INCIDENCE OF CORRUPTION ON FORMAL AND INFORMAL SECTORS: IS THERE ANY SYMMETRY?

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Do the formal and informal sectors of production react symmetrically to higher frequency of corruption? The theoretical model developed in the paper qualifies the answer and explains certain empirical observations. In the informal sector while an increased frequency of corruption increases the entry cost, in the formal sector the effect remains uncertain. While abundance of firms definitely falls in the formal sector, in the informal sector it may either rise or fall in the economies with high share of formal sector employment and unambiguously falls in the economies with low share of formal sector employment. Finally, while the firm size distribution shifts towards relatively larger firms in the formal sector, in the informal sector the effect on firm size distribution remains uncertain in the economies with high share of formal sector employment and it shifts towards smaller size firms in the economies with low share of formal sector employment.

1.   INTRODUCTION

Bureaucratic corruption affects both entry of firms and their size distribution in a market. Generally, size of a firm is measured with respect to the level of sunk investment undertaken by it. Sunk costs, as defined by Sutton (1991), are the expenditures incurred with a view to enhance consumers' willingness-to-pay for the firm's products. These are supposed to be one-time investments intended towards successful establishment of a new firm. The amount of sunk cost depends on various factors like investments in research and development (R & D), marketing, education of

employees etc.[1] The larger firms, incurring higher amount of sunk cost earn higher profit and therefore grow large. In this paper the entrepreneurs trying to enter a market, besides incurring sunk investments, also pay towards bureaucratic corruption that is prevailing in the economy. We explore how a change in the frequency of corruption affects firm size distribution both in the formal and informal sector markets of an economy.

The paper finds that the effects of change in corruption-frequency on the size distribution and the entry cost of the formal and informal sector firms are not symmetric. Although the results are often uncertain in nature and depend on set of conditions that we have derived in the paper, there are some definite predictions as well. While it leads to entry of larger firms in the formal sector, the number of firms operating in this sector falls. As far as the informal sector is concerned, in the economies with low share of formal sector employment the size distribution unambiguously shifts towards smaller firms; the number of firms operating in this sector falls. While in the informal sector the entry cost rises with the rise in the frequency of corruption, in case of formal sector it remains uncertain.

The distinction between the formal and informal sector entrepreneurs in our paper has the following two attributes: First, following Bradley et al. (2012) we assume that the firms in the informal sector are involved in necessity-based entrepreneurship and therefore do not sell products which are much differentiated from each other (requiring low sunk investment) and therefore have low profitability. In contrast the formal sector firms are involved in opportunity-based entrepreneurship and sell products which are much differentiated from each other (requiring high sunk investment); therefore, have high profitability. Second, as pointed out by papers like Levenson and Maloney (1998), Djankov, La Porta, Lopez-De-Silanes and Shleifer (2002), Maloney (2004), Chakravarty and Bose (2011) the firms in the informal sector operate outside the official channel in contrast to the formal sector firms which operate inside the official channel.[2] In our model a formal sector entrepreneur requires to procure a government license to enter a market. In contrast the informal sector entrepreneur avoids the official channel and pays to the local mafia to enter a market. There are two levels of officials. The high-level official issues license to the entrepreneurs to enter the formal sector market in exchange of some graft payment. Once inside the market the entrepreneurs need to purchase the essential inputs for production from the low-level officials.[3] Each low-level official controls the provision of an essential input and supply these in exchange of some bribe payment. Thus, we consider both high level and low-level corruption as in Mukherjee and Roy (2014). So, an entrepreneur willing to enter the formal sector market pays at two levels: first, he pays to the high-level official for procuring the license and second, pays to the low-level officials for accessing the essential inputs. An informal sector

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[1] See Braunerhjelm (1999) for examples of sunk costs in firm-specific assets.
[2] For other distinctions between the formal and informal sectors of an economy see Guha-Khasnobis, Kanbur and Ostrom (2007) and Marjit and Kar (2011).
[3] See also Raj, Sen and Kar (2018) and Bhattacharya and Mukherjee (2019) on this.

entrepreneur, on the other hand, pays only to the mafia, who in turn pays to the corrupt officials. The number of low-level officials denotes the frequency of corruption in our model. Finally, those individuals who are not entrepreneurs in either of the two sectors work as wage earners in these   sectors.

Simultaneous presence of formal and informal sector markets is commonly observed in any developing economy. A formal sector firm enjoys a combination of secure property rights and better contractual capabilities. Whereas, an informal sector firm not being registered officially, faces higher risk of expropriation, different types of penalties business closer, but limited access to the legal system.[4] Then why do we observe firms operating in the informal sector at all? Papers like Levenson and Maloney (1998), Djankov, La Porta, Lopez-De-Silanes and Shleifer (2002), and Maloney (2004) explain that the firms operate in informal sector as the costs of formality are high for them. Based on data from 85 countries Djankov, La Porta, Lopez-De-Silanes and Shleifer (2002) find a considerable burden on the entrepreneur willing to register a firm with the appropriate authorities. For example, the average number of procedures required to start a firm in the formal sector around the world is 10, the average number of days is 47 and the official cost of following these procedures for a simple firm on average is 47 percent of annual per capita income of a country. The existence of corruption in developing countries is expected to inflate the cost. Svensson (2005), and Kaufmann, Kraay and Mastruzzi (2007) use cross-country data on the regulation of entry to find a correlation between the number of days to start a business and public perceptions of corruption. Treisman (2007) finds that the time necessary to register a business is the most significant in explaining corruption among an array of variables proxying for regulatory burdens. In a study based on urban informal sector in seven cities in India Bhowmik (1999) explains that municipal authorities, in cities which have provisions for issuing licenses to street vendors, are most reluctant to issue them or the provisions are such that it makes it almost impossible for most vendors to avail the licenses. The forms to be filled up for getting a license are so elaborate that it would be difficult for an illiterate or semi-literate vendor to apply for a license. In Mumbai, where there are around 200,000 hawkers, the municipal corporation has granted only 14,000 licenses. Moreover, the municipal corporation has stopped granting new licenses for the past two decades. Similar is the situation in Bangalore and Ahmedabad where most of the street vendors do not possess a license. So, the policies towards simplified entry regulation and crackdown on corruption are expected to reduce the entry cost and to increase the formal sector registration of the firms. While a large empirical literature (Monteiro and Assuncao (2006), Kaplan, Piedra and Seira (2007), Yakovlev and Zhuravskaya (2007), Bruhn (2008)) confirms this hypothesis, very little is known theoretically as well as empirically about the effect of such policies on: (i) the informal sector firms; and (ii) the size-distribution of firms in both the formal and informal sectors separately. The present paper contributes in this area.

