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# Corruption, competition and democracy

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## Abstract

This paper presents a model of the interaction between corrupt government officials and industrial firms to show that corruption is antithetical to competition. It is hypothesized that a government agent that controls access to a formal market has a self-interest in demanding a bribe payment that serves to limit the number of firms. This corrupt official will also be subject to a detection technology that is a function of the amount of the bribe payment and the number of firms that pay it. Under quite normal assumptions about the shape of the graph of the detection function, multiple equilibria can arise where one equilibrium is characterized by high corruption and low competition, and another is characterized by low corruption and high competition. Some suggestive empirical evidence is presented that supports the main hypothesis that competition and corruption are negatively related.

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## 1. Introduction

Corruption is generally viewed as one of the main obstacles to the growth and development of low-income countries, yet there has been relatively little theoretical

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analysis and a particularly scant amount of empirical analysis of such a widespread and perplexing problem, particularly concerning the consequences of corruption. The lack of extensive, objective and reliable data certainly accounts for the latter, but there is still much insight to be gleaned from models of the impacts and effects of corrupt governments on the economies they control. This paper presents an equilibrium model of corruption and the amount of industrial competition. It is assumed that a government agent has the ability to demand graft from large-scale, modern, ‘formal’ firms, but that the agent’s ability to collect rents is itself a function of the number of ‘formal’ firms. The model has the feature that under quite ordinary assumptions, multiple equilibria can arise where both a high corruption–low competition equilibrium, and a low corruption–high competition equilibrium exists. If competitive markets are important for producing efficient and innovative firms, then this model can help explain why some countries are seemingly stuck with high levels of corruption and low levels of development, while others are not. Through comparative statics exercises, the effects of governmental reform (in the form of increased policing over government agents or increased democratic participation) and technological innovation are explored. In a separate section, an attempt to address these issues empirically is made. Though data limitations are severe, some suggestive empirical evidence is presented that supports some testable hypotheses of the model.

Early work on corruption focused on understanding the incentives of the corrupt agent and rent seeking behavior (see for example, [Krueger, 1974](#); [Rose-Ackerman, 1978](#); [Shleifer and Vishny, 1993](#)). These early models posited a government agent who controls permits, access to markets, etc., as a kind of monopolist who is likely to charge rents. The introduction of competition and/or regulation therefore could help curtail corruption. More recent work has begun to focus on the causes and economic consequences of corrupt governments, especially for developing countries. One such strand of research, closely related to the current study, has focused on the impact that competition has on corruption (e.g., [Bliss and Di Tella, 1997](#); [Ades and Di Tella, 1999](#)). Other studies have looked at the causes of corruption including [Treisman \(2000\)](#), which finds empirical evidence that suggests, among other things, that more developed and more long-standing democratic countries are less corrupt, and [Mauro \(1995\)](#), which finds empirical evidence that suggests that corruption has a suppressing impact on private investment and growth.

In their paper, [Ades and Di Tella \(1999\)](#) posit that the amount of corruption is determined partially by the level of competition. However, [Basu \(1995\)](#) argues that in developing countries it is domestic firms’ interaction with the government that is the central feature of industrial organization.<sup>1</sup> Thus it is quite reasonable to assume that the level of corruption itself is a determinant of competition. The present study attempts to construct a simple model of corruption and competition that builds on the aforementioned studies, but that considers the level of competition in an economy and the level of corruption to be jointly determined. If corrupt government agents are in charge of licensing

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<sup>1</sup> Another related paper, [Waller et al. \(2002\)](#), examines the link between corruption and the structure of government, and explores the implications for the formal and informal sectors.

and regulation in the industrial sector, it is quite easy to understand that limiting the number of firms may be in their own interest. Corruption flourishes in the absence of efficient monitoring and it is hypothesized that more democratic governments, or more citizen involvement in governance, leads to more careful monitoring of agents which will have a depressing effect on the level of rent seeking the government can pursue.

Though the available data on corruption are generally poor and the limitations of the available data prohibit testing the model directly, the main assumptions of the model and its main testable implications are explored empirically. Suggestive evidence is found, through the analysis of cross-country data, that the level of corruption is inversely related to competition, that more civil liberties decrease the amount of corruption (and thus would be expected to increase competition), and that increased technology (as measured by the level of foreign direct investment) has no measurable effect on competition. As the level of corruption is a subjective measure and likely to be endogenous in a competition regression, a two-staged instrumental variable regression is also run to check the robustness of these results.

## 2. The model

One of the main features of less developed country governments is that they play a particularly active and interventionist role in the industrial sector. This intervention is principally directed at the large-scale, modern firms rather than the small scale, low technology firms (which are generally wide-spread in developing countries). Tybout (2000) argues that small producers in developing countries often escape government attention, and that government regulation and tax laws are enforced almost exclusively among the large, formal sector firms. A good deal of this interaction between government and large-scale industry is often informal, in the form of graft and other corrupt activities.<sup>2</sup>

This interaction between governments and firms will provide the basis of the first part of the model. It is assumed, like Murphy et al. (1989), that there exists a ‘competitive fringe’ of informal producers in a market that they share with imperfectly competitive ‘formal’ firms.<sup>3</sup> These formal firms can be thought of as the modern, technologically advanced producers that service the residual market that is not served by the informal firms. Examples of this abound in the developing world: small-scale iron smelters that provide small amounts of iron for small construction projects and the large-scale iron works that provide large amounts, or big pieces of iron for major construction projects that the small-scale producers are unable to supply; or small-scale printers that are able to handle small jobs but lack the necessary large printing machines for large jobs; or small

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<sup>2</sup> For the purposes of this paper, any payment made to the government by a formal firm will be termed a ‘bribe.’ Bribes are, in this sense, similar to the protection money that the mafia extracts: money to engage in what is an otherwise perfectly legal enterprise.

