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WHO MUST PAY BRIBES AND HOW MUCH? EVIDENCE FROM A CROSS-SECTION OF FIRMS

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Who Must Pay Bribes and How Much?

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Abstract

This paper uses a unique data set on corruption containing quantitative information on bribe payments of Ugandan firms. The data has two striking features: not all firms report that they need to pay bribes and there is considerable variation in reported graft across firms facing similar institutions/policies. To explain these patterns we develop a simple bargaining model. Consistent with the model, we find that the incidence of corruption can be explained by the variation in policies/regulations across industries. How much must bribe-paying firms pay? Combining the quantitative data on corruption with detailed financial information from the surveyed firms, we show that firms' "ability to pay" and firms' "refusal power" can explain a large part of the variation in bribes across graft-reporting firms. These results suggest that public officials act as price (bribe) discriminators, and that prices of public services are partly determined in order to extract bribes.

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1. Introduction

With few exceptions, research on the determinants of corruption has three common features.[1] It is based on cross-country analyses, it exploits data on corruption derived from perception indices, typically constructed from foreign experts' assessments of overall corruption in a country, and it explains corruption as a function of countries' policy-institutional environment.[2] These features are interlinked. The use of cross-country data naturally lends itself to study macro-determinants of corruption (and vice versa), and given the difficulties (and costs) of collecting quantitative data on corruption, the use of perception data makes it feasible to study a large cross-section of countries.

While the literature has provided important insights on the aggregate determinants of corruption, it also has its drawbacks. First, the use of perception indices raises concern about perception biases. Second, due to the aggregate nature of the data, it tells us little about the relationship between corruption and individual agents (i.e., an aggregation problem). Most importantly, macro determinants cannot, by definition, explain the within-country variation in corruption. Specifically, firms facing similar institutions and policies may still end up paying different amounts in bribes (for the same set of services received).

This paper avoids these problems by using a unique data set on corruption containing quantitative information on bribe payments of Ugandan firms. We ask two questions: who must pay bribes and how much? As in the cross-country work, we refer to the variation in policies/regulations (but across industries) to answer the question of the incidence of corruption. We find that firms typically have to pay bribes when dealing with public officials whose actions directly affect the firms' business operations. Such dealings cannot be easily avoided when, for example, exporting, importing, or requiring public infrastructure services.[3]

[1] A (incomplete) list of contributions include Mauro [1995], Ades and Di Tella [1997, 1999], Persson et al. [2000], Svensson [2000], and Treisman [2000]. For recent surveys of the literature on corruption, see Bardhan [1997].

[2] Kaufmann and Wei [1998] also use firm-level data (based on the Global Competitiveness Report index) to assess the validation of the "grease argument", but the data is perception based and derived from questions referring to country characteristics. Ades and Di Tella [1999] utilize the same source but use country averages. Hellman et al. [2000a,b] also use firm-level data. The data is numerical but ordinal (based on multi-category responses to questions on corruption). In line with the cross-country literature, they explain corruption as a function of the political-institutional environment. Di Tella and Schargrodsky [2000] use quantitative micro data (from hospitals) to study the relationship between corruption, wages and audits.

[3] While being a novel result in terms of firm-level data, the finding that firms more exposed to foreign trade are more likely to pay bribes squares nicely with the theoretical literature on rent-seeking and trade (see for example Krueger, 1974, and Bhagwati, 1982), as well as the recent cross-country literature on openness and corruption (see Ades and Di Tella, 1999). Wade's

How much must graft-paying firms pay? To answer this question, we develop a simple bargaining model in which firms, if forced to pay bribes in order to continue their operations, bargain about the amount with a rent-maximizing public official.[4] The group of graft-paying firms face the same set of rules and regulations, but they differ in profitability and choice of technology. These firm characteristics determine a firm's ability to pay bribes and the cost of reallocating its business elsewhere so as to avoid this; i.e., the value of a firm's outside option. We combine the quantitative data on corruption with detailed financial information from the surveyed firms to test this bargaining hypothesis and find that firms' "ability to pay", proxied with their current and expected future profitability, and firms' "refusal power", measured by the estimated alternative return on capital, can explain a large part of the variation in bribes across graft-reporting firms. The results are statistically robust and remain intact when instrumenting for profits. These findings suggest that public officials act as price (bribe) discriminators, and that the prices of public services are determined in a bargaining process where firms' outside options matter.

Modern research on the economics of corruption began with Rose-Ackerman [1975, 1978]. Despite more than two decades of research, however, 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 the extraction of bribes, they fail to internalize the effect of their demands for bribes on other officials' income, thereby leading to very high corruption levels. 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

(1982) account of corruption in the public canal irrigation system in India is also consistent with our finding on the incidence of corruption and public service provision.

[4]The model rests on two assumptions. First, public officials are expected profit maximizers, subject to the constraints that the firm might exit and that the official might get caught and punished. Second, by exiting firms can avoid paying bribes. Both assumptions are consistent with 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 in many Sub-Saharan African countries, 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 (see also Wade, 1982, for a detailed description of how illicit revenue from the distribution of water and contracts in India are aggregated and channeled up the bureaucratic and political 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.

the most inefficient firms out of business, thereby 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. The bargaining hypothesis we propose builds on this body of work, although it differs in one key aspect: firms' ability to pay bribes or their power to avoid them differ in observable ways, so that public officials make different bribe demands across firms.