[4] See Monteiro and Assuncao (2006).

The theoretical model we present in this paper is close in its scope with Bliss and Di Tella (1997) and Bruhn (2008). Though some papers like Choi and Thum (2004) and Svensson (2003) study the effect of corruption on abundance of firms in a market and conclude that corruption induces exit, with the exception of Bliss and Di Tella (1997) a paper that studies entry cost of the firms is rare. However, Bliss and Di Tella (1997) deals only with the formal sector of an economy and studies the interaction between corruption and market competition. We adapt the Bliss and Di Tella (1997) framework in three different ways to suit our purpose. First, we introduce sunk cost in it which allows us to analyze firm size distribution. We consider size distribution of prospective entrant firms in a market as a given data[5] and following the works of Cabral and Mata (2003) and that of Luttmer (2007) we assume it to have a Pareto distribution. The firm size distribution gets endogenously determined in this model as perturbations around the initial distribution. Second, we introduce different layers of bureaucratic corruption in it so that we can study the effect of frequency of corruption on entry cost and firm size distribution. Third, we find a way to introduce informal sector similar to Bruhn (2008) in our adapted Bliss and Di Tella framework. We also model the behavior of the mafia providing protection services to the informal sector firms.[6] Thus, the paper contributes to the existing literature being one of the first papers to theoretically predict the differential impact which the increased frequency of corruption may have in the formal and informal sectors of production.[7] The theoretical result presented in the paper while confirms the empirical observations of Bruhn (2008) that as the entry procedures are made simple the wage earners, rather than informal sector entrepreneurs, emerge as formal sector entrepreneurs and of De Soto (1989) that in Peru corruption forces entrepreneurs to establish new firms in smaller scale. But our results provide new insights about the effect of reduced corruption-frequency on the formal sector and informal sector firms.

Section 2 of the paper describes the model. The Model consists of two subsections. The first one explains informal sector and the second one deals with formal sector. Section 3 derives the results. The Section 4 following concludes.

2. MODEL

We consider an economy with its working population, the size of which is measured as 1, being divided into two sectors – formal and informal. In either of the sectors one can either be an entrepreneur or an employee of one of the firms operating in that sector. Each entrepreneur starts a firm and depending on which sector (formal/informal) the firm operates, the entrepreneur is known as a formal or an informal sector entrepreneur.

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[5] Possibly due to imperfections in the capital market.
[6] In this we follow the approach of Gambetta (1996).
[7] See Kar et al (2019) for a theoretical model which studies the effect of trade liberalization on informal sector of an economy.

Before entering the market, a firm may incur certain amount of sunk investments having positive impact on its operating profit. Typical examples of this type of investments can be the expenditures made on establishment, advertisements, R&D activities, training of the employees etc. It is also common knowledge that bureaucratic corruption exists in the economy. A formal sector entrepreneur using official channel to establish a firm pays bribe both to the license-issuing corrupt high level official at the entry-stage and to each of the low level officials who are in charge of supplying essential inputs required in production, e.g. land area, water supply, electricity etc at the production stage. The informal sector entrepreneurs however avoid the official channel and pay to the local mafia, who in turn pays to the corrupt officials. The number of low-level officials denotes the frequency of corruption in this model.

The higher income earned in entrepreneurship compared to the wage rate prevailing in either of the sectors explains the existence of entrepreneurship in these sectors in spite of the costs associated with it. Because of the higher amount of sunk investments typically formal sector employees are more skilled and earn higher wage w_f than informal sector wage w_i. We assume w_f is fixed institutionally and w_i is market determined.[8] A formal sector entrepreneur earns higher than w_f and an informal sector entrepreneur earns higher than w_i. For simplicity we assume that the income earned by an informal sector entrepreneur is lower than w_f. So formal sector population is relatively well off compared to the informal sector population and has higher purchasing power. We assume also that the informal sector of production exclusively serves the informal sector population. Similarly, the formal sector of production exclusively serves the formal sector population. This assumption has been made again for simplicity. We discuss the implication of relaxing this assumption as we progress: the basic results of the model would remain unchanged even if the assumption is relaxed.

The amount of sunk investment $S \geq 0$ is private information to a firm. However, it is common knowledge that S follows Pareto distribution.[9] with its cumulative distribution function $F(S)$ having the properties: $F_1 > 0$ and $F_{11} < 0$, where the subscripts denote the order of differentiation.

The following subsections discuss the returns to the informal and formal sectors of production separately.

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[8] This is a standard Harris-Todaro assumption in development economics literature; see Ray (1998) for details.

[9] Cabral and Mata (2003) show that firm size distribution is stable over time and skewed to the right. Luttmer (2007) takes up two cases. In the first case where technologies available to potential entrants improve at an exogenous rate and the entrants are not much heterogeneous, then equilibrium firm size distribution follows Pareto distribution. In the second case where there is endogenous growth of technologies and the entrants can imperfectly imitate the incumbent firms, the log of firm size follows a gamma distribution. However, all possible firm size distributions have a tail similar to that of a Pareto distribution. In this paper we take Pareto distribution of the firm size as given data and consider small perturbation around it determined at the equilibrium. Note the results are not dependent on the assumption about the initial distribution of firm size.