<sup>3</sup> This assumption is well-supported by empirical evidence that shows a high degree of dualism in the size distribution of firms in developing countries. To wit: in developing countries, large-scale enterprises often produce for the same markets as do very small-scale enterprises (with the concomitant dearth of mid-sized firms). See Tybout (2000) for an excellent review of the evidence. This is also related to the model in Emerson (2002).

construction operations that cannot handle big projects such as high rises because they lack the necessary heavy equipment.<sup>4</sup>

A government agent oversees the formal firms and demands a bribe payment in order for firms to escape costly interference. Formal firms are willing to pay bribes to the agent because there is a benefit from doing so. The benefit comes from the fact that this bribe payment creates an entry cost, which in turn creates an environment for the formal firms that is not perfectly competitive and, therefore, positive economic profits are realized. Formal firms are modeled as Cournot competitors.

The second part of the model will address how the formal firms influence government agent's actions. This part of the model will rely on the relatively straightforward assumption that the larger the bribe payment demanded by the agent, and/or the larger the number of firms that bribes are demanded from, the more likely the corrupt agent is of being detected. In addition, it will later be additionally assumed that the greater the amount of political participation in an economy, the more likely a corrupt agent is of being detected. The assumption that the greater the number of formal firms is negatively related to corruption will be explored in the empirical section of the paper. It will also be shown theoretically that increased monitoring of government officials (which will be assumed to be part and parcel of a more open society) can both reduce corruption and increase competition. This implication of the model fits well with the received empirical evidence, for example, Treisman (2000) finds that long-term democratic participation is negatively correlated with corruption, but will also be tested in the empirical section. Finally, the model shows that increased efficiency of firms through, perhaps, increased technology or technological transfers can also have the same effect of promoting competition, something that is explored in the empirical section as well.

### 2.1. Corruption and the market

The competitive fringe is made up of  $m$  identical, price-taking, small-scale firms (henceforth referred to as 'informal firms'). Informal firms are not subject to demands for bribe payments by the government agent. Each informal firm has a supply curve determined by their marginal cost curve, which is assumed to be upward sloping. The aggregate supply curve for the competitive fringe is defined as  $S \equiv S(p)$ , where  $S'(p) > 0$ .<sup>5</sup> Therefore, each informal firm's individual supply curve is  $S(p)/m$ .

The total market demand is defined as  $D \equiv D(p)$ , where  $D'(p) < 0$ . Therefore firms that wish to enter the formal market face the residual demand curve that is given by  $D(p) - S(p) \equiv Q(p)$ . This residual demand curve is assumed to be linear and is given by:

$$Q = \frac{a - p}{b}, \quad (1)$$

<sup>4</sup> These types of differences are related to capital constraints and do not necessarily mean that there are scale economies although the story follows in either case.

<sup>5</sup> This part of the model is similar to the model presented in Encaoua and Jacquemin (1980) and re-stated in Basu (1993).

where  $a$  and  $b$  are positive constants. Inverting this yields the inverse demand function faced by formal firms:

$$p = a - bQ. \tag{2}$$

The two demand curves and the competitive fringe supply curve can be illustrated by a simple diagram, as is done in Fig. 1.

$Q$  is equal to the total output of all firms in the formal industry and so

$$Q = \sum_{i=1}^n q_i, \tag{3}$$

where  $n$  is the number of Cournot competitors in the formal market and  $q_i$  is firm  $i$ 's output. Each firm confronts this demand function and has a per-period cost function

$$c_i(q_i) = cq_i, \forall i, \text{ where } c > 0. \tag{4}$$

In addition to the cost of production above, each period the government agent demands a graft payment, or bribe,  $B$  from the formal firms. The next section formalizes this by deriving the amount of the bribe as the solution to the government agent's revenue maximization problem.

### 2.2. The market and the government agent's ability to bribe

This section presents a simplified political economy model in which there exists a corrupt government agent that is responsible for the oversight for the formal firms, to wit: the agent is in a position to demand a bribe payment in order for firms to enter and operate in the formal market. Formal firms have the option to shut down and escape the demands of the government agent. Other than the presence of the government agent, however, new firms face no other barrier to becoming formal firms. In equilibrium, formal firms pay the

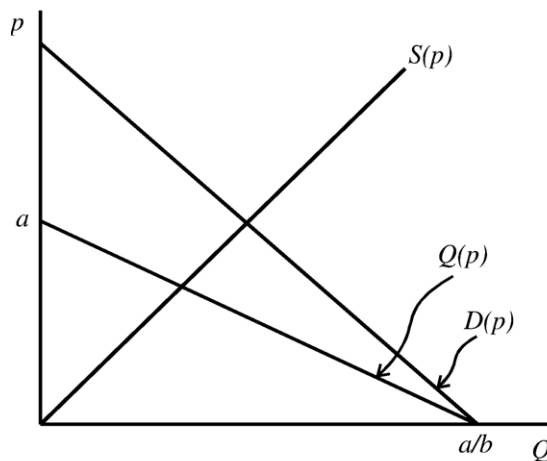


Fig. 1. Supply, demand and the residual demand curve.

bribe because it is in their best interest to do so. The government agent is, therefore, able to collect bribe payments, but the agent's corrupt action is subject to detection and, if detected, the agent loses the bribe payment and his/her position. Informal firms are not subject to bribe demands from the government agent. A key assumption of this analysis is that the agent's probability of detection is increasing in both the frequency and intensity of the bribe demands. That is to say that it increases with the number of formal firms that graft is demanded of and the size of the bribe demanded.

The agent's probability of detection will be formalized by a function that represents the probability that the government agent is detected and removed from his/her position. As mentioned above, this will be a function both of the level of the bribe payment they demand from the formal sector firms, as well as the number of formal firms. Because the agent is the only government in this model, 'detection' means detection by the citizenry, not some other government entity. Therefore, the detection technology will be assumed to depend on factors outside the government itself: an informed and educated population including a free and active press, the degree of political participation in the country, the presence of an independent judiciary, etc. In other words, things that determine how likely it is that the population knows that corruption is occurring and how able they are to do something about it. Therefore, for a given level of democracy (openness or political participation on the part of citizens), this detection function will be a determinant of the equilibrium level of bribe payments and number of firms.

