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Who Must Pay Bribes and How Much?

Evidence from a Cross-Section of Firms

Jakob Svensson

Ugandan firms typically have to pay bribes when dealing with public officials whose actions directly affect the firms' business operations. How much? The more a firm *can* pay, the more it *has* to pay.

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Summary findings

Svensson exploits a unique data set on corruption containing information about estimated bribe payments by Ugandan firms. To guide the empirical analysis he develops a simple rent-extortion model, which yields predictions on both the incidence of bribery and the amount paid. Both predictions are consistent with the data.

Firms typically have to pay bribes when dealing with public officials whose actions directly affect the firms' business operations. And the amount paid in bribes is not a fixed sum for a set of public services but depends on the firm's ability to pay.

Controlling for other potential explanations of the relationship between "ability to pay" and equilibrium graft, Svensson shows that the more a firm can pay, the more it has to pay.

This paper—a product of Macroeconomics and Growth, Development Research Group—is part of a larger effort in the group to study the causes and consequences of corruption. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Rina Bonfield, room MC3-354, telephone 202-473-1248, fax 202-522-3518, email address abonfield@worldbank.org. Policy Research Working Papers are also posted on the Web at www.worldbank.org/research/workingpapers. The author may be contacted at jakob.svensson@iies.su.se. November 2000. (43 pages)

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1. Introduction

Until recently it was considered impossible to systematically measure corruption at the firm level. As a result, questions such as "who must pay bribes" and "how much" were at best supported by anecdotal evidence. However, with appropriate survey methods and interview techniques firm managers are willing to discuss corruption with remarkable candor. Thus, quantitative micro data on corruption can be collected. This paper exploits an unique data set containing such information for a cross-section of firms in Uganda. We find that the incidence of bribery is positively correlated with bureaucrats' control rights over firms' business operations. Firms typically have to pay bribes when dealing with public officials whose actions directly affect the firms' business operations, and such dealings cannot be easily avoided when, for example, exporting, importing, or requiring public infrastructure services. The amount paid, in turn, is a function of firm characteristics: a firm's current and expected future profits and to what extent the firm's capital stock is sunk. Thus, demanded bribes do not appear to be fixed sums for *given* public services, but depend on firms' abilities to pay. Controlling for other potential explanations of the relationship between "ability to pay" and equilibrium graft, we show that the more a firm could pay the more it has to pay.

To guide the empirical analysis on the incidence and level of graft we develop a simple principal agent model. The model rests on three assumptions.[1] First, bureaucrats are assumed to be expected profit maximizers, subject to the constraints that the firm might exit and that the bureaucrat might get caught and punished. Second, by exiting (which broadly should be interpreted as moving to another sector/region or using alternative production techniques so as to minimize contacts with the bureaucracy) firms can avoid paying bribes. Third, there are many bureaucrats, each being uncertain of remaining in a position to extract rents. Based on these three assumptions we develop a simple rent-extraction model. The model produces a set of structural equations on the relationship between firm characteristics and the incidence and level of corruption that we take to the data.

[1]These assumptions are grounded in case-study evidence of corruption in Sub-Saharan Africa and elsewhere. Thomas (1999) argues that the lack of control over personnel decisions, the lack of performance-based evaluations and hiring, and the power to fire government post-holders instantly with minimal explanation, have given bureaucrats and office holders with hiring and firing power opportunity to demand a share of the income stream from those lower in the hierarchy. Increased uncertainty of tenure has also created strong incentives for those in government posts to extract as much and as quickly as possible to protect against impending unemployment or transfer to a less lucrative position (see also Bayart, 1993). De Soto (1989), Johnson et al. (1998), Johnson et al. (2000), and Friedman et al. (2000) show that corruption (opportunity of rent extraction) drives firms to the unofficial economy.

Modern research on the economics of corruption began with Rose-Ackerman (1975, 1978). However, despite its practical importance for many developing countries, economic studies on corruption at the firm level are rather limited. Shleifer and Vishny (1993) analyze a bureaucracy selling a government-produced good (e.g., a permit), noting that if the officials do not coordinate to extract bribes they fail to internalize the effect of their demands for bribes on other officials' income, leading to very high corruption levels. Moreover, they argue that the need for secrecy makes corruption much more distortionary than taxation. Bliss and Di Tella (1997) study the relationship between corruption and competition. They show that if bureaucrats have the power to extract money from firms under their control, they will drive the most inefficient firms out of business, enhancing the profitability of remaining firms, which in turn makes it possible to demand larger bribes. Choi and Thum (1999) use a similar model to study the effects of repeated extortion.[2] Our model builds on this body of work, although it differs in one key aspect: firms' ability to pay bribes or avoid them differs in observable ways, so public officials make different bribe demands across firms.

The empirical literature on corruption has recently experienced a boom. Mauro (1995) analyzes the relationship between investment and corruption, showing that corruption has a substantially negative effect on private investment and growth. Wei (1997a,b) finds that corruption discourages foreign investment, and more so than direct taxation. Tanzi and Davoodi (1997) study the effect of corruption on public finance. They find that corruption adversely affects both the composition and level of public expenditures/investment. Kaufmann and Wei (1998) examine the relationship between corruption and management time wasted with bureaucrats. Contrary to the "efficient grease" argument, they find that firms that face more "bribe demand" are also likely to spend more management time with bureaucrats. Ades and Di Tella (1997, 1999), Svensson (2000), and Treisman (2000) deal with the causes of corruption. Ades and Di Tella (1997, 1999) find that corruption is higher in countries with more active industrial policy, and in countries where firms enjoy higher natural or policy induced rents, while Svensson (1998) shows that foreign aid is associated with higher corruption in polarized societies, but that democracies seem to be less subject to this adverse effect of aid. Treisman (2000) test several hypotheses on the determinants of corruption. He shows that countries with protestant traditions, histories of British rule, and long exposure to democracy are less corrupt.

This paper extends the empirical literature in two ways. First, we use firm-level data on corruption. The existing body of empirical work is based on cross-country analyses that tell us little about the relationship between corruption and individual firms. Second, our data set contains quantitative information on estimated

[2]For recent surveys of the literature on corruption, see Bardhan (1997) and Wei (1999).

bribe payments of Ugandan firms. The existing empirical literature exploits data on corruption derived from perception indices, typically constructed from foreign experts' assessments of overall corruption in a country. While making it possible to study broader macro determinants and consequences of corruption, it also raises concern about perception biases that we avoid by using quantitative information.[3]

This paper is organized as follows. In section 2 a simple model is presented. Section 3 discusses the implication of relaxing some of the simplifying assumptions in the model. Section 4 takes the model's prediction to the data and discusses the empirical findings. Section 5 and appendix A.2. deal with implications and extensions, and section 6 concludes.

2. A Model for Estimating the Incidence and Level of Graft

Below we set out a simple model to guide the empirical work. The objective is to show that firm-specific features should have implications for both the incidence and level of graft. To derive explicit solutions to the graft level equation we make a number of simplifying assumptions. In section 3 and appendix A.2. we discuss the effects of relaxing them.

Consider an economy consisting of a large number of firms and bureaucrats. Each firm is in the territory of one bureaucrat. We assume that the bureaucrats are expected profit maximizers. Thus, in each period he maximizes bribe payments subject to the constraints that the firm might exit (in which case no bribes are collected), and that he might get caught and punished.

The bureaucrats have discretionary power within the given regulatory system in the sense that they can customize the nature and amount of harassment on firms to extract bribes. The extent to which this could be done depends on the bureaucrats' "control rights" over the firms' business operations. We consider only private firms so by control rights we mean the extent to which the bureaucrats can constrain the firms' business decisions and influence their cash flows. These indirect control rights stem from the existing regulatory system and the fact that bureaucrats have discretion in implementing, executing, and enforcing rules and benefits affecting firms, such as business regulations, licensing requirements, permissions, taxes, exemptions, and public-goods provision.

[3]Kaufmann and Wei (1998) also use firm-level data (based on the Global Competitiveness Report index) to assess the validation of the "grease argument". However, the data on corruption and its correlates are based on answers to questions referring to the country in which the firm is active, rather than firm-specific experiences and characteristics. Moreover the data is primarily of a qualitative nature (indices). Ades and Di Tella (1999) utilize the same source but use country averages.

As in Shleifer and Vishny (1994) we could think of the degree of control rights as determining the threat point or the leverage in the "negotiation" between a public official and a firm. When bureaucrats have low control rights a firm may refuse to pay the demanded bribes without any major consequences on its business operations. However, when bureaucrats have high control rights, the firm must either pay the bribe or exit.

Bureaucrats' degree of control rights differ across sector and location. As an example, bureaucrats' control over exporting firms is typically high since such firms need additional licenses (to export) and have to deal with more government agencies (such as customs), while bureaucrats' control rights over firms in the informal sector are low since such firms seldom deal with bureaucrats and (by assumption) operate outside the formal and regulated economy. To simplify, we assume there are two sectors, $j = \{s_1, s_2\}$, which differ with respect to bureaucratic control. Specifically, firms in sector s_1 must pay if bribes are demanded, or exit, while firms in sector s_2 have enough leverage to avoid paying bribes without any significant impact on their business operations.

A bureaucrat dealing with a firm in sector s_1 will demand a bribe if the expected gain of receiving the bribe is larger than the expected cost. That is,

$$g - \delta m g > 0$$

where g is the graft and δ is the probability of getting caught. We assume that the punishment of getting caught (or personal cost of being fired under corruption accusations) is proportional to the bribe payment, with $m > 0$ being the punishment coefficient. Thus, $\delta m g$ is expected punishment (or cost) of demanding bribes.

As in Ades and Di Tella (1999), Erard and Feinstein (1994), and others, we allow for the existence of both honest and dishonest public officials. Thus we assume that the personal cost m differs across individuals. The distribution of m is assumed to be uniform over $[0, \bar{m}]$ and is known to all players. Further, to capture the inherent uncertainty of tenure we assume that the bureaucrats at each time period face an exogenously given probability $1 - q$ of being fired.[4]

At time 0, the bureaucrats must choose what sector to work in. The wage rate is normalized to zero. Each sector (i.e., public agencies interacting with firms in that sector) employs 50 percent of the total number of public servants. A bureaucrat who is indifferent between working in sector s_1 or s_2 will be randomly selected into a sector with openings.