2.1. Informal Sector

Informal sector of an economy is typically characterized by necessity-based entrepreneurship (Bradley et al., 2012) where small firms sell products with lesser degree of differentiation among themselves. The entrepreneurs enter the market "informally" without a government license (Levenson and Maloney, 1998; Djankov, La Porta, Lopez-De-Silanes and Shleifer, 2002; Maloney, 2004; Chakravarty and Bose, 2011). For entering the market as well as for accessing the essential inputs like land area, electricity, water supply etc. these entrepreneurs adopt illegal route and pay to the local mafia. The mafia not only provides access to the essential inputs, but also provides security to the firms both against the extortion effort of other mafia outfits in the locality and the eviction threat from the local authority. Thus, firms in informal sector do not have to deal with either the high level or the low-level bureaucrats directly. However, the mafia has to pay bribes for the essential inputs to the corrupt low-level bureaucrats (security from the eviction threat can be imagined as another essential input). Therefore, the return to an informal sector entrepreneur can be written as:

$$\pi_i(A_i, S_i, G_i) = P_i(A_i, S_i) - S_i - G_i, \tag{1}$$

where, A_i and S_i denote the abundance of firms in the informal sector market and level of sunk cost incurred by a representative firm respectively. $P_i(A_i, S_i)$ is the operating profit of the informal sector firm, which is the respective function of abundance of firms in the market and the level of sunk cost incurred by the firm. The payment made to the mafia is represented by G_i.

As the abundance of firms increases in the informal sector the operating profit of a typical firm in this sector falls i.e. $\frac{\partial P_i}{\partial A_i} < 0$.

Since informal sector entrepreneurs cater to consumers with low purchasing power, product differentiation is not important for them. So, we assume:

Assumption 1: $0 < \frac{\partial P_i}{\partial S_i} < 1$.

Assumption 2: $P_i \rightarrow P_0 > w_i + G_i$ as $S_i \rightarrow 0$.

While assumption 1 implies that product differentiation results in a less than proportionate rise in the operating profit of a firm in informal sector, assumption 2 guarantees that even if a firm does not incur any amount of sunk investment, still it can ensure a positive amount of profit by operating in the informal sector. Given assumption 1, the validity of assumption 2 is reasonable. Below we argue that had it not been the case no firm would have existed in the informal sector market. The assumptions also help to explain the substantial difference in size among the formal and informal sector firms.

Let us now look at the allocation of the population between the informal sector entrepreneurship and employment. The profit function $\pi_i(A_i, S_i, G_i)$ is a continuous function in S_i, and with assumption 1 being the characteristic feature of the informal sector market, $\pi_i(A_i, S_i, G_i)$ is also monotonically declining in S_i. The informal sector wage rate w_i, however, is not a function of S_i. Given assumption 2, since $\pi_i(S_i)$ is continuous and monotonically declining in S_i, there must exist a value of $S_i = \hat{S}$ such that for all $S_i \leq \hat{S}$, $\pi_i(S_i) \geq w_i$. Therefore, all entrepreneurs with $S_i \leq \hat{S}$ operate a firm in the informal sector market. However, the individuals with $S_i > \hat{S}$ either become informal sector employees or enter the formal sector. $\hat{S}$ is the critical level of sunk cost at which

$$\pi_i(A_i, \hat{S}, G_i) = w_i, \tag{2}$$

holds. Therefore, $\hat{S}$ solves:

$$\hat{S} = P_i(A_i, \hat{S}) - G_i - w_i, \tag{3}$$

as $\hat{S}(A_i, G_i, w_i)$. Now change in $\hat{S}$ due to a change in abundance of firms, the informal sector wage and the amount of graft payment can be determined as follows. Since, $\frac{\partial P_i}{\partial A_i} < 0$ and $0 < \frac{\partial P_i}{\partial S_i} < 1$, from (3):

$$\frac{d\hat{S}}{dA_i} = \frac{\frac{\partial P_i}{\partial A_i}}{1 - \frac{\partial P_i}{\partial S_i}} < 0, \tag{4}$$

$$\frac{d\hat{S}}{dG_i} = -\frac{1}{1 - \frac{\partial P_i}{\partial S_i}} < 0, \text{ and} \tag{5}$$

$$\frac{d\hat{S}}{dw_i} = -\frac{1}{1 - \frac{\partial P_i}{\partial S_i}} < 0. \tag{6}$$

As either of the three variables A_i, G_i or w_i rises in their values, the amount of profit falls at each level of S_i, intuitively explaining the signs of the derivatives in equations (4), (5) and (6) respectively above.

2.2. Formal Sector

Following Bradley et al. (2012) we assume the formal sector firms are involved in opportunity-based entrepreneurship and produce products which are much differentiated from each other. Therefore, it must be the case that the sunk investments have more than proportionate return in terms of operating profit. Since sunk investments are important for the formal sector firms, we also assume that they cannot earn a positive operating profit without incurring a positive amount of sunk investment.

The assumptions distinguishing the formal sector production are:

Assumption 3: $\frac{\partial P_f}{\partial S_f} > 1$.

Assumption 4: $P_f \to 0$ as $S_f \to 0$.

The operating profit earned by a firm once it enters the formal sector market (P_f) however depends not only on the level of sunk cost it has incurred (S_f), it also depends on the abundance of firms in the formal sector market (A_f) and the frequency of corruption denoted by the number of low level officials (n) approving the use of the essential inputs in government disposal. Higher level of sunk cost differentiates its product better and thus larger amount of operating profit is earned. Assumption 3 implies that in the formal sector since the consumers like to consume differentiated products a certain increase in sunk cost results in more than proportionate increase in the operating profit enjoyed by the formal sector firms. But even in a market with differentiated product as the abundance of firms' increases, operating profit of each firm falls. Finally, as the frequency of corruption increases, firm's variable cost of production also increases causing a fall in its operating profit[10]. Let $P_f(A_f, S_f, n)$ denote operating profit function of a formal sector firm. Then we expect: $\frac{\partial P_f}{\partial A_f} < 0$, $\frac{\partial P_f}{\partial S_f} > 0$ and $\frac{\partial P_f}{\partial n} < 0$.

We denote the total profit of a representative formal sector firm as:

$$\pi_f(A_f, S_f, n, G_f) = P_f(A_f, S_f, n) - S_f - G_f,$$

where G_f represents the amount of graft charged by the corrupt high-level official to the formal sector entrepreneur using the official channel of entry. The formal sector wage rate $w_f > w_i$ is not a function of S_f.

Observe assumption 4 implies: $\pi_f(A_f, S_f, n, G_f) \to -G_f$ as $S_f \to 0$.