The government agent's objective is to maximize his expected revenue by choosing the level of the bribe that each formal firm must pay and the number of firms the bribe is demanded from. The agent's revenue function is given by  $R(B,k) \equiv Bk$ , where  $B$  is the level of the bribe and  $k$  is the number of the  $n$  formal firms in the economy that a bribe is demanded from. There is, however, a probability of detection which can be thought of as either occurring before the bribes are collected, or that, once detection has occurred, bribe revenues are confiscated from the agent. This probability is a function of both the size of the bribe and the number of firms. The size of the bribe is included because the bigger the bribe, the harder to conceal. The number of firms is included to capture the idea that the more widespread the corruption, the easier to detect. Later this function will be expanded to depend on the level of democracy as well, but for now this will be suppressed to ease exposition.

The probability of detection for the government agent is given as  $1 - \Phi(B,k)$ , where  $\Phi(B,k) \in [0,1]$ . It is assumed that the function  $\Phi$  is decreasing function of both arguments and that  $\Phi_{Bk}(B,k) < 0$ . If undetected the agent keeps the bribe payments, and if detected, the agent gets nothing. The government agent's objective function is therefore his expected revenue function:

$$ER(B,k) = \Phi(B,k)R(B,k) = \Phi(B,k)Bk. \quad (5)$$

The agent maximizes this expected revenue function by choosing  $B$  and  $k$ . Thus, the agent's expected revenue maximization problem can be expressed as:

$$\max_{B,k} \Phi(B,k)Bk, \text{ where } B \geq 0, 0 \leq k \leq n.$$

It can be immediately noted, however, that though the government agent is free to collect from  $k < n$  firms, it is never possible, in equilibrium, to collect a positive bribe from less

than all of the formal firms. This is due to the fact that other than the bribe, there is no barrier to entry to any other firm that wishes to become a formal firm. As explained in the next section, leaving some firms with a sizable positive profit will cause the number of formal firms to swell until Cournot profits are zero, leaving the agent unable to collect any positive bribe. Therefore, in equilibrium, it has to be the case that  $k=n$  if  $B>0$ .<sup>6</sup> This means that the government agent’s problem reduces to a single choice variable, but one that is dependent on the number of formal firms (which is determined in equilibrium).

Thus, the solution to the agent’s expected revenue maximization problem is a  $B$  that is a function of the number of formal firms,  $n$ , or:

$$B(n) = \operatorname{argmax} \Phi(B, n) B n \tag{6}$$

Taking the derivative of the objective function with respect to  $B$  results in the following first order condition:

$$B(n) = \frac{-\Phi(B(n), n)}{\Phi_B(B(n), n)} \tag{7}$$

Depending on the functional form of  $\Phi$ , the  $B(n)$  function can take on many forms. The slope of this function is given by the equation:

$$\frac{dB(n)}{dn} = \frac{-\{[\Phi_B(B(n), n)B'(n) + \Phi_n(B(n), n)]\Phi_B(B(n), n) - [\Phi_{BB}(B(n), n)B'(n) + \Phi_{Bn}(B(n), n)]\Phi(B(n), n)\}}{[\Phi_B(B(n), n)]^2}$$

Thus, solving for  $B(n)$  yields:

$$B'(n) = \frac{\Phi_B \Phi_n - \Phi \Phi_{Bn}}{\Phi \Phi_{BB} - 2\Phi_B^2}$$

The numerator is positive from the fact that the first term is positive by  $\Phi_B < 0$ , and  $\Phi_n < 0$ , and the second term is positive by  $\Phi > 0$ , and  $\Phi_{Bn} < 0$ . The sign of the denominator is negative if  $\Phi_{BB} < 0$ , and therefore this function will slope downward, but if  $\Phi_{BB} > 0$ , the slope is ambiguous and could be both positive and negative in intervals over the range of the function. If the  $B(n)$  function is downward sloping we know that the more formal firms there are in an economy, the lower the bribe payment the government agent will try and extract.

### 2.3. The full model

Formal firm per-period profits are a function of their output decisions,  $q_i$ , those of their competitors, and the level of the bribe payment they must make to the government,  $B$ . Without the bribe payment, formal firms’ profits are the Cournot profits:

$$\Pi_i^F(q_i, n) = (a - bQ - c)q_i.$$

Adding the bribe payment yields the profit function,

$$\Pi_i^{FB}(q_i, n) = (a - bQ - c)q_i - B(n), \tag{8}$$

<sup>6</sup> Note also that the government agent will never choose a  $B=0$  as long as  $n>0$ .

and the resulting optimal amount of output, per-period, for each firm is

$$q^C = \frac{a - c}{(n + 1)b}, \quad (9)$$

which is the standard Cournot output. The level of the bribe payment,  $B$ , does not affect each firm's optimal output decision because it is a fixed payment each period and does not affect a firm's marginal revenue or cost.

Equilibrium in this model is a price at which the  $n$  formal firms output and the competitive fringe output, given by  $S(p)$ , is equal to total demand,  $D(p)$ . It is easy to see that the equilibrium price is exactly the Cournot equilibrium price from the formal sector:

$$p^C = \frac{a + nc}{1 + n}. \quad (10)$$

Note that the aggregate supply for the competitive fringe is a function of  $p^C$ , given by  $S(p^C)$ , and since  $S'(p) > 0$ , it can be seen immediately that as the price rises, so does competitive fringe productive activity. Note also that, as long as  $a - c > 0$  (which it must be for the existence of an industry),  $\partial p^C / \partial n < 0$ . Thus, if  $B(n)$  is downsloping, as  $B$  increases, the number of formal firms ( $n$ ) falls, the price ( $p^C$ ) rises and, as a result, the competitive fringe becomes larger (as measured by output).