The equilibrium allocation of public servants is easy to characterize. All public servants with personal cost $m \leq \delta^{-1}$, i.e., bureaucrats that will always ask for a bribe, will choose to work with firms in sector s_1, while all civil servants with

[4]A fired public servant is assumed to be replaced by a new bureaucrat with the same characteristics.

personal cost $m > \delta^{-1}$ will be randomly allocated to the remaining openings. The probability ρ that a randomly picked bureaucrat in sector s_1 will ask for bribes is hence $\rho = 1 - \frac{1}{2}(\delta\bar{m})^{-1}$ if $\delta^{-1} < \frac{\bar{m}}{2}$ and $\rho = 1$ otherwise. Bureaucrats more prone to demand bribes will choose to work in agencies that have discretionary power over firms.[5]

The probability that a randomly drawn firm i must pay bribes, denoted by $p(i)$, can now be stated as

$$p(i) = \sigma(i \in s_1) * \rho \tag{2.1}$$

where $\sigma(i \in s_1)$ is the probability that firm i is active in sector s_1.

Given that a firm is matched with a corrupt bureaucrat in period t, we can solve explicitly for the probability of that firm being forced to pay bribes in each future period (as evaluated from period t), p_{t+n}. This probability function is given by $p_{t+n} = q^n - q^n\rho + \rho$.

There exists a large number of firms. Firms' objective is to maximize present discounted value of expected cash flows (i.e., profits net of bribes). Each firm i is endowed with capital k and an individual-specific skill factor η^i (knowledge) of production in sector s_1. η^i is distributed according to a known distribution function $G(\cdot)$. Invested capital is partly sunk. Let α^i be the share of invested capital that could be resold and reinvested; that is, α captures the sunk cost component of the firm's production technology. At time 0 each firm faces the choice of either investing in sector s_1 or in sector s_2. Due to indivisibilities of capital, the firm must decide to invest in only one sector.

The firms produce goods x_1 and x_2, which are traded on the world market. The world market prices θ and 1, respectively, are exogenously given as the country is a price taker. The production technologies are given by $x_1^i = f(k^i, l^i; \eta^i)$ and $x_2^i = f(k^i, l^i)$, where $f_\eta > 0$ and l is labor. There is unlimited labor supply at the wage rate w (markup on the rural subsistence wage). We assume that the price of good 1 is uncertain; that is, θ_t is a stochastic variable. θ_t is assumed to be independently and identically distributed over time, with bounded support $[\underline{\theta}, \bar{\theta}]$. Time t profit in sector s_1 can then be written as a function of the observable inputs k and l,

$$\pi(k, l(w/\theta_t); \eta, \theta_t \mid s_1) = \theta_t f(k, l(w/\theta_t); \eta) - wl(w/\theta_t),$$

where firm-specific superscripts have been dropped for convenience and where the labor demand function, $l(w/\theta_t)$, is implicitly defined by the first-order condition,

[5] This endogenous response to differences in control rights is consistent with recent empirical evidence on corruption in the public sector. For example, results from surveys of public officials in Albania, Georgia, and Latvia suggest that there may even be a market for "high rent" positions (World Bank, 1998a, see also Thomas, 1999).

$\theta_t f_l(k,l;\eta) - w = 0$. Thus, at each time period the firms adjust their labor force such that the marginal product of labor is equal to the real wage. Similarly, period t profits in sector s_2 are $\pi_t(k,l(w)\,|\,s_2) = f(k,l(w)) - wl(w)$.

With no bribes, firm i:s value functions are,

$$V_t(k\,|\,j) = E_t \sum_{n=1}^{\infty} \beta^{n-1}\pi(k,\cdot|\,j) \quad \text{for } j = \{s_1, s_2\}, \tag{2.2}$$

where E_t is the expectation operator conditional on information at time t. If a firm invests in sector s_1 and faces a corrupt bureaucrat, the firm must either pay the required bribe or exit the sector. The latter constitutes an optimal response if the expected loss of exiting (foregone net profits today and in the future) is lower than the expected gain (alternative return on reversible capital). That is,

$$\begin{aligned}\pi(k,\theta_t,\cdot|\,s_1) - g(\theta_t) + E_t \textstyle\sum_{n=1}^{\infty} \beta^n \left[\pi(k,\theta_{t+n},\cdot|\,s_1) - p_{t+n}(s_1) g(\theta_{t+n})\right] \\ \leq \textstyle\sum_{n=1}^{\infty} \beta^{n-1}\pi(\alpha k,\cdot|\,s_2),\end{aligned} \tag{2.3}$$

where $g(\theta_t)$ is graft in period t as a function of θ_t. In (2.3), the first two terms are current net profit when facing a corrupt bureaucrat. The third expression is expected discounted future net profits. In each period $t+n$ the firm makes expected profit $E_t\pi(k,\theta_{t+n},\cdot|\,s_1)$ (evaluated at t), and with a probability $p_{t+n}(s_1)$ faces a corrupt official and must also pay bribes. The term on the right side of the exit constraint (2.3) is the discounted flow of profits the firm would make if it sold and reinvested its partly sunk capital in sector s_2 the first period.

Firms cannot borrow to pay bribes, so in each period the firms' realized cash flow must be non–negative; that is,[6]

$$\pi(k,\theta_t,\cdot|\,s_1) - g(\theta_t) \geq 0 \tag{2.4}$$

for all t.

We can now determine the equilibrium graft. Assume (2.4) holds (a sufficient condition is stated below). The corrupt bureaucrat will demand bribe payments so as (2.3) just binds. Note that $E_t\pi(k,\theta_{t+n},\cdot|\,s_1)$ is constant and independent of θ_t for all $n > 1$. Thus the expected optimal bribe payment $E_t g^*(\theta_{t+n})$ is constant and independent of θ_t for all $n > 1$. Consequently, at each time period $t+n$, the corrupt bureaucrat faces an "exit constraint" (2.3) that is identical apart from the first term, current profit $\pi(k,\theta_t,\cdot|\,s_1)$. Rewriting (2.3) yields,

$$g(\theta_t) = \pi(\theta_t,\cdot|\,s_1) + E_t \sum_{n=1}^{\infty} \beta^n \left[\pi(\theta_{t+n},\cdot|\,s_1) - p_{t+n}(s_1) g(\theta_{t+n})\right] - \sum_{n=1}^{\infty} \beta^{n-1}\pi(\alpha k,\cdot|\,s_2). \tag{2.5}$$

[6]The results are not qualitatively affected if we allow the firms to borrow.

Equation (2.5) gives a mapping from the space of possible $g(\theta)$ into itself: a given $g(\theta)$ implies an expected future flow of net profits, which in turn implies a new $g(\theta)$ from (2.5). The fixed point of this mapping is,

$$g^{*i}(\theta_t) = \pi(k, \theta_t, \cdot|\, s_1) + \frac{p''}{1+p'}\bar{\pi}(k, l^i, \cdot|\, s_1) - \frac{1}{(1-\beta)(1+p')}\pi(\alpha k, \cdot|\, s_2) \quad (2.6)$$

where $\bar{\pi}(k, \cdot|\, s_1) \equiv E_t\pi(k, \theta_{t+n}, \cdot|\, s_1)$ for all $n \geq 1$, and $p' \equiv \beta\left(\frac{q(1-\beta)+\rho(1-q)}{(1-\beta)(1-q\beta)}\right)$, and $p'' \equiv \frac{\beta(1-q)(1-\rho)}{(1-\beta)(1-q\beta)}$.[7]

Equation (2.6) suggests that the amount of bribes a firm needs to pay depends on current profits (+), expected future profits (+), and the alternative return to capital (−), $\pi(\alpha k)$. Having a technology with low sunk cost component strengthens the firm's "bargaining" position in that exiting becomes more profitable. As a result the public official will demand a lower bribe. Higher profits today or higher expected future profits have the reverse effect, the firm's bargaining position weakens and it is forced to pay higher bribes.

Furthermore, equation (2.6) implies that $g(\theta_t)$ is a *negative* function of ρ (and indirectly of p). That is, the lower the probability that bureaucrats will demand bribes, the higher the equilibrium graft when matched with a corrupt bureaucrat. Expected graft, $p * g(\theta_t)$, however, is a positive function of ρ. The reason for this result is simple. Everything else being equal, a lower ρ (and p) implies increased expected future net profits. Higher future profits weaken the firm's bargaining position since exiting becomes relatively more costly. As a result, the corrupt bureaucrat can demand higher graft. In equilibrium, the increase in $g(\theta_t)$ cannot outweigh the fall in p, since that would imply that a lower p would result in lower expected future net profits, and thus lower $g(\theta_t)$ - a contradiction.

From (2.6) it is straightforward to determine under what conditions the borrowing constraint (2.4) holds. Specifically, equation (2.4) holds if

$$1 - \frac{(1-q\beta)\pi(\alpha k, \cdot|\, s_2)}{\beta(1-q)\bar{\pi}(k, l^i, \cdot|\, s_1)} \leq \rho \ . \quad (2.7)$$

[7] To solve the fixed point problem note that for the exit constraint to bind in every period the difference $d \equiv \pi(k, \theta, \cdot|\, s_1) - g(\theta)$ must be constant over time. Substituting d into (2.5), noting that

$$E_t \sum_{n=1}^{\infty} \beta^n \left[p_{t+n} d + (1 - p_{t+n})\pi_{t+n}\right] =$$

$$= \beta\left(\frac{q(1-\rho)}{1-q\beta} + \frac{\rho}{1-\beta}\right) d + (1-\rho)\beta\left(\frac{1}{1-\beta} - \frac{q}{1-q\beta}\right) E_t\pi_{t+n} \ ,$$

and rearranging yields expression (2.6).

Thus, if ρ is sufficiently high, equilibrium graft is always less than gross profit.

Equations (2.1) and (2.6) provide a structural model of the relationship between graft and firm characteristics. The incidence of bribery is a function of where the firms choose to locate, the firms' main areas of activities, as well as the expected personal cost to the bureaucrat of being fired under corruption accusations. Given that a firm faces a corrupt official and must pay bribes, the amount paid depends on firm characteristics: current profits, the extent to which the firm's capital is sunk, and expected future profits.

Before proceeding to estimate equations (2.1) and (2.6), it is useful to consider relaxing some of the simplifying assumptions in the model. This is important not only to show to that the model's qualitative results are robust to alterations, but also to better understand the empirical findings presented below.

3. Extensions and implications

In reality, a bureaucrat does not have full information about a firm from whom he wishes to extract bribes. The shock θ and profits are not directly observed, neither is the sunk cost component. As illustrated in an example in appendix A.2., incomplete information will create informational rents that the firm can capture. Thus, the linear relationship between profits and grafts identified in equation (2.6) will only be an approximation. The qualitative results, however, remain when introducing asymmetric information.

The likelihood of facing a corrupt bureaucrat in the future is uncertain in the model. This likelihood is a function of a number of exogenous parameters; probability of getting caught, distribution of the personal cost of getting fired under corruption accusations, and the inherent uncertainty of tenure, but also depends on the endogenous choice of bureaucrats to differences in control rights across sectors. With no uncertainty, a one-period model would suffice to study the problem, since future profits, $\bar{\pi}(k, l^i, \cdot | s_1)$, would then not matter.

