}^{'}\ for\ \forall\ i = 1,2, \ldots, k; \forall\ l = 1,2, \ldots m$. By symmetry of the firms it must be $R_{il}^{'} = R_{i}^{'}$ where $R_{i}^{'}$ satisfies the following equation

$$[R_{i}^{'} + (m-1)R_{i}^{'}]^{-1}(Y^{'})^2 - R_{i}^{'}[R_{i}^{'} + (m-1)R_{i}^{'}]^{-2}(Y^{'})^2 = 1, \forall\ i = 1,2, \ldots, k$$

This solves for $R_{i}^{'} = \frac{m-1}{m^2}(Y^{'})^2$.

Hence, the total amount of bribe accrued to the 'high' level official at the *i*th industry becomes

$$\bar{R}_{i}^{'} = \frac{m-1}{m}(Y^{'})^2 \qquad (19)$$

Out of $\bar{R}_{i}^{'}$ the 'high' level official at the *i*th industry pays out $(p_j^{*} - c_j)Y^{*}$ to the *j*th 'low' level official ($\forall\ j = 1,2, \ldots, n$) to compensate for her loss from participating in the coalition. The total compensation paid to all the *n* 'low' level officials turns out to be $[Y^{*}\sum_{j=1}^{n}(p_j^{*} - c_j)]$. The coalition is feasible if $\bar{R}_{i}^{'}$ - $Y^{*}\sum_{j=1}^{n}(p_j^{*} - c_j) \geq \overline{R_i^{*}}$.

However, the feasibility of the coalition does not ensure its stability. The 'high' level official at the *i*th industry observes that the terms and conditions of the coalition described above do not prevent unilateral deviation by any one of the *n* 'low' level officials from the agreed terms of the coalition. The *j*th official can profitably deviate from charging the official price c_j for the *j*th service by charging $p_j^{'} > c_j$ on the assumption that all other officials will not deviate and will continue to charge the official price for their services. The *j*th low level official chooses $p_j^{'}$ to maximize her deviation payoff $[(p_j^{'} - c_j)Y^{''} +$

$(p_j^* - c_j)Y^*]$ where $Y^{"} = \frac{1}{2}[a - (c_1 + \cdots + c_{j-1} + p_j^{'} + c_{j+1} + \cdots + c_n)]$. Since $[(p_j^{'} - c_j)Y^{"} + (p_j^* - c_j)Y^*] > (p_j^* - c_j)Y^*$ the deviation always takes place $\forall\, j = 1,2,\ldots,n$ and the coalition breaks down.

It is possible to show that the deviation from the coalition is prevented through payment of an incentive $t^{'} = (a - c(n))Y^{"}$ to the *j*th official. With such an incentive scheme the *j*th official chooses $p_j^{'}$ by maximizing $[(p_j^{'} - c_j + (a - c(n)))Y^{"}]$. The first order condition for maximization solves for $p_j^{'} = c_j$. Therefore the deviation is prevented for all $j = 1,2,\ldots,n$ and $Y^{"} = Y^{'}$. If $(a - c(n))Y^{'} \geq (p_j^* - c_j)Y^*$, just by paying $(a - c(n))Y^{'}$ to each of the officials the 'high' level official can ensure both participation in the coalition, as well as non-deviation from it. The total payment to the 'low' level officials in this case is: $n(a - c(n))Y^{'}$. Otherwise, she has to pay $(p_j^* - c_j)Y^*$ to the *j*th 'low' level official and $Y^* \sum_{j=1}^{n}(p_j^* - c_j) = Y^*(P^* - c(n))$ to all of them. By substituting the values of $Y^*, P^*, Y^{'}$ from (8), (7) and (18) in the respective expressions we observe, $n(a - c(n))Y^{'} > Y^*(P^* - c(n))$. So the sufficient condition for existence of a stable coalition turns out to be

$$\bar{R}_i^{'} - n(a - c(n))Y^{'} \geq \overline{R_i^*}. \qquad \forall\, i = 1,2,\ldots,k \tag{20}$$

Proposition 3: *A stable coalition between the 'high' and the independent 'low' level officials never forms.*

Proof: A stable coalition between the 'high' and the independent 'low' level officials successfully forms if condition (20) holds.

Substituting the values of $\bar{R}_i^{'}, Y^{'}$ and $\overline{R_i^*}$ respectively from (19), (18) and (11) in (20) we conclude that inequality (20) holds if the following inequality holds:

$$m[1 - \frac{2n(n+1)^2}{(n+1)^2 - 1}] \geq 1.$$

But since $\frac{2n(n+1)^2}{(n+1)^2-1} > 1$ for all values of $n \geq 2$ and $m \geq 2$, the above inequality never holds. Therefore inequality (20) can never hold in reality. The statement of the proposition follows. □

Proposition 3 explains why we observe corrupt independent 'low' level officials in an economy. Although official-price-charging-'honest' 'low' level officials are desirable for the interest of the 'high' level officials and from the welfare perspective of the economy as well, the 'low' level corruption persists. Thus the proposition provides an explanation behind the empirical observation made by De Soto (2000) that in many developing countries, quite contrary to the expectation, large number of independent 'low' level officials exists. The existence of 'large' number of independent complementary-service-providing officials on the other hand explains low income level of these countries.