In order to determine the equilibrium number of firms in the formal sector, it is useful to recognize that there exists a type of incentive compatibility constraint for each individual firm. Firm  $i$  will only compete in the formal market if doing so yields non-negative profit:

$$\Pi_i^{FB}(q_i, n) = (a - bQ - c)q_i - B(n) \geq 0. \quad (11)$$

This, of course, will bind at the solution as, in the long-run, firms will enter the formal market as long as there are economic profits being made, and will exit if profits are less than zero.<sup>7,8</sup> In order to identify equilibrium points, we can use Eq. (9), along with Eq. (8), to find the equilibrium number of firms in the formal market given the bribe function (7) of the government agent. Finding the equilibrium number of formal firms then, is equivalent to finding the  $n$ 's that solve the following expression

$$B(n) = \frac{(a - c)^2}{(n + 1)^2 b}. \quad (12)$$

<sup>7</sup> To ensure that the formal firm-positive bribe equilibrium will be attained, the agent could allow a small positive profit (however, small enough so that the  $(n + 1)$ -th firm would make a negative profit if it decided to enter and pay the bribe). To keep the analysis simple, however, a common break-even assumption, where a firm decides to enter the formal market at the break-even point, is employed.

<sup>8</sup> This is also an expression of the formal firms' reaction functions to the government agent's bribe demand. These and  $B(n)$ , the agent's reaction function, are used to find simultaneous Nash equilibria and determine the equilibrium number of firms.

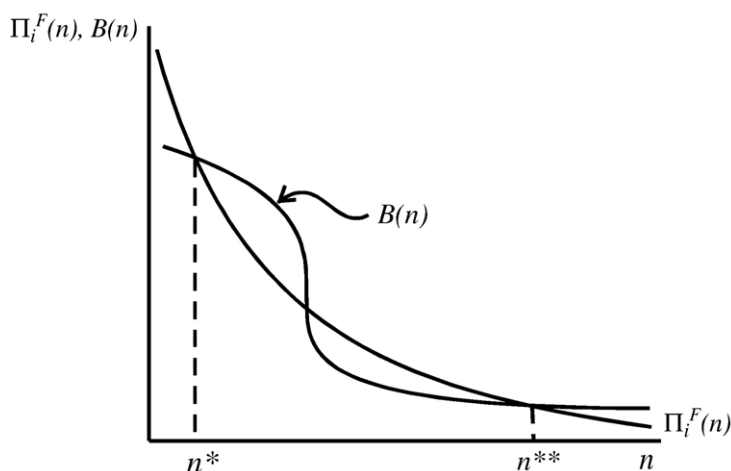


Fig. 2. Formal firm equilibria.

The equilibrium number of firms,  $n^*$ , is the  $n$  (or set of  $n$ 's) that solves Eq. (12). The solution, or solutions, to this equation depends critically on the shape of the  $B(n)$  function. As described above, this function can take on any number of shapes. One such relationship is shown in Fig. 2.<sup>9</sup> This graphs formal firm per-period profits before government intervention, or Cournot profits ( $\Pi_i^F(n)$ ), as a function of  $n$ , along with the function  $B(n)$ .

In Fig. 2, there are three potential equilibria: two of these are at  $n^*$  and at  $n^{**}$ , and the other is at the intermediate equilibrium but it is not a stable equilibrium in the sense that if we perturb  $n$  slightly higher or lower, the natural dynamics of firm exit and entry will cause the economy to head off to  $n^{**}$  or to  $n^*$ , respectively. It is easy to check that all three are equilibrium points. Thus, for the purposes of exposition, only the  $n^*$  and  $n^{**}$  equilibria will be focused on. The equilibrium at  $n^*$  is characterized by high level of bribes (high corruption) and a low number of formal firms (low competition). The  $n^{**}$  equilibrium is characterized by low bribes (no corruption) and a high number of formal firms (high competition). The dynamics of the model suggest that, for a wide category of functional forms for  $B(n)$ , there will be a type of development trap in which there is a high level of corruption and competition will be low. Breaking out of this trap will require that the number of formal firms become greater than the intermediate equilibrium.

It is a well-known result of the Cournot model that total profits are inversely related to  $n$  and are maximized at the monopoly level of output. Thus, holding the detection technology constant, it is in the best interest of the corrupt agent to limit the number of firms and, thus if the agent could choose among the equilibria, they would prefer the

<sup>9</sup> For ease of exposition this function is shown as a s-shaped curve, but a downsloping  $B(n)$  with a simple linear relationship would have the same multiple-equilibrium properties.

equilibrium at  $n^*$ . This assures the government agent of the maximum revenue possible. As far as social welfare is concerned, it is quite easy to see that the larger is  $n$ , the larger is the gain to society (not including the corrupt agent). This is because the more competitive are the formal firms, the lower will be the price and the higher is output. With government rent seeking, therefore, the number of formal firms falls and consumer surplus falls with it.

Finally, it is worthwhile to note that if the bribe detection technology is constant and independent of the size and number of bribe demands, the equilibrium result would be simply to demand a bribe that is equal to the monopoly profit and thus allow a market with only a single firm.<sup>10</sup> It is also worth noting that if the present analysis were changed to allow for a sequential game where the government agent moves first, only the  $n^*$  (high corruption and low competition) equilibrium would result.

### 3. The effects of government reform and technological innovation

In this analysis government reform will be thought of as those actions that increase the probability of detection for a given level of graft and number of formal firms. For example, increased democratization in the form of more individual political power may make it more likely that a reformist government or reformist policies will be implemented as individuals are given more ‘say’ in the operations of government.<sup>11</sup> Note that consumer welfare is unequivocally better in the case of low or no corruption relative to high corruption, implying that the general population would be in favor of reforms. It may also be the fact that, regardless of political power, the general population is ill-informed of corrupt government behavior due to the lack of a government watchdog in the form of an independent judiciary, free press, etc. Without knowing that the government is behaving badly, the general population cannot be expected to act in its own best interest and demand reforms. In terms of the model at hand, it is reasonable, then, to suggest that increased political power and increased information (which will fall under the rubrics of ‘democracy’ and ‘openness’ in this analysis) will serve to lower the probability that a corrupt government agent will avoid detection and sanction.