In the model, each firm is in the territory of one bureaucrat. As in Bliss and Di Tella (1997) and Choi and Thum (1999), we thus abstract from coordination issues and competition among public officials. Allowing competition among bureaucrats would in some instances increase the firm's bargaining power and thus reduce the equilibrium graft, given $\pi(k, \theta_t, \cdot | s_1)$, $\bar{\pi}(k, l^i, \cdot | s_1)$, and $\pi(\alpha k, \cdot | s_2)$. Still the qualitative relationship between profits, alternative return, and corruption would remain.[8]

We have taken the technology choice as given, i.e., the sunk-cost component

[8]However, to the extent that officials impose costs rather than benefits, it is not clear why competition would reduce corruption (see discussion in Rose-Ackerman, 1999).

(α_i) is exogenous. Allowing the firm to choose what capital goods to purchase complicates the picture (the technology choice in a model of repeated rent extortion is studied in detail in Choi and Thum, 1999). In our model, the extent to which capital investments are sunk or not influences the firm's bargaining position versus the bureaucrat. Low sunk costs imply that the cost of exiting becomes smaller, and from equation (2.6), lower grafts when matched with a corrupt official. Thus, the firm might find it profitable to choose a "technology" that yields higher per-period operation costs but indirectly reduces the amount of bribes the firm needs to pay. In appendix A.2. we endogenize the choice of α^i and show that the choice of technology depends on the parameters of the model, and in particular on ρ. If the incidence of bribery is high, the relative return of adopting a technology with inefficiently low sunk cost component is also high. For the empirical work it should be noted that the "technology-effect" would tend to mask the negative relationship between the sunk-cost component and corruption, and thus work against us.

Maybe the most restrictive assumption of the model is the assumption that profits are not influenced by the amount of bribes paid, and that there is no feedback from corruption to equilibrium profits (through entry and exit into the market).[9] Our choice to abstract from these effects does not imply that we do not think they might be important. However, we believe our more restrictive set-up is a good first approximation for two reasons. First, most firms in the sample are small (median is 34 employee). Causal empiricism suggests that the regulatory process is not captured by these types of firms in less developed countries in general and in Uganda in particular, but a small set of large, politically powerful enterprises. Second, the inherent uncertainty of tenure for those in government posts, documented by for example Thomas (1999), suggests that public officials heavily discount the future. Thus, dynamic graft-schemes that intend to maximize revenue by implicitly controlling entry and exit may simply not be credible, since the uncertainty of tenure creates strong incentives for those in government posts to extract as much and as quickly as possible to protect against impending unemployment or transfer to a less lucrative position. Finally, the feedback from corruption to profits has already been extensively studied in the literature (see Bliss and Di Tella, 1997). Therefore we abstract from it in order to focus on the novel issue of determining the differences in bribe demands across firms.

Despite these arguments it is crucial to evaluate how the results would change

[9] For models on rent-seeking see Buchanan, 1980; Tollison, 1982; Tullock, 1967, Bhagwati, 1982; Krueger, 1974. On regulatory capture see Laffont and Tirole, 1994, and references given therein. Bliss and Di Tella, 1997; and Choi and Thum, 1999, develop extortion models in which the public official chooses graft, where corruption may cause exit (or restrict entry) which may affect profits of the remaining firms and thus their potential to pay bribes.

if these effects were allowed in the model. The rent-seeking and regulatory capture models would also predict a positive relationship between profits and corruption. In these types of models the association arises because bureaucrats and politicians compete for rents associated with bribes and kickbacks by selling government favors. Alternatively, regulations benefiting firms are "acquired" by industries through bribes. Thus, the relationship is driven by reverse causation. Note that the predicted association between the share of sunk investments and corruption would not arise from these models. Moreover, as discussed below, for the reverse causation argument to bias the results it must be the case that the size of the government favor is linked to the amount paid in bribes. A simple extension of the model (yielding the same empirical predictions) is that all bribe-paying firms receive preferential government treatment, for instance they obtain a valuable license. Our identifying assumption is that the price of this license is determined by the firm's ability to pay.

The extortion model of Bliss and Di Tella (1997), where corruption may cause exit (or restrict entry) which may affect profits of the remaining firms and thus their potential to pay bribes, would also suggest a positive association between bribes and profits. The interpretation, however, would be slightly different: profitable firms are forced to pay higher bribes but one reason for why they are profitable in the first hand is that they could "afford" to pay bribes while other potential competitors which could not have been driven out of the market.

As discussed in detail in section 4.3, empirically we try to separate the aforementioned effects by instrumenting for profits.

4. Estimating the Incidence and Level of Graft

4.1. Specification

Equations (2.1) and (2.6) provide a structural framework to study the incidence and level of graft across firms. The incidence equation (2.1) states that the probability that a randomly drawn firm i must pay bribes depends on sector/location specific factors and on the personal cost to the bureaucrat of getting caught. This personal cost is not observable, and we choose to capture it with the random variable ν. Thus

$$p^i = \chi' \mathbf{w}^i + \nu^i \ , \tag{4.1}$$

where $\mathbf{w}_i$ is a vector of sector and location specific variables. Since p^i is not observed, we have to reformulate the incidence equation as follows. Let $e^i = 1$ be the event that a firm faces a corrupt bureaucrat and must pay bribes ($g_i > 0$). Then,

$$\Pr(e_i = 1) = \Phi(\chi' \mathbf{w}_i) \tag{4.2}$$

where Φ is the standard normal distribution function.

To estimate the graft level equation (2.6) we replace the unobserved $E_t\pi(k,l,\cdot)$ with current stock of capital, k, and labor, l, plus a forecast/measurement error ε_1, and the unobserved $\pi(\alpha k,\cdot)$ with a proxy of αk plus a measurement error ε_2. The resulting specification is

$$g^i = \gamma_0 + \gamma_\pi \pi^i + \gamma_k k^i + \gamma_l l^i + \gamma_{\alpha k}\alpha^i k^i + \mu^i, \qquad g_i > 0 \tag{4.3}$$

where γ_0, γ_π, γ_k, γ_l, $\gamma_{\alpha k}$ are coefficients and $\mu^i = \varepsilon_1 + \varepsilon_2$. We assume that ν_i and μ_i have a bivariate normal distribution with zero means and correlation δ, and let σ_μ denote the standard deviation of μ. According to the model γ_π, γ_k, $\gamma_l > 0$ and $\gamma_{\alpha k} < 0$.

The sample selection model (4.2)-(4.3) can be estimated by a two-step procedure (see Heckman, 1979), where in the second step the inverse Mills ratio $\hat{\lambda}_i = \phi\left(\hat{\chi}'\mathbf{w}_i\right)/\Phi\left(\hat{\chi}'\mathbf{w}_i\right)$ is included to adjust for the sample selection bias. Thus, the empirical specification is,

$$g^i = \gamma_0 + \gamma_\pi \pi^i + \gamma_k k^i + \gamma_l l^i + \gamma_{\alpha k}\alpha^i k^i + \gamma_\lambda \lambda^i + \upsilon^i \tag{4.4}$$

where $\gamma_\lambda = \delta\sigma_\mu$. Note that the disturbance term in the second stage regression is heteroskedastic,

$$\mathrm{Var}(\upsilon^i) = \sigma_\mu^2(1 - \delta^2\zeta_i)$$

with $\zeta_i = \hat{\lambda}_i(\hat{\lambda}_i + \hat{\chi}'\mathbf{w}_i)$.

4.2. Data

Before proceeding it is useful to take an initial look at some of the data. All data used in the paper is from the Ugandan Industrial Enterprise Survey (see appendix for details). The survey was initiated by the World Bank primarily to collect data on constraints facing private enterprises in Uganda. It was implemented during the period January-June 1998.

Until recently it was considered impossible to systematically collect micro data on corruption. However, with appropriate survey methods and interview techniques firm managers are willing to discuss corruption with remarkable candor. Thus, quantitative firm-level data on corruption can be collected. The empirical strategy used to collect information on bribe payments across firms in Uganda had the following six key components. First, the survey was implemented by an employers' association (Ugandan Manufacturers Association). Given the business community's general distrust of the public sector, it was decided that the survey should be implemented by an agency that most firms had confidence in, rather than, for example, the statistics department. Second, the corruption related questions (and the whole survey instrument) were carefully piloted and built on existing surveys on regulatory constraints. Third, the enumerators were trained by survey experts. Fourth, the questions on corruption were phrased in an indirect fashion to avoid implicating the respondent of wrongdoing. For example, the key question on bribe payments was reported under the following question, "Many business people have told us that firms are often required to make informal payments to public officials to deal with customs, taxes, licenses, regulations, services, etc. Can you estimate what a firm in your line of business and of similar size and characteristics typically pays each year?". Fifth, the corruption-related questions were asked at the end of the interview, by which time the enumerator (hopefully) had established necessary credibility and trust. Finally, to enhance the reliability of the corruption data, multiple questions on corruption were asked in different sections of the questionnaire.[10] Consistent findings across measures significantly increase the reliability of the data. The data collection effort was also aided by the fact that the issue of corruption has been partly desensitized in Uganda. Over the past few years several awareness-raising campaigns have been implemented on the subject and the media regularly reports on corruption cases.[11]

It is worth noting that even with underreporting and non-responses, as long as the sample is representative and the misreporting is not *systematically* correlated with the firm characteristics, these problems only stack the deck against us.

We were able to collect bribery data for 176 firms out of 243 sampled. Of the 67 firms that did not respond to the corruption question, about one third refused to answer other sensitive questions in the questionnaire (e.g., about cost and sales). As a group, the approximately 40 firms that declined to answer specific questions about corruption did not differ significantly with respect to size, profits, and location from the group of graft-reporting firms. Thus, we find no evidence that the sample is not representative.

We collected answers to multiple questions on corruption. The key corruption variable we exploit below is reported bribe payment. Two other variables are related to delivery of public services. The respondents were asked the total cost (including informal payments) of getting connected to the public grid and acquiring a telephone line. As discussed in Svensson (1999), controlling for location (with respect to public grid), these are services for which one would expect firms to pay the same amount to acquire. Thus, deviations from the given price

[10]The survey instrument had roughly 150 questions (500 entries), a handful which were related to corruption. Given the length of the questionnaire, the survey was labor and time intensive and typically consisted of at least two visits to each firm by one or two enumerators to accommodate the manager's time schedule.