3. Conclusions

This paper explores the relation between frequency of bribery and the level of corruption in an economy. It presents a model of bureaucracy in an economy with independent 'high' and 'low' level bureaucrats, both the levels being corruptible. The 'high' level corruption points out to the high level bureaucrats who take advantage of their position of power and provide preferential treatment to the firms against rent-seeking activity or gainful lobbying. On the other hand the situation of low level bureaucrats selling essential services to firms in exchange of bribe consists of 'low' level corruption. The number of 'low' level bureaucrats proxies for 'frequency' of bribe demand a representative firm faces conducting its operation in these economies. The model exploits the conjecture expressed in Lambsdorff (2007) that the increase in power of the corruptible bureaucrats works as an inherent check on the level of corruption in the economies in deriving its main results. Here the increase in bribe frequency reduces the scale of operation of the firms by increasing their marginal cost of production and thereby adversely affects the bribe revenue collected both at 'high' and 'low' levels of bureaucracy. The overall corruption of the economy also falls.

The paper contributes to the literature in three important ways: first, it argues that the ranking of the economies as reported by Corruption Perception Index (CPI) published by the organizations like Transparency International based on bribe "frequency" data may not reflect the ranking of the economies according to their overall size of corruption; second, it points out that higher bribe "frequency" in an economy as reflected in CPI is indicator of lower size of 'high' level corruption in the economy; third, it explains why a stable coalition between the 'high' and 'low' level bureaucrats does not materialize and therefore it explains why we observe high 'low' level bribe frequency as we observe it in the low income countries. The paper also provides a new explanation of why we do not observe 'kleptocracies' in most of the real world situations.

The results derived in the paper imply that the well known policy rhetoric like controlling bribe 'frequency' or controlling power of 'low' level bureaucrats may indeed bring about economic development but may fail to control the overall size of corruption in economies. Therefore policies for controlling the overall size of corruption and the policies for promoting economic development must be different from each other. The high overall size of corruption can be seen as the price paid for high level of economic development.

How important are the assumptions made in the model? The assumption of symmetry of the industries present in the economy helps to simplify calculations of the model. However the results are not dependent on this assumption. In industries with inelastic demand pattern although the effect of increased bribe 'frequency' would be limited, since it would be very pronounced in the industries with elastic demand, in aggregate the results of the model would still go through. Similarly if less number of firms compete for entry in an industry, the 'high' level bribe revenue falls in that particular industry; but this keeps the results unchanged. The model also assumes that corruption does not lead to exit of firms from the industry. This assumption is also not crucial for validity of the results of the model. In fact Zenger (2011) taking into account the possibility of exit in his model derives similar result as Proposition 2 of our model in the case of 'low' level corruption in economies. In the model we do not take into account of punishment on the corrupt bureaucrats. The assumption is supported by the fact that in economies with independent bureaucrats, the bureaucrats derive their independence from lack of effective punishment from the higher authority. But even if we introduce punishment for the 'low' level bureaucrats in our model, as long as it fails to eliminate 'low' level corruption, it merely increases the marginal cost of the essential inputs they supply to the firms, and therefore does not have any effect on the results derived in the paper.

The model can have many interesting applications. It can be used to study the effect of bribe frequency on the concentration and size distribution of firms in an industry. It can also be used to study the effect of trade liberalization in an economy. In particular it can be used to throw light on the necessity of bureaucratic reform along with the trade liberalization. These remain as our future research agenda.

References

Bliss, C. and R. Di Tella (1997): Does Competition Kill Corruption? *Journal of Political Economy*, 105 (5), 1001-1023.

Celentani, M., J. J. Ganuza and J. L. Peydro (2004): Combating Corruption in International Business Transactions, *Economica* 71, 417 – 448.

De Soto, H (2000): *The Mystery of Capitalism*, Basic Books: New York.

Grossman, S. J. (1995): Dynamic Asset Allocation and the Informational Efficiency of Markets, *Journal of Finance L* (3), 773-787.

Kahana, N. and S. Nitzan (2002): Pre-assigned Rents and Bureaucratic Friction, *Economics of Governance* 3, 241 – 248.

Lambsdorff, J.G. (2001): How Corruption in Government Affects Public Welfare – A Review of Theories, Centre for Globalization and Europeanization of the Economy, Gottingen, Discussion Paper 9.

Lambsdorff, J.G. (2007): *The Institutional Economics of Corruption & Reform-Theory, Evidence and Policy*, Cambridge University Press: Cambridge.

Moe, T. M. (1984): The New Economics of Organization, *American Journal of Political Science* 28 (4), 739-777.

Mookherjee, D. and I.P.L. Png (1995): Corruptible law Enforcers: How Should They Be Compensated, *The Economic Journal* 105 (428),145-159.

Olken, B.A. and P. Barron (2009): The Simple Economics of Extortion: Evidence from Trucking in Aceh, *Journal of Political Economy* 3 (117), 417-452.

Shleifer, A. and R. Vishny (1993): Corruption, *Quarterly Journal of Economics* 108 (3), 599-617.

Zenger, H. (2011): Uncoordinated Corruption as an Equilibrium Phenomenon, *Journal of Institutional and Theoretical Economics* 167, 343-351.