Given this, the detection technology is assumed to depend on the level of democracy or openness,  $\alpha$ . Consider two different levels of democracy or openness,  $\alpha_1$  and  $\alpha_2$ , where  $\alpha_2 > \alpha_1$ , or economy two is more open and democratic than economy one. We can express the detection technologies as conditional on the level of democracy, and for a given level of bribe payment and number of formal firms:  $\Phi(\bar{B}, \bar{n} | \alpha_1) > \Phi(\bar{B}, \bar{n} | \alpha_2)$ . Thus for a given level of bribe payment and number of formal firms, a corrupt agent has a higher probability of detection in economy two than in economy one. If it is assumed that the

<sup>10</sup> This may be something equivalent, perhaps, to the crony capitalist extremes of, for example, the Philippines and Indonesia excepting for the fact that in those cases monopoly rents appear to be shared either formally, through high licensing fees, or informally, through family ties.

<sup>11</sup> Bardhan and Mookherjee (2000) present a model in which local control improves monitoring partly because of greater feedback from local residents, similar to the idea of ‘say’ here.

level of democracy simply shifts the vertical intercept of the  $\Phi$  function, or that the marginal effects are the same, then we can state Proposition 1:

**Proposition 1.** *The level of the bribe demand will be smaller for every  $n$  in regime 2.*

**Proof.** Consider the optimal condition for the  $B(n)$  function. If, for every  $n$  and for every  $B$ ,  $\Phi(\bar{B}, \bar{n}|\alpha_1) > \Phi(\bar{B}, \bar{n}|\alpha_2)$ , then, the fact that for a given  $n$  the  $B$  that solves Eq. (8), must be smaller for regime 2 than for regime 1, or

$$B_1(n) \equiv \frac{-\Phi(B(n), n|\alpha_1)}{\Phi_B(B(n), n)} > \frac{-\Phi(B(n), n|\alpha_2)}{\Phi_B(B(n), n)} \equiv B_2(n), \tag{14}$$

is most easily seen in a simple figure. Consider Fig. 3 below. If we assume that  $\Phi_B(B(n), n)$  is the same for both regimes 1 and 2, then the solution to the equation  $B(n) = [-\Phi(B(n), n)] / [\Phi_B(B(n), n)]$  for both regimes 1 and 2 is the intersection of the  $-\Phi$  function for each regime with the  $\Phi_B$  function in  $(\Phi, B)$ -space. Note that in Fig. 3,  $B_2 < B_1$ .

Thus for the two regimes,  $B_2(n) < B_1(n)$ . □

This will have interesting consequences for the equilibria shown in Fig. 2. Note that now, as seen in Fig. 4, the stable high corruption, low competition equilibrium ( $n'$ ) has lower corruption and higher competition than the previous equilibrium ( $n^*$ ), as might be expected. However, the unstable low corruption, high competition equilibrium now occurs at a slightly lower number of formal firms than before, suggesting that it has now become easier to break out of the corruption trap. The new low corruption, high competition equilibrium (not shown in the figure) now occurs at a higher number of firms and lower

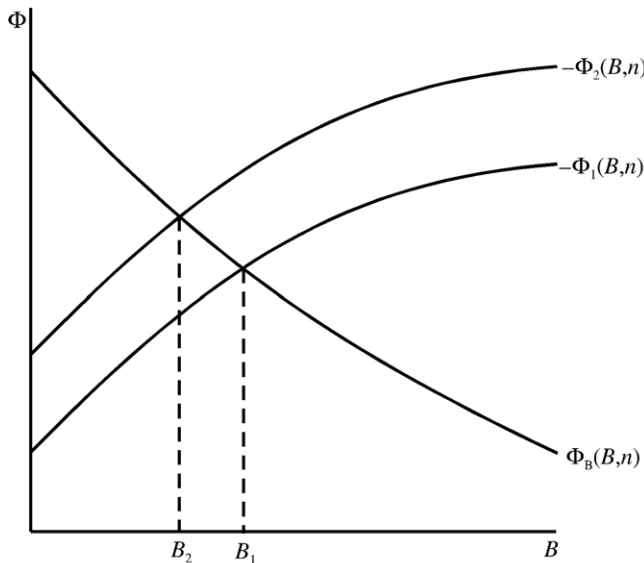


Fig. 3. Bribe demands and democracy.

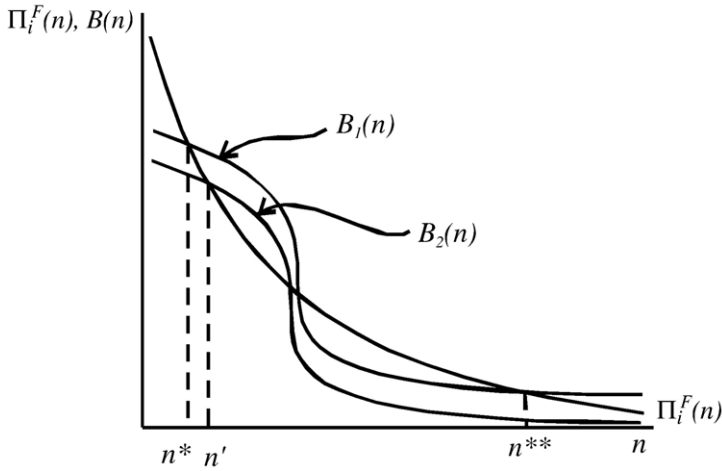


Fig. 4. Increased monitoring.

corruption (bribe) than before. It is important to note, however, that this result is dependent on the shape of the bribe function but would be true as well for a down-sloping linear relationship.

A similar result is obtained if we allow for technology transfers or exogenous technological improvements on the part of the formal firms. These types of improvements would have the effect of decreasing marginal costs for all firms, thus increasing per-firm profits for every level of competition. Graphically, this would lead to a movement upward of the  $\Pi_i^F(n)$  function, leading to the same results that are shown in Fig. 4, as shown in Fig. 5 below. Again, these results depend critically on the shape of the bribe function and actual effects are an empirical issue, the theme of the next section.