[11]See Ruzindana et al. (1998) and World Bank (1998b).

typically reflect graft. Of the 25 firms that had been connected to the public grid over the past three years, all reported positive bribe payments. The partial correlation (controlling for location) between connection costs and bribes is 0.67. The picture is similar for deviations from the fixed price of a telephone connection. Of those 77 firms that reported positive deviations, 15 did not report bribe data. The simple correlation between the excess price of telephone connections and reported bribe payments for the remaining firms is 0.41. The correlations are illustrated in Figures 1-2 and simple regressions are reported in Table 1. To summarize, reported bribe payment is highly correlated with other corruption-related variables derived from the survey data. We believe the consistent findings across measures significantly enhance the reliability of the bribe data.

Of the 176 firms that answered the question on graft, 33 reported that they did not have to pay bribes, while 143 reported positive graft. As shown in Table 2, there are noticeable differences between the two groups of firms corresponding to the model's prediction.[12] Non-bribing firms tend to have characteristics suggesting they are operating in sectors with little or no contact with bureaucrats. They receive significantly less public infrastructure services, they are less involved in foreign trade, and pay less taxes (particularly when controlling for tax exemptions). Moreover, they spend significantly less time dealing with government regulations and less money on accountants and specialized service providers to deal with regulations and taxes.

At the same time, the groups are similar with respect to cost of security (in fact the cost of security per worker is higher for the group of non-bribing firms) and the incidence of robbery and theft. These results suggest that while being in sectors where bureaucrats have low control rights over firms' business operations insulates such firms from public corruption, it does not protect them from other sources of discretionary redistribution such as theft.

The average firm in the non-bribing group is smaller (measured by number of workers), but the difference is not significant when all firms are included in the samples. Dropping three outliers (two standard deviations above the mean) from the group of firms reporting no bribe payments, however, results in a significant difference in size between the two groups (p-value 0.02), with non-bribing firms being smaller.

For the firms that reported positive bribes, the average amount of corrupt payments was about USD 8,300 (in 1997), with a median payment of USD 1,800.

[12] As a consistency check, we compared the subsample of firms that reported zero bribe payments with the subsample that reported positive graft to control if the former group systematically answered "difficult" questions with "0". However, there is no significant difference in the share of zeros reported to questions such as cost of security, profit tax, and investment, between the two subsamples.

These are large amounts, corresponding to USD 88 per worker, or roughly 8 percent of total costs.[13] The median firm paid bribes equivalent to 28 percent of its investment in machinery and equipment. The distribution of bribes is depicted in Figure 3a-3b.

4.3. Results

Table 3 reports a series of probit regressions, corresponding to equation (4.2), which attempt to explain the probability that a firm faces a corrupt bureaucrat and therefore needs to pay bribes ($g^i > 0$), as a function of sector and location specific variables. The dependent variable is a zero-one dummy taking the value 1 if the firm reported positive bribe payments and zero otherwise. Data sources and definitions are reported in the appendix.

As shown in Table 3, the incidence of corruption is significantly correlated with several of the proxies of formality, or sectors over which bureaucrats have high control rights. Thus, firms receiving public services and are engaged in trade (measured either as share of export [*export*] or as a dummy variable taking the value 1 if the firm either exports or imports or both and zero otherwise [*trade*]), have a higher probability of facing a corrupt bureaucrat and therefore of having to pay bribes. Firms that pay more types of taxes also face a higher probability of paying bribes, particularly when controlling for tax exemptions. The *pay tax* variable does not enter significantly different from zero in Regression 4, but this result is partly due to the fact that several of the non-tax-paying firms are formally exempt from paying taxes. Thus, the *pay tax* variable captures both firms that due to their location do not pay tax, and formal sector firms that are exempt from paying tax. We can partly correct for this by interacting a measure of tax exemptions with the *pay tax* index. The results are reported in Regression 5. The *pay tax* variable now enters significantly at the 5 percent level.

The proxies of formality are highly correlated. The correlation between *pay tax* and *trade* (*infrastructure services*) is 0.60 (0.47), and the correlation between *trade* and *infrastructure services* is 0.35. To avoid multicollinearity problems the three variables are combined to a "formal sector index" by principal components analysis. The variable *formal sector* is the first principal component. The result of using this composite variable is reported in Regression 6 and illustrated in Figure 4. As predicted, firms active in the formal sector have a higher probability of facing a corrupt bureaucrat and paying bribes.

We next turn to equation (4.4) and an explicit examination of the amount of

[13]For comparison, the cost of fuel (which is heavily taxed and considered expensive) constituted on average 6.2 percent of total costs, wages constituted on average 17.9 percent, and interest payments to total costs constituted 6.8 percent.

bribes paid.[14] To estimate this equation data on current profits, capital stock, sunk cost component, and labor force are needed. Profits are defined as gross sales less operating costs and interest payments (*profit*). Capital stock is measured as the resale value of plant and equipment (*capital stock*); that is, the monetary value the firm manager reported it would get if it sold all of its machinery and equipment. Labor force is total employment (*employment*). All data are for 1997 and the monetary values are expressed in US dollars.

The extent to which a firm's production technology is sunk is not directly observable and we therefore choose to estimate it using data on reported capital stock values. Managers were asked to provide a valuation of their firms' assets. Apart from resale value; i.e., the value of a firm's stock of capital on the market, managers reported the "replace value"; that is, how much it would cost to replace all machinery and equipment with similar new assets. The ratio of these two values (resale to replace) captures the extent of physical depreciation of the asset, transaction costs (size of second-hand market), and relative price effects (changes in prices of final goods that determine the underlying profitability of the capital stock). In the model, the sunk cost component α is directly related to the latter two effects of liquidating the capital stock. To capture this, we regress the ratio of resale to replace values of the capital stock to the average age of the capital stock and a constant (all variables in logs). The residual in this regression (*sunk cost component*) then captures the part of the divergence between the resale and replacement values of capital that does not depend on physical depreciation. A negative value indicates a sunk capital stock.

The dependent variable, g^i, is reported bribe payments to public officials (in US dollars), both in nominal values (in Table 5-6), in logarithms (in Table 7-8), and per employee (Table 9-10). The basic model identifies a linear relationship. However, the linear relationship is not likely to be robust to slight modifications of the model, as discussed in section 3.

Regression 1 (Table 5) reports the base specification. The standard errors are derived from the appropriate covariance matrix of γ for which heteroskedasticity is explicitly taken into account.[15] All variables enter significantly and with expected signs. Corruption is positively correlated with current profits, employment, capital stock, and negatively correlated with the alternative return to capital.[16]An increase in the stock of capital has a positive "direct" effect on required bribe payments, but due to partly sunk investments it also affects the equilibrium amount

[14]Summary statistics are reported in Table 4.

[15]See Heckman (1979) for an expression of the asymptotic covariance matrix.

[16]The sunk cost component is a generated regressor. As such, the estimates of the standard errors may be biased. However, under the null hypothesis that the estimated coefficient on αk is zero, the standard errors are unbiased. Thus, the t-statistic for the null hypothesis is not invalidated (Pagan, 1984).

of graft through the multiplicative term $\alpha^i k^i$. The marginal effect of k^i is positive for $\alpha^i < 0.023$, implying that for roughly 76 percent of the firms in the sample capital investment is associated with higher bribe payments.

There are two apparent outliers in the sample: one firm reported (negative) profits almost 7 standard deviations below the mean (6.5 standard deviations below zero), and one firm reported bribe payments almost 8 standard deviations above the mean.[17] Regression 2 displays the same regression once these outliers are dropped from the sample. The fit of the regression improves and the standard errors of all variables are significantly reduced. The standard errors of the regression are reduced by more than one-third.

In Regression 3 we add the sunk cost proxy to control if the restricted specification reported in Regressions 1-2 is valid. The sunk cost variable enters insignificantly and all other results are unchanged, thereby providing support for the restricted specification employed.

The base specification is augmented with additional controls in columns (4)-(5). Regression 4 adds a proxy of the degree of competition (number of competitors for the firm's principal product). An approach to corruption control often put forward suggests that increasing competition may be a way to reduce the returns from corrupt activities (see e.g., Rose-Ackerman, 1999). However, once the variables proxying for γ_i are included, the degree of competition adds no new information. This result supports recent theoretical work on corruption and competition which stresses that both variables are endogenously determined (see discussion in section 3 and below). If this is the case it is incorrect to take the number of firms as an indicator of the level of competition in the market, since corruption affects the flow of returns from a particular investment and thus the number of firms in a free-entry equilibrium (see Bliss and Di Tella, 1997).

The model discussed in section 2 deals with bureaucratic extortion. Obviously there are other reasons for why one would observe bribes in equilibrium. For instance, firms might bribe public officials to receive public contracts, favorable tax treatment, exemptions from regulations, etc.. It is difficult to find data that could proxy for these other sources of corruption. However, in Regression 5 we add one such indicator: a dummy variable taking the value 1 if the firm sells part of its output to the government. The presumption is that firms actively involved with the government face stronger incentives to bribe public officials for current and future contracts. Controlling for profits, employment, capital stock, and to what extent the firm's capital is sunk, the *sell to government* dummy enters insignificantly and all other variables remain unchanged. Of course, this result by itself does not exclude the possibility that firms are bribing public officials for

[17]We suspect the outliers are due to reporting errors. The two observations are outliers also in the regressions, i.e., based on the residuals, and remain outliers when scaling with employment.

contracts and exemptions, but simply suggests that the "prices" of these favors are functions of the firms' ability to pay (see further the discussion below on reverse causation).

We experimented with several other potential explanatory variables, including industrial category dummies, regional dummies, and market share. None of these variables had any significant effect on graft once the variables identified by the model (γ_i) were included.

Table 6 displays the base specification with the logarithm of bribe payment as dependent variable. Using the logarithm of graft as dependent variable improves the fit of the model. In Regression 1, all variables enter significantly at the 1 percent level. The results are similar if we add additional controls (Regression 2).

In Table 7 we reestimate the model (4.4) with all variables expressed in logarithms. This has the well-known advantage that the coefficients can be interpreted as elasticities. However, since both *profit* and the *sunk cost component* take negative values, we have to add constants to these terms. This in turn implies that the elasticities of bribe payments with respect to these variables are not constant. In the base specification reported in column (1), all variables again enter highly significant. The results are also robust to the inclusion of additional controls (Regression 2) and hold if we let the *sunk cost* proxy enters linearly (not shown).

Yet another concern is that the results are driven by spurious correlation (all variables are correlated with size). Simply controlling for size may not overcome this. To control for this possibility we reestimated the model in rates by scaling all variables with employment size. In Table 8, the dependent variable is thus reported bribe payment in USD per employee. As evident, the relationship between current and expected profit rates (the latter proxied by capital/employment) and the bribe rate continues to hold. Also, the alternative return, scaled by size, remains significantly correlated with the bribe rate.