Note $\pi_f(A_f, S_f, n, G_f)$ is a continuous function in S_f. So, given assumption 4 there must exist a value of $S_f = S_0$ such that for all $S_f \geq S_0$, $\pi_f(S_f) > w_f$. Thus all individuals who invest $S_f \geq S_0$ enter the formal sector market as entrepreneurs. S_0 is the critical level of sunk cost at which

$$\pi_f(A_f, S_0, n, G_f) = w_f, \tag{7}$$

holds. Therefore, S_0 solves:

$$S_0 = P_f(A_f, S_0, n) - G_f - w_f, \tag{8}$$

as $S_0(A_f, n, G_f)$. The individuals investing $S_f \geq S_0$ enter the formal sector market as

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[10] See Mukherjee and Roy (2014) for details.

an entrepreneur, while those unable to do so either become formal sector employees or enter the informal sector.

How does S_0 respond to changes in abundance of firms, frequency of corruption and amount of graft payment? Since $\frac{\partial P_f}{\partial A_f} < 0$, $\frac{\partial P_f}{\partial n} < 0$ and by assumption 3, $\frac{\partial P_f}{\partial S_f} > 1$, from (7) it follows:

$$\frac{dS_0}{dA_f} = \frac{\frac{\partial P_f}{\partial A_f}}{1-\frac{\partial P_f}{\partial S_f}} > 0, \tag{9}$$

$$\frac{dS_0}{dn} = \frac{\frac{\partial P_f}{\partial n}}{1-\frac{\partial P_f}{\partial S_f}} > 0, \tag{10}$$

$$\frac{dS_0}{dG_f} = -\frac{1}{1-\frac{\partial P_f}{\partial S_f}} > 0, \text{ and finally,} \tag{11}$$

$$\frac{dS_0}{dw_f} = -\frac{1}{1-\frac{\partial P_f}{\partial S_f}} > 0. \tag{12}$$

Note S_0 directly varies with all the three variables $A_f, n,$ and G_f. If any one of these variables increases in their values, the profit falls at each level of S_f: the sign of the corresponding derivatives follows.

2.3. Equilibrium

In equilibrium the values of (A_i, A_f, G_i, G_f) get determined as functions of the parameters of the model, which in turn determine the values of $\hat{S}$ and S_0 from equations (3) and (8) respectively.

From the above discussion it is evident that individuals who cannot spend at least S_0 amount in sunk investment are unable to start a firm in the formal sector. In that case they expect to earn w_f if they find a work in one of the formal sector firms. However, the formal sector wage rate is high and employment opportunity in this sector is limited. Therefore, those who cannot find employment in the formal sector enter the informal sector either as an entrepreneur or an employee. We assume $S_0 > \hat{S}$ to separate out the formal and informal sector entrepreneurship. This also ensures that there are wage workers in the economy. Since the absence wage workers in an economy is unrealistic, the assumption is justified. The corresponding equilibrium is represented as in Figure 1 below:
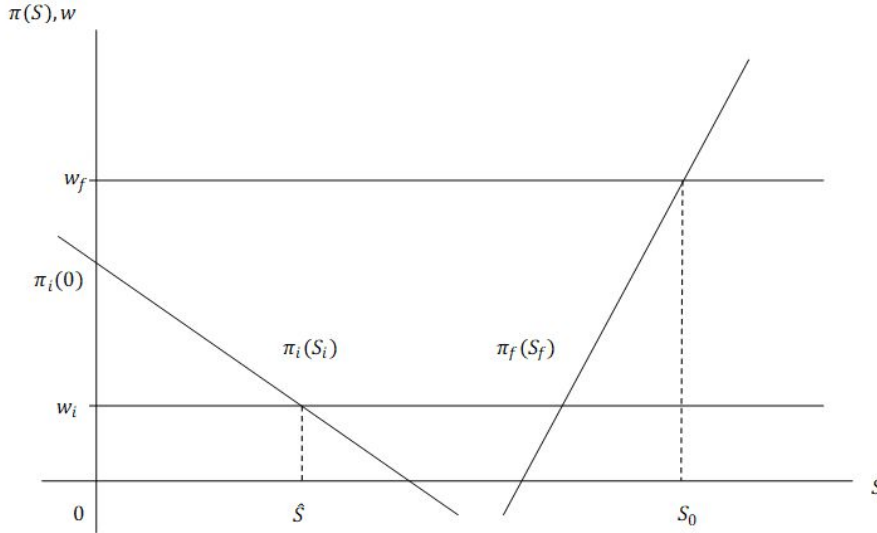
Figure 1.   Equilibrium in the Formal and Informal Sector Markets

From the figure above it is evident that the individuals who spend $\hat{S}$ or less in sunk investment become entrepreneurs in the informal sector and those who spend S_0 or more become entrepreneurs in the formal sector. The individuals in the middle become the wage earners. Among the wage earners who are able to find an employment in the formal sector enjoys higher wage rate w_f. The remaining labor force get inducted in the informal sector at a relatively lower wage w_i.

Note if we relax the assumption that the informal sector of production serves only the informal sector population and the formal sector of production serves only the formal sector population, since less profit is to be earned at each level of sunk cost the profit functions of the representative firms in each of the sectors become relatively flatter. But the description of the equilibrium remains unchanged.

The equations that define the equilibrium are described below. The abundance of firms in the informal and formal sectors is determined as:

$$A_i = F(\hat{S}), \tag{13}$$
$$A_f = 1 - F(S_0). \tag{14}$$

The value of G_i is determined by the mafia operating in the informal sector of the economy. Similarly, G_f is determined by the high-level officials in the government. First, we discuss the determination of G_i.

As described above in the informal sector market the mafia not only provides access to the essential inputs, but also provides security to the firms both against the extortion

effort of other mafia outfits in the locality and the eviction threat from the authority. We assume the mafia has to incur a cost $C(G_i, n)$ for the services provided by it, where $\frac{\partial C}{\partial G_i} > 0$, $\frac{\partial C}{\partial n} > 0$, $\frac{\partial^2 C}{\partial G_i^2} \geq 0$, and $\frac{\partial^2 C}{\partial n \partial G_i} < 0$. The explanation of the functional specification of the cost follows.