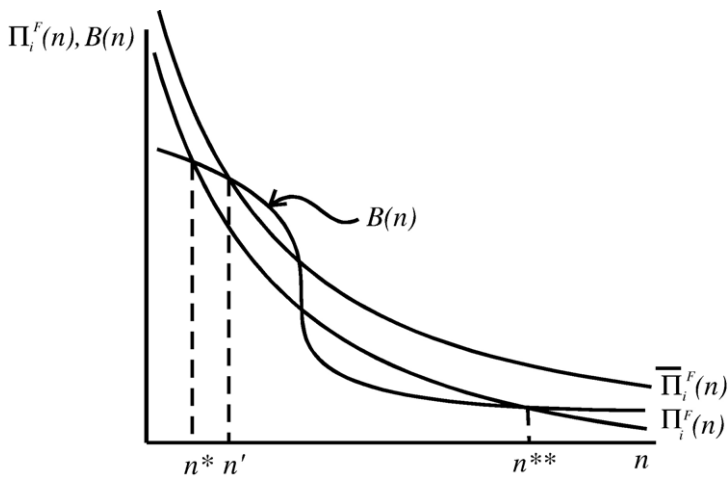


Fig. 5. Increased firm efficiency.

#### 4. Empirical evidence

Though data limitations are such that a comprehensive test of the model is not possible, there are a few key assumptions and testable implications of the model that can be explored. The main testable implications are as follows: the higher the level of corruption is (or amount of bribe payment demanded from formal firms), the lower is the competitiveness of the economy, and both increased democratization and increased technology transfers should be associated with lower corruption and higher competitiveness. The main implication is that the more ‘democratic’ the country is, the less corrupt it is (again, as measured by the level of the bribe demand).

Though data exist that purport to measure the level of corruption, the amount of political freedoms and the level of competitiveness in countries, these data are very problematic. In all cases these data are subjective, often ordinal and are based on a cross-section of countries. Even more problematic is that fact that many of the same subjective criteria are probably used in forming these measures, or rankings, of corruption, democracy and competition. Though the analysis of this type of data has now an established place in the literature, one should be cautious in drawing conclusions of causality in any empirical study of corruption for these reasons. Thus the results presented in this study, while very similar in nature to its predecessors, should be taken with the same note of caution.

In addition, there are no good measures of the variables that drive the theoretical model in this paper (prevalence and magnitude of bribes, number of ‘formal’ firms, level of political power of individuals, the level of openness, etc.) and so surrogate measures will have to be employed to serve as proxies for the real variables. Thus because of the limitations of the empirical exercise, it is best to consider this as suggestive evidence that explore the same issues as the theoretical section, rather than an empirical test of the model.

The thrust of the empirical investigation is the effect of corruption on competitiveness. As is illustrated by the model, however, corruption is likely an endogenous variable in a competitiveness regression so instrumental variables techniques will be employed in an attempt to control for the endogeneity problem. As with all regressions involving instrumental variables the key question is what variables should be utilized as instruments. Fortunately, the model and discussion above suggest a set of good instruments. As noted above the detection technology is dependent on the level of openness, or monitoring, of the government by the population, thus a set of variables that measure the degree of democratic freedom and openness existent in a society will serve as instruments.

The data employed in this study are from a number of sources. The measures of competitiveness are taken from the World Economic Forum’s *Global Competitiveness Report 2001*, and the Heritage Foundation’s *2001 Index of Economic Freedom*. Three different measures of corruption are employed to test the robustness of the results, they come from the World Bank,<sup>12</sup> Transparency International and the World Audit Organization. The World Audit Organization was also the source for the measure of

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<sup>12</sup> Kaufmann et al. (2002).

civil liberties. The data on the macroeconomic indicators and other economic measures of development were obtained from the World Bank's *World Development Report 2000/2001*.

The model presented in section two suggests that the amount of industrial competition is a function of the amount of corruption (the level of the bribe), suggesting an estimating equation of the following form:

$$\text{COMP}_i = \beta_0 + \beta_1 \text{CORR}_i + \beta_2 \text{GNP}_i + \beta_3 \text{GNP}/\text{CAP}_i + \beta_4 \text{FDI}_i + \beta_5 \text{AREA}_i + \varepsilon_i \quad (15)$$

Where COMP is the level of competitiveness (or economic freedom) in a country, CORR is the degree of corruption that exists in that country and the rest of the regressors are other factors that could determine the level of competition in a country: gross national product (GNP), GNP per capita (GNP/CAP), the amount of foreign direct investment (FDI) and the physical size of the country (AREA). GNP, GNP per capita and FDI can all be considered proxies for the level of technological efficiency, or productivity, in a country which is hypothesized to have a positive effect on profits, but an ambiguous effect on competition.

The main problem with estimating Eq. (15) is that, as is stressed throughout the paper, the level of corruption variable is likely to be jointly determined with competitiveness and thus endogenous. Fortunately, the discussion of the detection technology suggests a set of variables that could serve as instruments for the corruption variable: as a proxy for democratic freedoms the level of civil liberties (CIVLIB) citizens enjoy in a country is used, also as a proxy for an involved and informed population, the amount of expenditures on education as a percent of GNP (ED), and the net enrollment ratios for primary (PRIED) and secondary (SECED) schools are included.<sup>13</sup> Together, these variables help determine the extent to which the citizenry of a country has the right to speak out and act against government corruption. As well as the extent to which the citizenry is educated and thus can be more effective in such actions. Thus a second regression equation, Eq. (16), is also utilized.

$$\text{CORR}_i = \delta_0 + \delta_1 \text{CIVLIB}_i + \delta_2 \text{ED}_i + \delta_3 \text{PRIED}_i + \delta_4 \text{SECED}_i + v_i \quad (16)$$

Together, these two equations form a triangular structure that lends itself naturally to a two-stage least squares regression (2SLS). However if  $\varepsilon$  and  $v$  are uncorrelated, estimating Eqs. (15) and (16) separately yields consistent estimators. As a first step then, these two equations will be estimated separately and then jointly using 2SLS.