Up until now we have relied on the restrictions of the model to estimate equation (4.4). Specifically, the model places restrictions on the supply of bribes (firms' incentives to pay bribes). In the model profits are exogenous and not influenced by the amount paid in bribes. However, other assumptions on the supply side would suggest that firms that pay high bribes get valuable government favors in return (e.g., they obtain valuable licenses, preferential market access, control of privatized companies, etc.). Thus, there may be a causal relation between the level/rate of bribes and profits; that is, the results may be influenced by reverse causation. Similarly, profits and corruption may be jointly determined to the extent that corruption may cause exit or restrict entry which may affect profits of the remaining firms and thus their potential to pay bribes.

As stressed above, it should be noted that for the reverse causation argument to influence the results it must be the case that the size of the government favor is linked to the amount paid in bribes. A simple extension of the model presented above (yielding the same empirical predictions) is that all bribe-paying firms receive preferential government treatment, for instance they obtain a valuable license. Our identifying assumption is that the price of this license is determined by the firm's ability to pay.

We deal with the potential endogeneity problem by instrumenting for profits using two different sets of instruments. Finding appropriate instruments in a firm-level data set is not easy. In particular this is so since it requires assumptions of the hitherto unmodelled determinants of profits.

The first set of instruments consists of firm specific variables which we argue are uncorrelated with both the error term in (4.4) and reported bribes, but are correlated with firms' profit potential (and realized profits). The instrument set includes proxies of human and social capital: a dummy variable indicating if the owner/manager has a University diploma (*university*); a dummy indicating if the owner/manager has had previous experience from working abroad or in a foreign owned firm (*experience*); age of the firm (*age*); and a measure of foreign ownership (*foreign*). These variables are presumably correlated with productivity and profits. An indicator that is the case is provided in Reinikka and Svensson (1999). In a large panel of firms from five African countries they show that foreign ownership, age, and experience are good predictors of profits. We also include the distance (*distance*) to the main trading center, the capital Kampala, which presumably affect firms' operating costs. The last instrument is the cost of security per employee (*cost of security per employee*). As discussed in Collier and Gunning (1999), risk arising from, for example, crime is an important determinant of the performance of African enterprises. The cost of security is one proxy of the cost of risk management.

As depicted in Table 5 there are other variables which are uncorrelated with reported bribes, but potentially correlated with profits, such as number of competitors and market share. However, since there might be an indirect link between these variables and corruption, we do not include them as instrument. In so doing we attempt to identify the "exogenous" component of profit, and thus control for the possible feedback from corruption to profits through the market structure.

As a complement we try a different instrument strategy by using industry-location averages of profits as instrument. This is a potentially good candidate for an instrument since the data reveal that there are systematic differences in profit rates across sectors. Presumably, having netted out the firm-specific component of profits, the differences in observed profits depend on the underlying characteristics of the industries and/or locations that determine their profitability. Furthermore we know that in the sample of bribe-paying firms, the industrial and regional dummies are uncorrelated with the reported level of bribe payments holding the other controls constant.

Table 9 reports the results of using instrument variables techniques, with bribe rate (bribe payment in USD per employee) as dependent variable.[18] All variables continue to enter significant. The coefficients on the profit rate are in fact even larger than those reported above. This result is likely driven by the fact that the IV-strategy also mitigates the attenuation bias due to measurement errors. Despite the data collection strategy profits are likely to be a noisy variable. The instruments perform well. The first set of instruments increase the R^2 in the first-stage regression by 6 percentage points. The Hausman test also reveals that we cannot reject the null hypothesis of the validity of the instruments; that is, we find no evidence that the instruments for the profit rate belong in the corruption regression.

Despite the IV-results it should be stressed that in reality some firms may still benefit (and possibly a lot) from corruption. What this type of econometric work identifies is what is true on average, or in general, and on average the data suggest that the level and rate of grafts are driven by the firms' abilities to pay. This result is also consistent with other preliminary work on the Uganda data set. Fisman and Svensson (1999) show that once controlling for possible simultaneity biases, there is a strong negative relationship between bribery payments and firm growth (growth in sales or employment). The effect is about three times greater than that of taxation and much stronger after outliers are excluded. Svensson (1999), studying the cost of obtaining connection to public services, finds that there is no relationship between the cost (including informal payments) and the time it takes to get connected to the public grid and/or acquire a telephone line. Both studies hence suggest that firms paying higher bribes on average do not receive faster or more valuable services in return.

In Table 10 we have calculated the effects on corruption (bribe payment) of: (i) a one standard deviation increase in the explanatory variables, and (ii) a one-percent increase in the explanatory variables. The calculations show that the effects identified in the model are qualitatively large. For example, a one-standard deviation increase in profits is associated with roughly USD 100 in additional bribe payments per employee (equal to 0.76 standard deviations), while an one-standard deviation reduction in the sunk cost component implies a reduction in bribes of around one-third standard deviation.

[18] The results are very similar, though slightly weaker than those reported above, when running the regression in levels; i.e., not scaling with number of employees.

5. Implications

In the model corruption has potentially two adverse consequences. It discourages investment in sector s_1 and shifts production to sector s_2. We label this the allocation effect. Note that although bureaucrats realize that demanding bribes may cause exit, they do not take into account how exit affects the overall allocation of firms between different sectors.

Second, if firms not only can choose between sectors, but realistically also can choose what technology to apply, firms will tend to pick a more reversible (but possibly less efficient) capital stock. We label this the technology effect. In appendix A.2. we elaborate on these two effects and show that they are functions of the parameters of the model.

6. Concluding remarks

15 years ago in the *Handbook of Econometrics* survey of economic data issues, Griliches (1986) observed " ...since it is the "badness" of the data that provides us with our living, perhaps it is not at all surprising that we have shown little interest in improving it, in getting involved in the grubby task of designing and collecting original dataset of our own". Griliches observation is still a fair one when it comes to data on governance and corruption. One contribution of this paper has been the collection of what we believe to be an unique data set to analyze the causes and consequences of corruption at the firm level. Despite our data collection strategy, however, there are likely to be cases of misreporting in the sample, and for this reason the paper has not focused on the level or incidence of bribes, but rather on their correlates. We believe that the strategy used to collect information on grafts has minimized any systematic biases in the correlation between reported grafts and the set of controls we use.

To guide the empirical analysis we have developed a simple model of bureaucratic extortion. The model yielded predictions on both the incidence of bribery and the amount paid, and both predictions are consistent with the data. Firms typically have to pay bribes when dealing with public officials whose actions directly affect the firms' business operations, and such dealings cannot be easily avoided when, for example, exporting, importing, or requiring public infrastructure services. Further, the amount paid is a function of firm characteristics: a firm's current and expected future profits and to what extent the firm's capital stock is sunk. Thus, the amount of bribes paid does not appear to be a fixed sum for given public services, but depends on firms' abilities to pay - the more a firm could pay the more it has to pay. Or in other words, the "price" a firm must pay for a given service is a function of the firm's ability to pay. We have shown that these findings are robust to a number of potential statistical problems.

These results have clear policy implications (for an elaborated discussion on policy issues see Svensson, 2000). If the bribe a firm needs to pay is an outcome of a bargaining process, collective actions on the part of the business community so as to strengthen the bargaining position of individual firms may be a successful strategy to reduce the cost of doing business in countries suffering from systemic corruption (collecting and disseminating information about corrupt practices; informing the private sector and the public about service standard, guidelines and norms of major service providers; increasing individual firms ability to commit to no-bribery; and recognizing those how are doing a good work by resisting corruption, are examples of such measures).

Another potential reform involves giving bureaucrats overlapping jurisdictions to reduce their monopoly power, as discussed in Rose-Ackerman (1999). The ability to extract rents would fall if firms could simply refuse to deal with a corrupt official and try someone else. However, as noted by Rose-Ackerman, competitive bureaucracy has limited value in cases where officials impose costs rather than benefits (e.g., having two rather than one policeman knocking on the door asking for bribes may not be preferable), so the potential overall effect of such a reform might not be large.

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A. Appendix

A.1. Data description and sources

All data used in the paper are from the Ugandan Industrial Enterprise Survey (see Reinikka and Svensson, 1999, for details). The survey was initiated by the World Bank primarily to collect data on constraints facing private enterprises in Uganda and was implemented during the period January-June 1998 by the Ugandan Manufacturers Association (an employers' association). The enumerators were trained by World Bank survey experts. The sampling frame was based on an Industrial census from 1996 and was confined to five general industrial categories (commercial agriculture, agro-processing, other manufacturing, construction, and tourism). Based on number of enterprises, these five sectors constituted 52 percent of the private sector, and almost 80 percent of employment in 1996. The chosen sample size was 250 establishments (out of 1282 enterprises in the census in the five industrial categories). Within these five industrial categories, commercial agriculture made up 26 percent of employment, agro-processing 28 percent, other manufacturing 32 percent, construction 12 percent and tourism 2 percent. Balancing the importance of the different industrial categories at present with the likely importance in the future, the initial plan prescribed selecting 50 establishments in commercial agriculture, 50 in agro-processing, 100 in other manufacturing, 25 in construction, and 25 in tourism. Five geographical regions were covered in the sample (Kampala, Jinja/Iganga, Mbale/Tororo, Mukono, and Mbarara). These regions constitute more than 70 percent of total employment. Three general criteria governed the choice of procedure in selecting the sample from the eligible establishments. First, the sample should be at least reasonably representative of the population of establishments in the specified industrial categories. Second, the establishments surveyed should account for a substantial share of national output in each of the industrial categories. Third, the sample should be sufficiently diverse in terms of firm size to enable empirical analysis on the effects of firm size. To account for these three considerations, a stratified random sample was chosen using employment shares as weights. The final sample surveyed constituted 243 firms and was fairly similar to the initially selected stratified sample, both with respect to location and size.

The survey instrument had roughly 500 entries and a handful of them were related to corruption. *Bribe payments* were reported under the following question, "Many business people have told us that firms are often required to make informal payments to public officials to deal with customs, taxes, licenses, regulations, services, etc. Can you estimate what a firm in your line of business and of similar size and characteristics typically pays each year?". The question was asked at the end of the interview by which time the enumerator would have established a necessary credibility and trust.