The entry in the mafia market is unregulated. Therefore, a mafia faces high threat of entry from the other competing mafias. As G_i increases the informal sector market becomes more lucrative for all the competing mafia outfits. Then the incumbent mafia outfit has to spend more for protecting its turf. Therefore, $\frac{\partial C}{\partial G_i} > 0$. We also assume, $\frac{\partial^2 C}{\partial G_i^2} \geq 0$. Similarly, as the number of low-level officials (n) rises the frequency of corruption rises. The implication for the mafia of this is the increase in the cost of purchasing the inputs for providing its services. Therefore, $\frac{\partial C}{\partial n} > 0$. But as the frequency of corruption rises, since the cost of operation of the incumbent mafia outfit rises the mafia business turns out to be less lucrative to the outsiders and the incumbent mafia has to spend less to ward off the potential entrants. Therefore, $\frac{\partial^2 C}{\partial n \partial G_i} < 0$.

Since S_i is unobservable for a particular firm, the mafia charges the same amount of protection money from every entrepreneur entering the informal sector market. However, deciding about G_i the mafia has the following concern. As the overall profit of the firms also depends on G_i; a higher G_i may render entry unprofitable for some firms, causing a fall in the number of entrants. But, decreasing abundance of firms reduces the payoff of the mafia. Thus, the amount of G_i is determined in a manner such that it does not intimidate all the entrepreneurs from entering the market and the payoff of the mafia is maximized.

The expected payoff of a mafia outfit is written as:

$$F[\hat{S}(A_i, G_i, w_i)]G_i - C(G_i, n),$$

which is maximized with respect to G_i. Assuming that an interior solution to the maximization problem exists, the optimum choice of G_i must satisfy the following first order condition for maximization:

$$F[\hat{S}(A_i, G_i, w_i)] + G_i F_1[\hat{S}(A_i, G_i, w_i)]\frac{\partial \hat{s}}{\partial G_i} - \frac{\partial C}{\partial G_i}(G_i, n) = 0. \tag{15}$$

The second order condition for maximization is satisfied if and only if:

$$2F_1(\hat{S})\frac{\partial \hat{s}}{\partial G_i} + G_i F_{11}(\hat{S})\left(\frac{\partial \hat{s}}{\partial G_i}\right)^2 - \frac{\partial^2 C}{\partial G_i^2} < 0 \tag{16}$$

holds. As we progress, we assume inequality (16) to hold. Now we discuss determination of G_f by the high-level officials in the formal sector of the economy.

The high level official while choosing the level of graft G_f would make a similar argument as the mafia makes in the informal sector and demands same level of graft from all potential entrants in the formal sector of production. But since she has a secured official position, like the mafia she does not have to incur cost to protect her position. She maximizes her payoff $[1 - F(S_0)]G_f$ with respect to G_f. Assuming an interior solution to the maximization problem, the optimum choice of G_f must satisfy the following first order condition for maximization:

$$1 - F[S_0(A_f, n, G_f)] - G_f F_1[S_0(A_f, n, G_f)]\frac{\partial S_0}{\partial G_f} = 0. \tag{17}$$

The second order derivative of the maximand with respect of G_f must be strictly negative, and is satisfied if and only if:

$$2F_1(S_0) + G_f F_{11}(S_0)\frac{\partial S_0}{\partial G_f} > 0, \tag{18}$$

holds. As we progress, we assume inequality (18) to hold.

Notice that the equilibrium values of (A_i, A_f, G_i, G_f) are determined in this model from the system of four equations (13), (15), (14) and (17) as functions of n along with other parameters like w_i and w_f. The results of the paper are derived from the comparative static exercise of change in the frequency of corruption (n) on the equilibrium values of (A_i, A_f, G_i, G_f). We do this in the next two subsections starting with the case of the formal sector. The case of informal sector follows.

3.   RESULTS

3.1.   Effect of Change in Frequency of Corruption on the Formal Sector

As the frequency of corruption (n) changes, note, w_f being fixed does not change. However, the change in n may have an effect on w_i, which works through market forces. We will discuss this possibility in section 2.5 below. But since the change in w_i does not have any effect on the formal sector of production, it is apparent that (A_f, G_f) gets determined from equations (14) and (17) alone. Therefore, at the equilibrium from equations (14) and (17) we obtain:

$$\frac{dA_f}{dn} = -\frac{F_1(S_0)^2\frac{\partial S_0}{\partial n}}{F_1(S_0)^2\frac{\partial S_0}{\partial A_f} + 2F_1(S_0) + G_f F_{11}(S_0)\frac{\partial S_0}{\partial G_f}}, \tag{19}$$

$$\frac{dG_f}{dn} = -\frac{\left(F_1(S_0) + G_f F_{11}(S_0)\frac{\partial S_0}{\partial G_f}\right)\frac{\partial S_0}{\partial n}}{\left(F_1(S_0)^2\frac{\partial S_0}{\partial A_f} + 2F_1(S_0) + G_f F_{11}(S_0)\frac{\partial S_0}{\partial G_f}\right)\frac{\partial S_0}{\partial G_f}}, \tag{20}$$

and derive the following propositions.

Proposition 1: *As the frequency of corruption rises the amount of graft charged by the high level official for entry to the formal sector market rises if and only if* $\left(F_1(S_0) + G_f F_{11}(S_0)\frac{\partial S_0}{\partial G_f}\right) < 0$; *remains constant if and only if* $\left(F_1(S_0) + G_f F_{11}(S_0)\frac{\partial S_0}{\partial G_f}\right) = 0$; *and falls if and only if* $\left(F_1(S_0) + G_f F_{11}(S_0)\frac{\partial S_0}{\partial G_f}\right) > 0$.

Proof: Since $\frac{\partial S_0}{\partial A_f} > 0$, $\frac{\partial S_0}{\partial n} > 0$, $\frac{\partial S_0}{\partial G_f} > 0$ and inequality (18) holds the statement of the proposition follows from equation (20).

As the frequency of corruption increases, operating profit of the formal sector firms' falls. Consequently, the high-level official understands that the firms' critical level of sunk cost would increase. So fewer firm would enter the market. If $F_{11} \approx 0$ and Pareto distribution function is very flat, the expected loss due to non-entry of firms would be very high. Therefore, lower amount of graft would be charged. The opposite is likely to happen if F_{11} is very high.