The measures of corruption that are utilized in this study come from three different sources, but are all subjective indices of corruption. In the case of World Audit it is a relative ranking of all countries it lists from least corrupt to most corrupt, for Transparency

<sup>13</sup> While there are a number of measures of variables related to 'democracy,' civil liberties was chosen as it is both: not constructed by using data on corruption, and considered less likely to be conflated with corruption in a respondents attempt to estimate. Nevertheless, it is probably not much better (nor much worse) than the others.

International it is a ranking based on a subjective score from 1 (most corrupt) to 10 (least corrupt), and both are based on surveys of business people. The World Bank's corruption data it is a composite of various subjective rankings however higher numbers are associated with higher control of corruption or lower corruption. To maintain internal consistency and for intuitive purposes, I invert the last two rankings so that, in all three cases, higher numbers indicate more corruption. It is also important to note that these rankings are not uniform nor are they necessarily cardinal. Though the formulation of opinions that create these subjective data remain unobservable and thus the use of such data is troubling, objective data might be just as problematic were they available. For instance, data on the number of corruption charges brought against civil servants might be capturing differences in the criminal justice systems across countries rather than the amount of corruption.

The measures of competitiveness come from two sources. The first is a ranking based on a survey of business leaders in many countries conducted annually by the World Economic Forum (I invert the list so that the highest number equals the most competitive). In these surveys the business leaders are asked to compare a large number of aspects of their local business environment with global standards, and thus this is a subjective measure as well. There were 4600 respondents for this survey. The second is an index constructed by The Heritage Foundation and the Wall Street Journal, which includes 161 countries and is based on a 'score' from each of 50 different variables covering such areas as trade policy, government intervention and policy, foreign investment, property rights, etc. Both measures are utilized to check for robustness.

These measures are, however, a far cry from the ideal measure that would match up to the theory: the number of 'formal' firms in each industry (or an average), or, failing that, some kind of Herfindahl index or concentration ratio by industry and country. But such data are not available. These measures do potentially serve as good proxies, however, in that they attempt to capture the business climate in each country and are likely to be correlated with the number of formal firms in each market.

Finally the measure of civil liberties is derived from a survey conducted by the World Audit Organization. In this survey a set of questions were asked that relate to civil liberties such as the freedom of the press, of religion, of assembly, political organization, the independence of the judiciary, secure property rights, etc. From the responses received for each individual question, a score is generated and the total score is then used to come up with this index.<sup>14</sup> The summary statistics for all of the data employed in this study are given in [Table 1](#).

The model posits that the level of competition in the formal market is determined by the level of corruption (the bribe function) and the profit function for the firms (which is determined by the level of productivity). The model suggests that increasing corruption will decrease the level of competitiveness at the imperfect competition equilibrium, which implies that there should be a negative correlation between competition and corruption. The model also suggests that more productive sectors should, in the face of corruption, be

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<sup>14</sup> Measures of democratic freedoms, political rights and press freedoms were also constructed and/or calculated, but as they are constructed using much of the same information, multi-colinearity is a major problem. I therefore chose to use a single measure that captures the essential attributes of democratic participation.

Table 1  
Summary statistics

Variable	Observations	Mean	Std. dev.	Minimum	Maximum
Competitiveness	75	−38	21.79	−75	−1
Economic Freedom	152	−3.04	0.76	−5	−1.3
World Bank Corruption	158	0.01	0.94	−2.25	1.47
Transparency International Corruption	91	−4.76	2.39	−9.9	−0.4
World Audit Organization Corruption	90	52.41	24.02	0	88
Civil Liberties	192	−3.58	1.81	−7	−1
Foreign Direct Investment 1998	128	4827.80	18970.67	−356.00	193373.00
Education Expenditures 1997	121	4.57	1.97	0.70	10.60
Primary Enrollment Ratio 1997	110	84.98	20.01	24.00	100.00
Secondary Enrollment Ratio 1997	105	65.95	25.58	9.00	100.00
Population 1999	187	31.78	120.42	0.02	1250.00
Area 1999	187	713.28	1942.85	0.00	17075.00
GNP 1999	161	185.67	776.37	0.04	8351.00
GNP per capita 1999	160	5274.31	9034.45	19.71	44640.00

more competitive, so there should be a positive correlation between the productivity proxies and competition. Again, as these are all dependent on the shape of the  $B(n)$  function, the real effects are an empirical issue.

To test these propositions Eq. (15) was first estimated separately for all three measures of competition and for both measure of competitiveness. The results from these regressions are given in Table 2. For both measures of competitiveness and for each measure of corruption, the coefficient estimates are all negative and significant at the 1% level. These results suggest that there is a very strong correlation between corruption and competition where less corrupt countries have more competitive industrial markets. The rest of the coefficients are not significant, suggesting that there is no conclusive evidence to support the hypothesis that increased productivity leads to higher overall market competitiveness in the presence of corruption.<sup>15</sup> It could be that there is a fair amount of correlation among the regressors (especially with the corruption measures) leading to less precise point estimates, or that the proxies used for productivity are poor.

Eq. (16) was estimated separately as well, and the results of these regressions (for each corruption measure) are presented in Table 3. These results are again consistent across all three measures of corruption. In each case there are two main determinants of the level of corruption: the amount of civil liberties (the proxy for democracy) and the secondary education enrollment ratio (hypothesized to be another important component of

<sup>15</sup> Note that in this specification, the level of corruption is being held constant, which in the model it is not. But holding  $B$  at some level and increasing productivity unambiguously leads to a higher level of competitiveness in the model.