Other variables: *capital stock* = resale value of plant and equipment in USD (1997); *competitors* = number of competitors for the firm's principal product; *cost of accountant* = monthly cost of accountant, lawyer, agent, specialized service provider to deal with regulation and taxes in USD (1997); *cost of security* = annual cost of security in USD

(1997); *distance* = distance (miles) from Kampala; *employment* = total employment (1997); *experience* = binary variable taking the value 1 if the owner/manager has had previous experience from working abroad or in a foreign owned firm; *export* = share of sales exported (1997); *foreign* = foreign ownership in percent; *formal sector* = first principal component derived from principal components analysis of 'trade', 'pay tax', 'infrastructure service'; *infrastructure service* = index (0-5) of availability of public services (electricity, water, telephones, waste disposal, paved roads), 1 if available 0 otherwise, index is the sum of the binary availability variables for the five services; *incidence of robbery and theft* = binary variable taking the value 1 if the firm was a victim of robbery, and/or theft during 1995-1997, 0 otherwise; *pay tax* = index (0-6), sum of six binary (0=no, 1=yes) variables reflecting types of taxes the firm pays (import duty, import commission, withholding tax, excise tax, VAT, corporate tax [profit tax]) (1997); *profit* = gross sales less operating costs and interest payments in USD (1997); *sunk cost component* = residual from the regression of the ratio of resale to replace values of the capital stock to the average age of the capital stock and a constant (all variables in logs); *sell to government* = binary variable taking the value 1 if the firm sells part of its output to the government, 0 otherwise; *tax exemptions* = index (0-2) of tax exemptions on corporate tax, import duties, with 0=no exemptions, 2=fully exempted; *time spent dealing with taxes and regulations* = percentage of senior management's time spent each month dealing with government regulations (1997); *trade* = binary variable taking the value 1 if the firm either exports or imports itself or both and zero otherwise (1997); *university* = binary variable taking the value 1 if the owner/manager has a University diploma.

A.2. Implications and extensions

A.2.1. Asymmetric information

In reality a bureaucrat does not have full information about a firm from who he wishes to extract bribes. The shock θ and profits are not directly observed, neither is the sunk cost component. Incomplete information will create informational rents that the firms can capture. Thus, the linear relationship between profits and grafts identified in equation (2.6) will only be an approximation. As an example, assume θ (and π) can take two values, high profits $\pi(k, \theta_H)$, which occurs with probability $\frac{1}{2}$, and low profits $\pi(k, \theta_L)$. Furthermore, consider the case when the bureaucrats only receive a signal, θ_S, of the state of nature. θ_S is equal to the true state with probability $\mu \geq \frac{1}{2}$. Let g_L be the level of graft that solves

$$\pi(k, \theta_L \,|\, s_1) - g_L + E_t \textstyle\sum_{n=1}^{\infty} \beta^n \left[\pi(k, \theta_{t+n}, \cdot \,|\, s_1) - p_{t+n}(s_1) g_L\right]$$

$$= \textstyle\sum_{n=1}^{\infty} \beta^{n-1} \pi(\alpha k, \cdot \,|\, s_2)$$

and g_H be the level of graft that solves

$$\pi(k, \theta_H \mid s_1) - g_H + E_t \sum_{n=1}^{\infty} \beta^n \left[\pi(k, \theta_{t+n}, \cdot \mid s_1) - p_{t+n}(s_1) g_H\right]$$

$$= \sum_{n=1}^{\infty} \beta^{n-1} \pi(\alpha k, \cdot \mid s_2)$$

That is, g_L (g_H) is the level of graft that makes the firm in bad [good] states indifferent between paying the demanded bribes and exiting. It is straightforward to show that if $g_L \geq \mu g_H$, the bureaucrat would demand graft g_L in each period irrespective of the signal, and the firm would capture the informational rents.[19]

A.2.2. The allocation effect

The allocation effect is similar to a highly progressive profit tax: corruption creates a wedge between the (marginal) product of capital and the return that can be privately appropriated by the investor, and the more so the higher the profits.

To evaluate the economy-wide consequences of this allocation effect note that we assume that firms take into account the corrupt bureaucrats' behavior when choosing where to locate. Substituting (2.6) into the firm's value function yields

$$V(k \mid s_1) = \left[\frac{(1+p')(1-\rho) - \rho p''}{1+p'} \bar{\pi}(k, l^i, \cdot \mid s_1) + \frac{\rho}{(1-\beta)(1+p')} \pi(\alpha k, \cdot \mid s_2)\right] \quad \text{(A.1)}$$

and

$$V(k \mid s_2) = \frac{1}{(1-\beta)} \pi(k, \cdot \mid s_2) \quad \text{(A.2)}$$

A firm will invest in sector 1 provided that $V(k \mid s_1) \geq V(k \mid s_2)$. Since $V(k \mid s_1)$ is an increasing function of η, it follows that the share of entrepreneurs locating in sector s_1 is $1 - G(\bar{\eta})$, where the cutoff value $\bar{\eta}$ is implicitly defined by equating (A.1) and (A.2).

Thus, provided that the expected return to capital in sector s_1 is sufficiently high, entrepreneurs with a comparative advantage of production in sector s_1 will invest there. Note that absent corruption, more firms would invest in sector s_1. Specifically, without corruption the share of entrepreneurs investing in sector s_1 is $(1 - G(\underline{\eta})) > (1 - G(\bar{\eta}))$, where $\underline{\eta}$ is implicitly defined by

$$\bar{\pi}(k; \bar{\eta} \mid s_1) - \pi(k, \cdot \mid s_2) = 0 \quad \text{(A.3)}$$

The severity of the allocation effect depends on α and ρ.

$$\frac{d\bar{\eta}}{d\alpha} < 0, \qquad \frac{d\bar{\eta}}{d\rho} > 0 \quad \text{(A.4)}$$

A less reversible capital stock raises the firm's potential loss of exiting sector s_1 and, everything else equal, results in higher bribe payments and lower profits in equilibrium.

[19] The informational rent is equal to the expected graft with full information $\frac{1}{2}\left(g(\theta_H) + g(\theta_L)\right)$, less graft with incomplete information g_L.

Lower net profits in sector s_1 implies that fewer firms will find it profitable to invest there. Likewise, an increase in the probability that public officials will demand bribes raises expected grafts $E_0 pg(\theta_t)$ and reduces expected net profits. As a result, fewer firms will invest in sector s_1.

A.2.3. Technology effect

The second effect, the technology effect, would arise if firms not only could choose where to locate, but also could choose what technology to apply, or more precisely what type of capital goods to purchase. Absent corruption, the extent to which the technology is sunk or not would not affect the firm's investment decision. Thus, the firm would buy capital goods so as to maximize $\pi(k, \cdot | j)$. With corruption, the decision is more complex, since the cost of exiting affects the firm's "bargaining" position versus the bureaucrat. A less sunk capital stock implies that the cost of exiting becomes smaller, and from equation (2.6), lower grafts when matched with a corrupt official. Thus, the firm might find it profitable to choose a "technology" that yields a lower gross return $\pi(k, \cdot | j)$, but indirectly reduces the amount of bribes the firm needs to pay.

The trade-off can be evaluated using the value function (A.1). Let the pair $\{k, \alpha\}$ capture the "technology" choice of the firm. Absent corruption, the optimal technology is $\{k^*, \alpha^*\}$. Assume that the firm can choose a less sunk investment $\alpha > \alpha^*$, but this is more expensive so less productive capital could be installed $k < k^*$.

Would the firm find it profitable to choose a less productive but more reversible capital investment? Differentiating the value function with respect to k and α yields

$$\frac{dV(\cdot | s_1)}{dk} = \varphi_k \frac{d\bar{\pi}(k, l^i, \cdot | s_1)}{dk} + \varphi_\alpha \frac{d\pi(\alpha k, \cdot | s_2)}{dk}$$

$$\frac{dV(\cdot | s_1)}{d\alpha} = \varphi_\alpha \frac{d\pi(\alpha k, \cdot | s_2)}{d\alpha}$$

where $\varphi_k \equiv \frac{(1+p')(1-\rho)-\rho p''}{1+p'}$ and $\varphi_\alpha \equiv \frac{\rho}{(1-\beta)(1+p')}$. Thus, the marginal effects depend on the composite coefficients φ_k and φ_α. Note that φ_k $[\varphi_\alpha]$ is a decreasing (increasing) function of ρ. In Figures 5a-5b the composite coefficients and the ratio φ_k/φ_α are plotted. If the incidence of bribery is high, the relative return of adopting a technology with inefficiently low sunk cost component is also high. In other words, the higher the probability of meeting a corrupt bureaucrat, the stronger the incentives to invest in a more reversible capital stock. Note that the gain of investing in less sunk capital does not result from lower realized costs of exiting, since in equilibrium the firm will not exit, but from higher expected net profits since the manager's leverage in the negotiation with the bureaucrats increases, and as a result equilibrium graft falls.

Figure 1: Partial correlation (graft & connection costs-public grid)

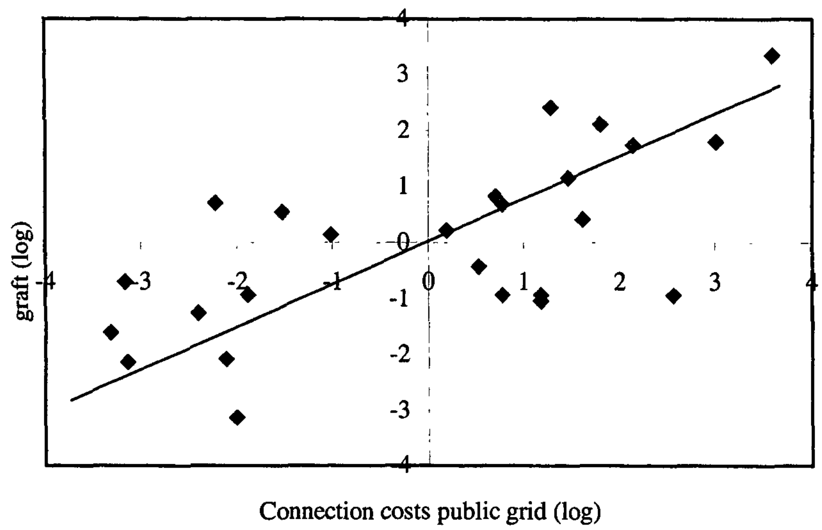


Figure 2: Correlation (graft & excess cost of telephone connection)