Proposition 2: *As the frequency of corruption rises (falls) the abundance of firms in the market falls (rises); relatively smaller (larger) firms do not enter (enter) the market.*

Proof: Since $\frac{\partial S_0}{\partial A_f} > 0$, $\frac{\partial S_0}{\partial n} > 0$, $\frac{\partial S_0}{\partial G_f} > 0$, condition (18) implies from equation (19) that $\frac{dA_f}{dn} < 0$. Therefore, first part of the statement of the proposition follows. Besides, it has already been established in (10) that, $\frac{dS_0}{dn} > 0$, which implies that with a rise in low level corruption only firms with larger amount of sunk cost can exist. Therefore, second part of the statement of the proposition follows.

As the number of corrupt low-level officials' increases, the marginal cost of operation of the formal sector firms rises. The critical level of sunk cost, exceeding which the entrepreneurs enter the formal sector market, also rises. As only the larger firms can afford to incur higher amount of sunk cost, abundance of firms' falls and only the larger firms enter the formal sector market.

3.2. Effect of Change in Frequency of Corruption on the Informal Sector

The change in frequency of corruption (n) affects the equilibrium values of (A_i, G_i) in two different ways. The direct effect works through the cost of operation of the mafia: as the frequency of corruption rises, since the mafia has to bribe a greater number of officials, its cost of operation rises and the mafia business appears to be less lucrative to the outsiders. The indirect effect, however, comes as a spillover of the change that takes place in the formal sector due to change in n. From Proposition 2 above we know that as n rises A_f falls. As A_f falls, given the downward rigidity of w_f, the scope of

employment in the formal sector falls. The informal sector wage rate (w_i) being market determined however falls absorbing the excess supply of labour. A fall in w_i in turn brings changes in (A_i, G_i). As we discuss the effect of change in n on (A_i, G_i) we first analyze the direct and indirect effects separately and subsequently combine them in deriving the propositions.

Direct effect: At the equilibrium given w_i from equations (13) and (15) we obtain

$$\frac{dA_i}{dn} = \frac{F_1(\hat{S})\frac{\partial \hat{S}}{\partial G_i}\frac{\partial^2 C}{\partial n \partial G_i}}{\left[2F_1(\hat{S})\frac{\partial \hat{S}}{\partial G_i}+G_iF_{11}(\hat{S})\left(\frac{\partial \hat{S}}{\partial G_i}\right)^2-\frac{\partial^2 C}{\partial G_i^2}\right]-F_1(\hat{S})^2\frac{\partial \hat{S}}{\partial A_i}\frac{\partial \hat{S}}{\partial G_i}+F_1(\hat{S})\frac{\partial \hat{S}}{\partial A_i}\frac{\partial^2 C}{\partial G_i^2}} \quad , \tag{21}$$

$$\frac{dG_i}{dn} = \frac{\frac{\partial^2 C}{\partial n \partial G_i}(1-F_1(\hat{S})\frac{\partial \hat{S}}{\partial A_i})}{\left[2F_1(\hat{S})\frac{\partial \hat{S}}{\partial G_i}+G_iF_{11}(\hat{S})\left(\frac{\partial \hat{S}}{\partial G_i}\right)^2-\frac{\partial^2 C}{\partial G_i^2}\right]-F_1(\hat{S})^2\frac{\partial \hat{S}}{\partial A_i}\frac{\partial \hat{S}}{\partial G_i}+F_1(\hat{S})\frac{\partial \hat{S}}{\partial A_i}\frac{\partial^2 C}{\partial G_i^2}} \quad , \tag{22}$$

and derive the following observations.

Observation 1: *Given w_i as the frequency of corruption rises (falls) the payment charged by the mafia for entering the informal sector market rises (falls).*

Proof: Since $\frac{\partial \hat{S}}{\partial G_i} < 0$, $\frac{\partial \hat{S}}{\partial A_i} < 0$, $\frac{\partial^2 C}{\partial n \partial G_i} < 0$ and $\frac{\partial^2 C}{\partial G_i^2} \geq 0$ along with condition (16) we can conclude from (22) that $\frac{dG_i}{dn} > 0$. Therefore, the statement of the observation follows.

Given w_i as the number of low-level officials' increases the mafia business turns out to be less lucrative to the outsiders and a mafia spends less to ward off the other mafia outfits. This decreases the marginal cost of raising G_i (since $\frac{\partial^2 C}{\partial n \partial G_i} < 0$) for the mafia. The marginal benefit from raising G_i however remains unchanged. Therefore, the mafia chooses to charge higher payment for its services.

Observation 2: *Given w_i as the frequency of corruption rises (falls) abundance of firms in the market falls (rises); relatively larger (smaller) firms do not enter (enter) the market.*

Proof: Since $\frac{\partial \hat{S}}{\partial G_i} < 0$, $\frac{\partial \hat{S}}{\partial A_i} < 0$, $\frac{\partial^2 C}{\partial n \partial G_i} < 0$ and $\frac{\partial^2 C}{\partial G_i^2} \geq 0$ along with condition (16) we can conclude from (21) that $\frac{dA_i}{dn} < 0$. Therefore, the first part of the statement of the observation follows. Given $\frac{dA_i}{dn} < 0$, from equation (13) since $F_1 > 0$, it must be the case that $\frac{d\hat{s}}{dn} < 0$. Therefore, we derive the statement of the second part of the observation.

Given w_i as the frequency of corruption rises since the entry cost is likely to rise entrepreneurs expect higher marginal cost of operation than before. This discourages

firms to enter the informal sector market. However, the possibility of a fall in the abundance of firms raises the expected profit of the entering firms. Observation 2 shows that the former effect dominates the latter and the payoff of the firms falls for all possible size. Thus, only the smaller firms operate in the informal sector market.