Table 2  
Competitiveness OLS regressions

Independent variables	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error
<i>Dependent Variable: World Economic Forum's Global Competitiveness Ranking 2001</i>						
Constant	−49.0071**	1.6965	−77.0923**	3.5769	−7.7101	7.8630
WB Corruption	−17.0976**	2.1566				
TI Corruption			−7.1682**	0.9993		
WAO Corruption					−0.6526**	0.1137
GNP per capita 1999	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003
GNP 1999	0.0028	0.0021	0.0025	0.0021	0.0035	0.0023
Foreign Direct Investment 1998	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001
Area 1999	0.0006	0.0004	0.0000	0.0004	0.0002	0.0004
Number of Observations	68		65		58	
Adjusted R <sup>2</sup>	0.8252		0.8121		0.7807	
<i>Dependent Variable: The Heritage Foundation's 2001 Index of Economic Freedom</i>						
Constant	−3.0549**	0.0680	−3.8294**	0.1428	−1.5334**	0.3212
WB Corruption	−0.5069**	0.0866				
TI Corruption			−0.2263**	0.0421		
WAO Corruption					−0.0239**	0.0046
GNP per capita 1999	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GNP 1999	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Foreign Direct Investment 1998	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Area 1999	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of Observations	113		113		113	
Adjusted R <sup>2</sup>	0.5481		0.5837		0.5758	

\* Indicates significance at the 5% level.

\*\* Indicates significance at the 1% level.

Table 3  
Corruption OLS regressions

Dependent variable	WB corruption		TI corruption		WAO corruption	
	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error
Constant	0.0650	0.4635	−2.5216	2.1259	46.7431**	17.6243
Civil Liberties	−0.2427**	0.0498	−0.4997**	0.1727	−6.9639**	1.8143
Primary Enrollment Ratio	0.0054	0.0052	0.0101	0.0245	0.1955	0.2006
Secondary Enrollment Ratio	−0.0172**	0.0046	−0.0511**	0.0145	−0.3696*	0.1562
Education Expenditure	−0.0784	0.0420	−0.2119	0.1217	−1.8795	1.2753
Number of Observations	97		71		67	
Adjusted R <sup>2</sup>	0.5784		0.5581		0.5251	

\* Indicates significance at the 5% level.

\*\* Indicates significance at the 1% level.

democracy). The coefficient estimates on civil liberties are all negative and significant at the 1% level meaning that the higher the level of civil liberties (democracy) in a country, the lower the level of corruption. Also, the coefficient estimates on the secondary school enrollment ratios are all negative and significant at the 5% level, suggesting that the more educated (at the high school level) are the citizens of a country, the less corruption exists in that country. If these two are indeed good proxies for the level of democracy, or the amount of monitoring of government officials, that exists in each country, they offer support of the hypothesis that better monitoring will lead to lower corruption which, in turn, should lead to increased competition.

Finally, a two-stage least squares estimation is performed on Eq. (15) which uses the independent variables of Eq. (16) as instruments for corruption which is likely endogenous (the 2SLS estimation also includes GNP/cap, GNP, FDI and area variables). These results are presented in Table 4 and are shown for completeness, even though a Hausman test does not reject the hypothesis that the OLS estimators of (15) are consistent. The important result is that the coefficient estimates on all three measures of corruption are significant at the 1% level and all have negative signs as in Table 2. Thus, these results support the hypothesis that corruption and competition are negatively related.

Table 4  
Competitiveness 2SLS regressions

Independent variables	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error
<i>Dependent Variable: World Economic Forum's Global Competitiveness Ranking 2000</i>						
Constant	-47.0028**	2.2099	-90.4900**	6.9828	14.7536	16.1141
WB Corruption	-24.3344**	4.1798				
TI Corruption			-11.2520**	2.0455		
WAO Corruption					-0.9947**	0.2442
GNP per capita 1999	-0.0004	0.0004	-0.0006	0.0004	-0.0005	0.0005
GNP 1999	0.0047	0.0024	0.0051	0.0027	0.0062	0.0031
Foreign Direct Investment 1998	-0.0001	0.0001	-0.0001	0.0001	-0.0001	0.0001
Area 1999	0.0007	0.0005	0.0003	0.0005	0.0003	0.0005
Number of Observations	62		59		52	
Adjusted $R^2$	0.7872		0.7584		0.7271	
<i>Dependent Variable: The Heritage Foundation's 2001 Index of Economic Freedom</i>						
Constant	-2.8933**	0.0957	-3.6312**	0.2345	-1.3155**	0.5596
WB Corruption	-0.7322**	0.1949				
TI Corruption			-0.1932**	0.0698		
WAO Corruption					-0.0258**	0.0085
GNP per capita 1999	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GNP 1999	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Foreign Direct Investment 1998	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Area 1999	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of Observations	87		67		63	
Adjusted $R^2$	0.5046		0.5868		0.5847	

Instruments used for corruption are civil liberties, primary enrollment ratio, secondary enrollment ratio, education expenditure, GNP, GNP per capita, foreign direct investment and area.

\* Indicates significance at the 5% level.

\*\* Indicates significance at the 1% level.

## 5. Conclusion

This paper presents a model of the interaction between corrupt government officials and industrial firms to show that corruption is antithetical to competition. It is hypothesized that a government agent that can demand graft from formal firms in a market has a self-interest in demanding a bribe payment that serves to limit the number of firms. This corrupt official will also be subject to a detection technology that is increasing in the amount of the bribe payment and the number of firms that pay it. Under quite normal assumptions about the shape of the graph of the detection function, multiple equilibria can arise where one stable equilibrium is characterized by high corruption (or bribe payment) and low competition, and another stable equilibrium is characterized by low corruption (or bribe payment) and high competition.

Suggestive empirical evidence is found that supports the main hypothesis that competition and corruption are negatively related. In addition, evidence is also found that higher education and more political rights and participation (democracy) have a depressing effect on corruption in a country.

While corruption is not a new topic, nor a neglected one, there have been a scant number of studies that focus on the consequences of corruption. This study demonstrates that if industrial competition is a development goal of a country, than measures aimed at curbing corruption could be very important component of policies that seek to bolster industrial competition.

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