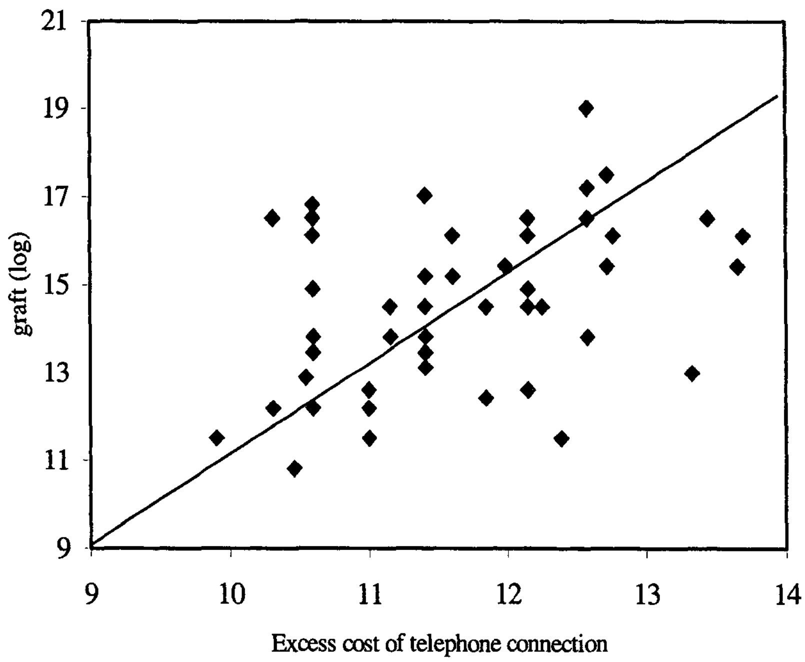


Table 1. Partial correlation : Connection costs and bribery[(i),(ii)]

Equation	(1)[(iii),(iv)]	(2)[(v)]
Dependent variable	Connection costs public grid (log)	Excess cost of telephone connection (log)
Constant	9.162 (.000)	10.75 (.000)
Bribe payments (log)	0.508 (.000)	0.068 (.001)
Adjusted R2	0.44	0.15
Observations	25	62

Note: (i) standard errors adjusted for heteroskedasticity (White, 1980); (ii) p-values in parenthesis; (iii) regression 1 includes a proxy of informality (*infrastructure service*); (iv) connection costs (public grid) has mean 6,330,400 USh and median 2,500,000 USh; (v) excess cost of telephone connection has mean 155,600 USh and median 90,000 USh.

Table 2: Sample characteristics

	Firms that reported zero bribe payments	Firms that reported positive bribe payments	p-value
Infrastructure service	3.24	3.70	0.048
Export	0.15	0.33	0.016
Pay tax	2.58	3.04	0.184
Pay tax (not tax exempted only)	2.50	3.28	0.031
Time spent dealing with taxes and regulations (log)	1.93	2.49	0.016
Cost of accountant etc. (log)	3.30	4.74	0.016
Cost of security (log)	7.17	7.48	0.569
Incidence of robbery and theft	0.52	0.58	0.497
Employment size (log)	3.61	3.88	0.342

Note: (i) average values in columns two and three; (ii) numbers in the fourth column are p-values for a test of the null hypothesis that the two means are equal.

Figure 3a: Distribution of firms according to bribe payments (log)

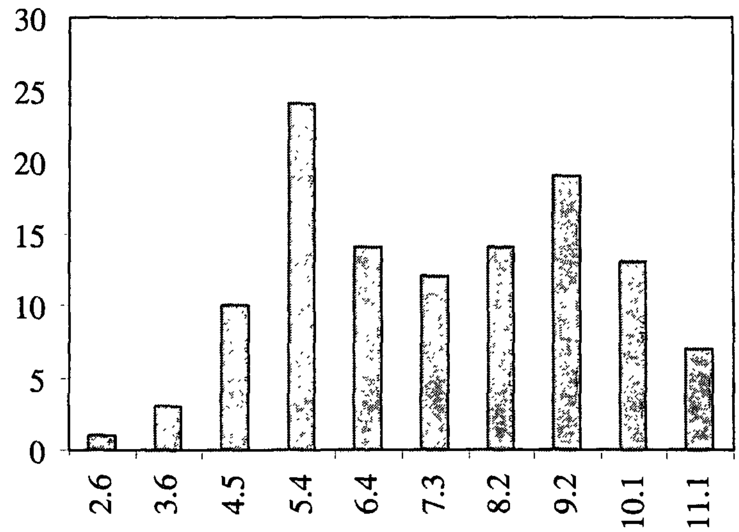


Figure 3b: Distribution of firms according to bribe payments

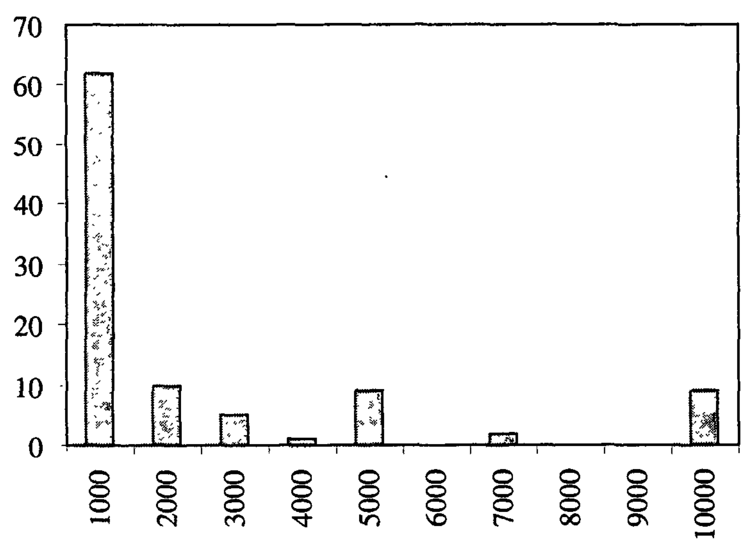
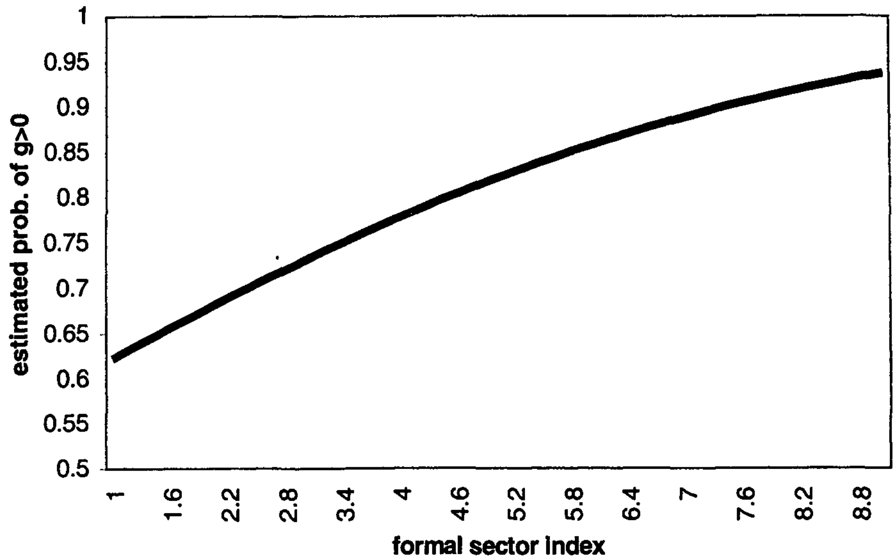


Table 3: Probit regressions on the incidence of corruption

Equation	(1)	(2)	(3)	(4)	(5)	(6)
Dep. variable	Incidence of graft	Incidence of graft	Incidence of graft	Incidence of graft	Incidence of graft	Incidence of graft
Constant	.203 (.554)	.747 (.000)	.647 (.000)	.613 (.004)	.309 (.255)	.179 (.588)
Employment	8.36E-5 (.848)	-7.58E-5 (.859)	-7.94E-5 (.857)	-7.66E-5 (.865)	-1.28E-4 (.780)	-.000 (.784)
Infrastructure service	.192 (.041)					
Export		.596 (.031)				
Trade			.430 (.070)			
Pay taxes				.096 (.173)	.187 (.037)	
Tax exemptions					1.14 (.018)	
Pay taxes* exemption					-.240 (.071)	
Formal sector index						.151 (.038)
Observations	176	176	167	173	172	167

Note: (i) dependent variable "incidence of graft" takes the value 1 if the firm reported positive bribe payments and 0 otherwise; (ii) p-values in parenthesis.

Figure 4: Estimated probability of having to pay bribes



Note: Based on regression 6, Table 3, with size evaluated at the mean.

Table 4: Sample characteristics of firms that reported positive bribes[(i),(ii)]

	All firms	All firms[(iii)]	Firms reporting low bribe payments[(iv)]	Firms reporting high bribe payments[(iii)]
Profit				
- mean	211,060	284,390	57,540	540,110
- median	27,270	27,270	11,230	95,690
- Std. dev.	1,134,460	1,048,116	119,660	1,489,290
Bribes				
- mean	7,850	6,270	280	13,020
- median	910	910	180	9,090
- Std. dev.	19,840	13,480	280	17,390
Resale value				
- mean	365,760	346,760	174,550	540,890
- median	90,910	90,910	38,640	227,270
- Std. Dev.	667,190	648,260	394,500	809,010
Employment				
- mean	119	109	36	192
- median	34	33	20	81
- Std. dev.	262	251	53	346
Reversibility				
- mean	.001	.001	.002	-.000
- median	.011	.011	.012	.009
- Std. dev.	.034	.034	.033	.035
Obs.	119	117	62	55

Note: (i) sample of firms for which data on corruption and other variables are available; (ii) profits, bribes, resale values in USD; (iii) excluding two extreme outliers; (iv) low bribe payment is graft smaller than USD 1000.

Table 5: Corruption regressions(i),(ii)

Equation	(1)	(2)(iii)	(3)(iii)	(4)(iii)	(5)(iii)
Dep. variable	Graft in USD	Graft in USD	Graft in USD	Graft in USD	Graft in USD
Constant	9,531 (6,693)	8,701 (4,509)	8,910* (5,101)	8,500* (4,609)	8,178* (4,169)
Profit	0.0033** (.0014)	0.0037*** (.0010)	0.0036*** (.0010)	0.0036*** (.0011)	0.0036*** (.0010)
Employment	17.11** (7.21)	11.39** (4.76)	11.53*** (4.28)	11.48** (4.98)	11.03** (4.45)
Capital stock	0.0071** (.0032)	0.0059** (.0023)	0.0061** (.0032)	0.0060** (.0024)	0.0063*** (.0021)
Sunk cost component* capital stock ("alternative return")	-0.309** (.119)	-0.259*** (.089)	-0.290*** (.096)	-0.259*** (.090)	-0.274*** (.081)
Sunk cost component			31,202 (36,634)		
Competitors				16.46 (131.5)	
Sell to government					-1,524 (2,063)
$\lambda^{(iv)}$	-16,638 (17,774)	-16,105 (11,849)	-16,489 (12,896)	-16,307 (11,607)	-13,781 (10,537)
Wald(v)	18.27 (0.00)	29.63 (0.00)	31.85 (0.00)	29.05## (0.00)	36.10## (0.00)
S.E. regression	18,728	12,168	12,184	12,278	11,075
Adjusted R2	0.11	0.18	0.18	0.18	0.22
Observations	119	117	117	116	114

Notes: (i) standard errors in parenthesis are adjusted for heteroskedasticity (Heckman, 1979); (ii) *** [**] (*) denote significant at the 1 [5] (10) percent levels; (iii) two extreme outliers dropped; (iv) λ is the inverse Mills ratio to adjust for selectivity with selection equation given by $P(e_i=1)=\Phi(c,employment,formal)$, i.e., Regression 6, Table 3; (v) Wald is the Wald-test statistic for testing if the coefficients on the π, k, l, αk are zero with p-values in parenthesis.