Indirect effect: At the equilibrium given n from equations (13) and (15) we obtain

$$\frac{dA_i}{dw_i} = \frac{F_1(\hat{S})\frac{\partial \hat{S}}{\partial w_i}\left(F_1(\hat{S})\frac{\partial \hat{S}}{\partial G_i} - \frac{\partial^2 C}{\partial G_i^2}\right)}{\left[2F_1(\hat{S})\frac{\partial \hat{S}}{\partial G_i} + G_i F_{11}(\hat{S})\left(\frac{\partial \hat{S}}{\partial G_i}\right)^2 - \frac{\partial^2 C}{\partial G_i^2}\right] - F_1(\hat{S})^2\frac{\partial \hat{S}}{\partial A_i \partial G_i} + F_1(\hat{S})\frac{\partial \hat{S}}{\partial A_i}\frac{\partial^2 C}{\partial G_i^2}} \quad , \tag{23}$$

$$\frac{dG_i}{dw_i} = -\frac{\left(F_1(\hat{S}) + G_i F_{11}(\hat{S})\frac{\partial \hat{S}}{\partial G_i}\right)\frac{\partial \hat{S}}{\partial w_i}}{\left[2F_1(\hat{S})\frac{\partial \hat{S}}{\partial G_i} + G_i F_{11}(\hat{S})\left(\frac{\partial \hat{S}}{\partial G_i}\right)^2 - \frac{\partial^2 C}{\partial G_i^2}\right] - F_1(\hat{S})^2\frac{\partial \hat{S}}{\partial A_i \partial G_i} + F_1(\hat{S})\frac{\partial \hat{S}}{\partial A_i}\frac{\partial^2 C}{\partial G_i^2}} \quad . \tag{24}$$

Observation 3: *Given n as the informal sector wage rate falls (rises), the amount of graft charged by the mafia rises (falls).*

Proof: Since $\frac{\partial \hat{S}}{\partial G_i} < 0$, $\frac{\partial \hat{S}}{\partial A_i} < 0$ and $\frac{\partial^2 C}{\partial G_i^2} \geq 0$ and inequality (16) holds we can conclude from (24) that $\frac{dG_i}{dw_i} < 0$. Therefore, the statement of the observation follows.

As the informal sector wage rate falls, firms' cost of production falls and they are expected to enjoy higher amount of profit. This induces the mafia to demand higher graft payment than before.

Observation 4: *Given n as the informal sector wage rate falls (rises), the abundance of firms' in the informal sector rises (falls); relatively larger (smaller) firms enter (do not enter) the market.*

Proof: Since $\frac{\partial \hat{S}}{\partial G_i} < 0$, $\frac{\partial \hat{S}}{\partial A_i} < 0$ and $\frac{\partial^2 C}{\partial G_i^2} \geq 0$ and inequality (16) holds we can conclude from (23) that $\frac{dA_i}{dw_i} < 0$. Therefore, the statement of the observation follows.

A fall in the informal sector wage rate reduces firms' cost of production. As a result, abundance of firms in the informal sector increases and the mafia raises the graft demand. The increased graft demand although raises firms' marginal cost of production, it fails to outweigh the former effect of a fall in the wage rate. Therefore, the critical level of sunk cost below which a firm enters into the informal sector (as shown in equation (6) that $\frac{d\hat{S}}{dw_i} < 0$) rises and relatively larger firms enter the market.

Now we combine the direct and indirect effects, discussed above, together to state the next two propositions of the model.

Proposition 3: *As the frequency of corruption rises (falls) the abundance of firms rises (falls) in the informal sector if $F_1(\hat{S}) > \bar{F}$, remains constant if $F_1(\hat{S}) = \bar{F}$, and*

decreases (increases) if $F_1(\hat{S}) < \bar{F}$, where $\bar{F} = \left(\dfrac{\frac{\partial^2 C}{\partial G_i^2} \quad \frac{\partial^2 C}{\partial G_i \partial n}}{\frac{\partial \hat{S}}{\partial G_i} \quad \frac{\partial \hat{S}}{\partial w_i}} \right)$. If $F_1(\hat{S}) > \bar{F}$, relatively larger firms enter the informal sector market. If $F_1(\hat{S}) < \bar{F}$, then relatively larger firms do not enter the market.

Proof: From equations (21) and (23) we can derive the relative strength of $\dfrac{dA_i}{dn}$ and $\dfrac{dA_i}{dw_i}$ as follows:

$$\left(-\frac{dA_i}{dw_i} \right) - \left(-\frac{dA_i}{dn} \right) = -F_1(\hat{S}) \frac{F_1(\hat{S})\frac{\partial \hat{S}}{\partial G_i}\frac{\partial \hat{S}}{\partial w_i} - \frac{\partial \hat{S}}{\partial w_i}\frac{\partial^2 C}{\partial G_i^2} - \frac{\partial \hat{S}}{\partial G_i}\frac{\partial^2 C}{\partial G_i \partial n}}{\left[2F_1(\hat{S})\frac{\partial \hat{S}}{\partial G_i} + G_i F_{11}(\hat{S})\left(\frac{\partial \hat{S}}{\partial G_i}\right)^2 - \frac{\partial^2 C}{\partial G_i^2} \right] - F_1(\hat{S})^2\frac{\partial \hat{S}}{\partial A_i}\frac{\partial \hat{S}}{\partial G_i} + F_1(\hat{S})\frac{\partial \hat{S}}{\partial A_i}\frac{\partial^2 C}{\partial G_i^2}}.$$

Since the denominator is negative with the fall in frequency of corruption abundance of firms will rise if an only if $\left(-\dfrac{dA_i}{dw_i} \right) > \left(-\dfrac{dA_i}{dn} \right)$, i.e, $F_1(\hat{S}) \dfrac{\partial \hat{S}}{\partial G_i}\dfrac{\partial \hat{S}}{\partial w_i} - \dfrac{\partial \hat{S}}{\partial w_i}\dfrac{\partial^2 C}{\partial G_i^2} - \dfrac{\partial \hat{S}}{\partial G_i}\dfrac{\partial^2 C}{\partial G_i \partial n} > 0.$

Therefore, the first part of the statement of the proposition follows. The second part of the statement follows since $F_1(\hat{S}) > 0$ and $F_{11}(\hat{S}) < 0$.

As frequency of corruption rises, abundance of firms in the informal sector market falls through direct effect. But as w_i falls consequent on fall in abundance in the formal sector market, abundance of firms in the informal sector rises through indirect effect. Since the two effects work in opposite directions, the net effect depends on the relative strength of the two effects. If $F_1(\hat{S})$ is above $\bar{F}(\hat{S})$ the indirect effect dominates the direct effect and the abundance increases. However, if $F_1(\hat{S})$ is below $\bar{F}(\hat{S})$ the opposite happens.

Proposition 4: *As the frequency of corruption rises (falls), the payment charged by the mafia for entering the informal sector market rises (falls).*

Proof: The statement of the proposition follows from the observations 1 and 3.