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 concludes.

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

The Uganda firm-level survey was designed to be representative of the population of firms in five main industrial categories. In such a data set, why would one expect to find some firms that need to pay bribes while others do not?

Consider an economy consisting of a large number of firms. Each firm is in the territory of one public official. The official is assumed to be an expected profit-maximizer. 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.

Public officials have discretionary power within the given regulatory system to customize the nature and amount of harassment on firms to extract bribes. The extent to which bribes can be collected depends on officials' "control rights" over firms' business operations. We consider only private firms so by control rights we mean the extent to which public officials can constrain firms' business decisions and influence their cash flows. These indirect control rights stem from the existing regulatory system and the discretion public officials have in implementing, executing, and enforcing rules and benefits that affect firms, such as business regulations, licensing requirements, permissions, taxes, exemptions, and public-goods provision.[5]

Bureaucrats' degree of control rights differ across sector and location. To simplify, we assume there are two sectors, $j = \{a, b\}$, which differ with respect to bureaucratic control. Specifically, firms in sector a must pay if bribes are

[5]As in Shleifer and Vishny [1994] the degree of control rights determines 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 public officials have high control rights, the firm must either pay the bribe or exit.

demanded, or exit, while firms in sector b have enough leverage to avoid paying bribes without any significant impact on their business operations.

A public official dealing with a firm in sector a 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 let the personal cost m differ across individuals. The distribution of m is assumed to be uniform over $[0, \bar{m}]$ and is known to all players.

At time 0 public officials choose what sector to work in. The wage rate is normalized to zero. Sector a employs a share α of the total number of public servants. A bureaucrat who is indifferent between what sector to work in will be randomly selected into a sector with openings.

The equilibrium allocation of public officials 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 a, while all civil servants with personal cost $m > \delta^{-1}$ will be randomly allocated to the remaining openings. Thus, bureaucrats more prone to demand bribes will choose to work in agencies that have discretionary power over firms.[6] We assume $\alpha > (\bar{m}\delta)^{-1}$, implying that not all public officials in sector a are corrupt.

Public officials are randomly matched (within each sector) with firms in each period. The probability that a randomly drawn firm i must pay bribes, denoted by $p(i)$, is then simply

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

where $\rho = (\alpha\delta\bar{m})^{-1}$ is the probability that a randomly picked bureaucrat in sector a will ask for bribes and $\sigma(i \in a)$ is the probability that firm i is active in sector a.[7]

Firms' 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

[6] This endogenous response to differences in control rights is consistent empirical evidence on corruption in the public sector (see for example Wade, 1982, and World Bank, 1998a).

[7] ρ can be determined by noting that the density function of m in sector a is the truncated $u[0, \bar{m}]$, i.e.,

$$\hat{u} = \frac{\bar{m}^{-1}}{\Pr[m \leq \alpha\bar{m}]} = \frac{1}{\alpha\bar{m}}$$

skill factor η_i (knowledge) of production in sector a. 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. Thus, $(1-\alpha_i)k_i$ is the reallocation cost of moving from sector a to sector b. At time 0 each firm faces the choice of either investing in sector a or in sector b. Due to indivisibilities of capital, the firm must decide to invest in only one sector.

The firms produce two 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 $x_{i1} = f(k_i, l_i; \eta_i)$ and $x_{i2} = f(k_i, l_i)$, where $f_\eta(\cdot) > 0$ 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; i.e., 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 a can then be written as a function of the observable inputs k and l,

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

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, $\theta_t f_l(k, l; \eta) - w = 0$. Period t profits in sector b are defined analogously.

If a firm invests in sector a and faces a corrupt bureaucrat, the firm must either pay the required bribe or exit the sector. Exit constitutes an optimal response if the expected loss of exiting (foregone net profits today and next period) is lower than the expected gain (alternative return on reversible capital next period). That is,

$$\pi(k, \theta_t, \cdot \,|\, a) - g(\theta_t) + E_t\beta\left[\pi(k, \theta_{t+1}, \cdot \,|\, a) - pg(\theta_{t+1})\right] \leq \beta\pi(\alpha k, \cdot \,|\, b), \qquad (2.2)$$

where E_t is the expectation operator conditional on information at time t and $g(\theta_t)$ is graft in period t as a function of θ_t. In (2.2), the first two terms are current net profit when facing a corrupt official. The third expression is expected discounted next period profits. In period $t+1$ the firm makes expected profit $E_t\pi(k, \theta_{t+1}, \cdot \,|\, a)$, and with a probability p faces a corrupt official and must also pay bribes. The term on the right side of the exit constraint (2.2) is the discounted profit the firm would make if it sold and reinvested its partly sunk capital in sector b the first period.