Table 6: Corruption regressions(i),(ii)

Equation	(1)	(2)
Dep. Variable	Graft in USD (log)	Graft in USD (log)
Constant	8.83***	8.86***
	(.892)	(.698)
Profit	5.5E-7***	5.4E-7***
	(1.0E-7)	(1.5E-7)
Employment	0.0023***	0.0023***
	(.0004)	(.0007)
Capital stock	9.8E-7***	1.0E-6**
	(3.5E-7)	(3.3E-7)
Sunk cost component* capital stock ("alternative return")	-3.5E-5***	-3.7E-5**
	(1.3E-5)	(1.3E-5)
Competitors		-0.0006
		(.019)
Sell to government		-0.234
		(.325)
λ(iii)	-7.32***	-7.19***
	(2.15)	(1.66)
Wald(iv)	51.64	42.12
	(0.00)	(0.00)
S.E. regression	1.74	1.73
Adjusted R2	0.35	0.35
Observations	117	113

Notes: (i) standard errors in parenthesis are adjusted for heteroskedasticity (Heckman, 1979); (ii) *** [**] (*) denote significant at the 1 [5] (10) percent levels; (iii) λ is the inverse Mills ratio to adjust for selectivity with selection equation given by $P(e_i=1)=\Phi(c, employment, formal)$, i.e., Regression 6, Table 3; (iv) Wald is the Wald-test statistic for testing if the coefficients on the π, k, l, αk are zero with p-values in parenthesis.

Table 7: Corruption regressions[(i),(ii),(iii)]

Equation Dep. Variable	(1) Graft in USD (log)	(2) Graft in USD (log)
Constant	-85.1***	-84.7***
	(28.6)	(30.5)
Profit (logarithm)	5.46***	5.46***
	(1.79)	(1.91)
Employment (logarithm)	0.649***	0.614***
	(.162)	(.159)
Capital stock (logarithm)	1.50**	1.67**
	(.679)	(.686)
Sunk cost component* capital stock (logarithm)	-1.84**	-2.07**
	(.924)	(.921)
Competitors (logarithm)		-0.100
		(.190)
Sell to government		-0.320
		(.303)
λ[(iv)]	-3.17*	-2.96*
	(1.78)	(1.72)
Wald[(v)]	63.85	66.76
	(0.00)	(0.00)
S.E. regression	1.61	1.61
Adjusted R2	0.44	0.44
Observations	117	113

Notes: (i) standard errors in parenthesis are adjusted for heteroskedasticity (Heckman, 1979); (ii) *** [**] (*) denote significant at the 1 [5] (10) percent levels; (iii) a constant 1E+7 is added to logarithm of *profit* and a constant 2 is added to *sunk cost* to avoid negative values; (iv) λ is the inverse Mills ratio to adjust for selectivity with selection equation $P(e_i=1)=\Phi(c, employment, formal)$, i.e., Regression 6, Table 3; (v) Wald is the Wald-test statistic for testing if the coefficients on the π, k, l, σk are zero with p-values in parenthesis.

Table 8: Corruption rate regressions(i),(ii),(iii)

Equation	(1)	(2)
Dep. Variable	Graft per employee in USD	Graft per employee in USD
Constant	120.1***	117.2**
	(45.1)	(47.9)
Profit per employee	0.0041***	0.0042***
	(7.4E-4)	(7.7E-4)
Capital stock per employee	0.0042*	0.0042*
	(.0022)	(.0022)
Sunk cost component* capital stock per employee ("alternative return per employee")	-0.238**	-0.240***
	(.091)	(.090)
Competitors		-1.001
		(1.289)
Sell to government		6.145
		(22.94)
$\lambda^{(iii)}$	-175.2	-135.9
	(119.2)	(116.9)
Wald(iv)	36.20	36.36
	(0.00)	(0.00)
S.E. regression	123.0	122.6
Adjusted R2	0.21	0.21
Observations	117	113

Notes: (i) standard errors in parenthesis are adjusted for heteroskedasticity (Heckman, 1979); (ii) *** [**] (*) denote significant at the 1 [5] (10) percent levels; (iii) λ is the inverse Mills ratio to adjust for selectivity with selection equation $P(e_i=1)=\Phi(c, employment, formal)$, i.e., Regression 6, Table 3; (vi) Wald is the Wald-test statistic for testing if the coefficients on the π, k, l, αk are zero with p-values in parenthesis.

Table 9: IV-regressions on corruption (i),(ii),(iii)

Equation	(1)(iv)	(2)(v)
Dep. Variable	Graft per employee in USD	Graft per employee in USD
Constant	121.9**	112.8**
	(53.27)	(54.5)
Profit per employee	.0052***	.0069***
	(.0017)	(.0018)
Capital stock per employee	.0039*	.0037
	(.0023)	(.0024)
Sunk cost component* capital stock per employee ("alternative return per employee")	-0.246**	-0.260***
	(.094)	(.098)
λ(vi)	-189.2	-186.6
	(144.8)	(147.6)
Wald(vii)	15.65	21.82
	(0.00)	(0.00)
Hausman(viii)		4.84
		(0.30)
S.E. regression	122.8	128.2
Adjusted R2		
Observations	117	114

Notes: (i) standard errors in parenthesis are adjusted for heteroscedasticity (Heckman, 1979); (ii) *** [**] (*) denote significant at the 1 [5] (10) percent levels; (iii) 2SLS estimation; (iv) instrument vector consists of industry-location averages of profit rate plus the covariates in (1); (v) instrument vector consists of the variables *university, experience, foreign, distance, age, cost of security per employee* plus the covariates in (2); (vi) λ is the inverse Mills ratio to adjust for selectivity with selection equation $P(e_i=1)=\Phi(c, employment, formal)$; (vii) Wald is the Wald-test statistic for testing if the coefficients on the π, k, l, αk are zero with p-values in parenthesis. (viii) Hausman is the TR^2-test statistic for no overidentifying restrictions, with p-values in parenthesis.

Table 10: Effects on corruption of changes in firm characteristics

Equation	(1)[i] *Change in bribe payment USD (st.d.) due to a one standard deviation increase in*	(2)[ii] *Change in bribe payment due to a one percent increase in [%]*
Resale value per employee	25.5 (0.19)	
Profit per employee	104.2 (0.76)	
Reversibility index	-42.1 (-0.31)	
Resale value		0.218
Profits		0.152
Reversibility index		-0.118
Employment		0.632

Note: (i) Calculations based on Regression 1; Table 9, with standard deviations in parenthesis. (ii) Calculations based on Regression 1; Table 7. The elasticity of corruption with respect to changes in profit is γ_π*[2.8E5/(2.8E5+1E7)] where 2.8E5 is mean profit and 1E7 is the scale factor, the elasticity of corruption with respect to capital is γ_α*ln(2+.011)+γ_k where .011 is the median value of the reversibility index and 2 is the scale factor, the elasticity of corruption with respect to the reversibility index is γ_α*ln(3.5E5)*[.011/(2+.011)] where 3.5E5 is mean capital stock.

Figure 5a: The technology effect

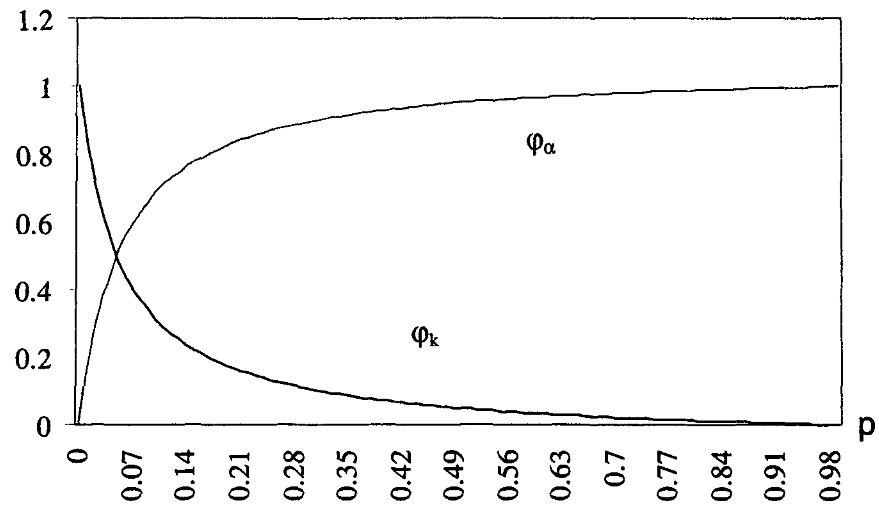
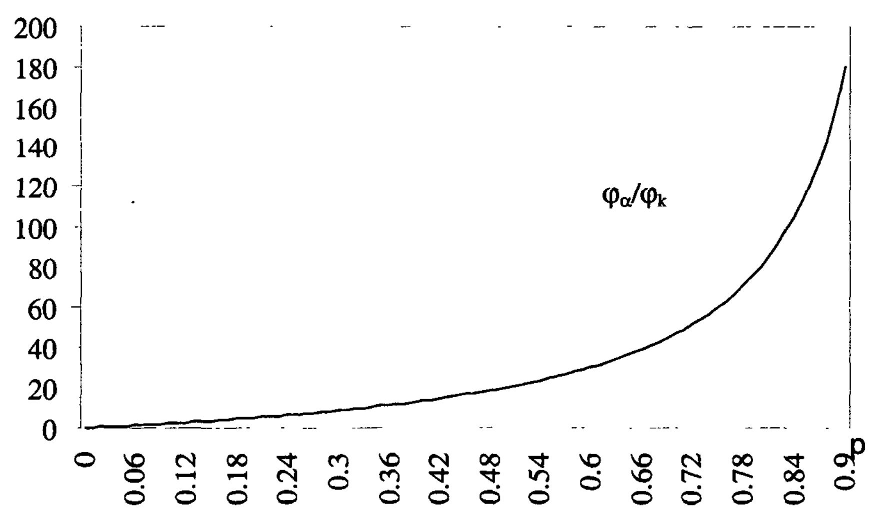


Figure 5b: The technology effect



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