A rise in the frequency of corruption raises mafia's cost for providing protection to the informal sector firms. As a direct effect the mafia demands higher payment than before. But as w_i falls consequent on fall in abundance in the formal sector market, abundance of firms in the informal sector market rises through indirect effect. More firms enter the market and the mafia also demands higher graft payment. Therefore, both the direct and indirect effects of increased frequency of corruption work in the same direction: the mafia demands higher payment for entering the informal sector market.

Propositions 1 and 2 derived in the context of formal sector of production are similar in spirit to the propositions derived in Bliss and Di Tella (1997). However, it is evident from propositions 3 and 4 that informal sector outcomes differ from the formal sector outcomes. Implications of the above propositions are the following. Suppose for controlling corruption the government decides to reduce the number of low-level

officials so that the frequency of corruption falls. According to proposition 1, in the formal sector reduced frequency of corruption brings an uncertain change in the graft demand of the high level official. That is, the high-level official may increase or decrease the graft demand due to a fall in the corruption frequency. Proposition 2 on the other hand, indicates that a reduced frequency of corruption increases the abundance of firms in that sector. More number of smaller firms would operate in the formal sector as the critical level of sunk cost falls. A falling frequency of corruption affects the informal sector also, but the effects are not the same. As corruption frequency falls the graft demand by the mafia falls with certainty. But the effect on abundance of firms in the informal sector becomes uncertain. The effect of fall in corruption frequency on size distribution of firms also turns out to be uncertain.

The economies where the size of the formal sector employment is very small at the initial equilibrium as in the case of most of the developing economies, the indirect effect of change in the frequency of corruption would be insignificant and therefore the ambiguity present in the statement of Proposition 3 would resolve. As the frequency of corruption rises (falls) since the direct effect dominates the indirect effect abundance of firms in the market falls (rises); relatively larger (smaller) firms do not enter (enter) the market. Therefore, the effect on abundance of firms turns out to be symmetric to the formal sector of production. However, as the frequency of corruption rises unlike the formal sector the firm size distribution becomes biased towards the smaller firms in the informal sector. This result explains the dominance of small size firms in the informal sector of production in the developing countries indexed with high corruption level as observed in empirical literature (De Soto, 1989).

4. CONCLUSIONS

The paper presents a theoretical model to explain the effects of frequency of corruption on firm size distribution, abundance of firms and entry cost in both the formal and informal sectors of production of a typical developing economy. The model exploits the basic characteristics of the two sectors of production, that the informal sector production is based on necessity-based-entrepreneurship selling non-differentiated products and avoiding official channels of operation and that the formal sector production is based on opportunity-based-entrepreneurship selling differentiated products. It explains the wide gap that exists in the firm size between the formal and informal sectors of production. At the equilibrium the entry cost (determined by the high level official in the formal sector and by the mafia in the informal sector), the abundance of firms and the firm size distribution respond to an exogenous change in frequency of corruption which is given by the number of low level officials in the bureaucracy.

Interestingly the paper finds that the effects of change in frequency of corruption can be opposite in the two sectors. It explains that the rise in frequency of corruption affects the formal and informal sectors of production in two different ways. As a firm has to

bribe a greater number of low-level officials the cost of entrepreneurship rises in the formal sector. In the informal sector also the cost of entrepreneurship rises since the mafia charges higher amount of money from an informal sector entrepreneur: the mafia does this because now the lower rent earned by the mafia (as it has to bribe more number of officials) makes its business less lucrative to its rivals and its marginal cost from charging higher bribe falls. The rise in cost of entrepreneurship in the formal sector has a direct negative effect on the abundance of firms in the formal sector of production: only larger firms take entry in the market. The high level official's demand for graft now depends on two factors: on the one hand she has an incentive to reduce her graft demand which would encourage more firms to take entry in the market inflating her collection; on the other hand she has an incentive not to reduce her graft demand as the reduced abundance of firms would mean higher profitability of entering firms. The paper identifies the condition under which the first effect dominates the second and vice versa. The finding is similar to Bliss and Di Tella (1997) in its spirit. However, the paper has a different result in the case of informal sector. As it has been explained above, in contrast to the formal sector the entry cost unambiguously rises in the informal sector of production. However, the paper explains that this may not reduce the abundance of firms in the informal sector of production. This happens because of the flexibility of informal sector wage rate. Due to rise in frequency of corruption as abundance of firms falls in formal sector production, the informal sector wage rate falls to accommodate the surplus labor. This lowers the cost of entrepreneurship in the informal sector. Therefore, unlike the result obtained in the formal sector the net effect on the abundance of firms and the size distribution of firms in the informal sector becomes uncertain. The uncertainty in the informal sector outcome is resolved in the economies with a very small share of formal sector employment like the developing countries in the world. The effect of change in frequency of corruption on abundance of firms in the informal sector turns out to be symmetric to the formal sector of production: it falls in both the sectors. However, unlike the formal sector as the frequency of corruption rises the firm size distribution becomes biased towards the smaller firms in the informal sector. This result explains the dominance of small size firms in the informal sector of production in the developing countries like Peru indexed with high corruption level empirically observed by De Soto (1989). It also explains the empirical observation made by Bruhn (2008) in Brazil that as the entry procedures are made simple (of similar consequence of a policy like crackdown on corruption) the wage earners, rather than informal sector entrepreneurs, emerge as formal sector entrepreneurs.

At the policy level, the results of the paper help one to understand the incidence of policies like crackdown on bureaucratic corruption in formal and informal sectors of an economy. It points out that the incidence in the two sectors which are different in their character may not be similar. As the frequency of corruption is reduced the mafia demands lower amount of money than before to allow entrepreneurial entry in the informal sector of production. In the formal sector of production, the graft demand by the high level official however depending on the initial condition may either rise or fall

following such a policy. The firm size distribution shifts towards relatively smaller firms in the formal sector, but in the informal sector it remains uncertain in the economies with high share of formal sector employment and it shifts towards larger size firms in the economies with low share of formal sector employment. A fall in frequency of corruption while raises the abundance of firms in the formal sector, in the informal sector the abundance of firms may either rise or fall in the economies with high share of formal sector employment and unambiguously rises in the economies with low share of formal sector employment. In developing countries various policies are taken towards formalization of informal sector and towards reduction of economic inequality. The results derived in the paper highlights the trade-off of such policies with the anti-corruption policies.

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