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and corresponding distribution function $\hat{U}(x) = \dfrac{x}{\alpha\bar{m}}$. Hence,

$$\Pr[m \leq \delta^{-1}] = \hat{U}(\delta^{-1}) = (\alpha\delta\bar{m})^{-1} \ .$$

Firms cannot borrow to pay bribes, so in each period the firms' realized cash flow must be non–negative; that is,[8]

$$\pi(k, \theta_t, \cdot|\, a) - g(\theta_t) \geq 0, \quad \text{for all } t. \tag{2.3}$$

We can now determine the equilibrium graft by solving for the recursive equilibrium. Assume (2.3) holds (a sufficient condition is stated below). The corrupt bureaucrat will demand a bribe payment so as (2.2) just binds. Rewriting (2.2) yields,

$$g(\theta_t) = \pi(\theta_t, \cdot|\, a) + E_t\beta\left[\pi(\theta_{t+1}, \cdot|\, a) - pg(\theta_{t+1})\right] - \beta\pi(\alpha k, \cdot|\, b). \tag{2.4}$$

Equation (2.4) gives a mapping from the space of possible $g(\theta)$ into itself: a given $g(\theta)$ implies expected $t+1$ net profits, which in turn implies a new $g(\theta)$ from (2.4). The fixed point of this mapping is,

$$g_i^*(\theta_t) = \pi(k, \theta_t, \cdot|\, a) + \frac{(1-p)\beta}{1+\beta p} E_t\pi(k, l^i, \theta_{t+1}, \cdot|\, a) - \frac{\beta}{1+\beta p}\pi(\alpha k, \cdot|\, b)\ . \tag{2.5}$$

Equation (2.5) suggests that the amount of bribes a firm needs to pay depends positively on current and expected future profits, and negatively on the alternative return to capital, $\pi(\alpha k)$. Having a technology with a 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.

Note that $g(\theta_t)$ is a negative function of p. That is, the lower the probability that bureaucrats in sector a demand bribes, the higher the equilibrium graft when matched with a corrupt official. Expected graft, however, is a positive function of p.

From (2.5) it is straightforward to determine under what conditions the borrowing constraint (2.3) holds. Specifically, equation (2.3) holds if

$$1 - \frac{\pi(\alpha k, \cdot|\, b)}{E_t\pi(k, l^i, \theta_{t+1}, \cdot|\, a)} \leq p\ . \tag{2.6}$$

Thus, if p is sufficiently high, $g^*(\theta_t)$ is always less than current gross profits.

3. Extensions and implications

Before proceeding to estimate equations (2.1) and (2.5) it is useful to consider relaxing some of the simplifying assumptions in the model. This is important not

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

only to show to that the model's qualitative results are robust to alterations, but also to better understand the empirical findings presented below.

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. In an earlier version of this paper, we show that incomplete information will create informational rents that firms can capture. Thus, the linear relationship between profits and grafts identified in equation (2.5) will only be an approximation.

In the model, each firm is in the territory of one official. 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 might increase the firm's bargaining power and thus reduce the equilibrium graft, but would not change the qualitative relationship between ability to pay and equilibrium graft.[9]

We have taken the technology choice (α_i) as given. Allowing the firm to choose what capital goods to purchase complicates the picture since low sunk costs imply that the cost of exiting becomes smaller and, from equation (2.5), lower grafts when matched with a corrupt official.[10] 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 1, 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 p. For the empirical work, it should be noted that the "technology-effect" would tend to mask the negative relationship between reallocation costs and corruption, and thus work against us.

There is no feedback from corruption to equilibrium profits in the model, although in reality this might be important. However, our more restrictive set-up is an accurate first approximation. Most firms in the sample are small (median firm has 34 employee). Causal empiricism suggests that in general and in Uganda in particular, the regulatory process is not captured by these types of firms but a small set of large, politically powerful enterprises. Moreover, 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. In addition, 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

[9] 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).

[10] The technology choice in a model of repeated rent extortion is studied in detail in Choi and Thum, 1999.

issue of determining the differences in bribe demands across firms. Finally, for the reverse causation argument to bias the results it must be the case that the size of the government favor (and the resulting gain for the firm) is linked to the amount paid in bribes. Our identifying assumption (relaxed in the robustness section 6.B.) is that the price of a government favor is determined by the firm's ability to pay.

4. Data

The data used in the paper is from the 1998 Ugandan enterprise survey (see Reinikka and Svensson, 2001a, for details). The survey, carried out during January-June 1998, was initiated by the World Bank and the Uganda Private Sector Foundation. Its primary goal was to collect data on constraints facing private enterprises in Uganda.[11]

The sampling frame was based on an industrial census from 1996 and was confined to five general industrial categories (commercial agriculture, agro-processing, light manufacturing, construction, and tourism).[12] These five sectors employ 80 percent of the total labor force in the industrial sector. The sample size was 250 establishments (out of 1282 enterprises in the census in the five industrial categories). 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). 70 percent of total employment is confined to these regions. Three general criteria governed the choice of procedure in selecting the sample from the eligible establishments. First, the sample should be 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

[11] The motivation for the survey was to examine the extent to which liberalizations and the profound macroeconomic and structural reforms implemented in the 1980s and the 1990s translated into higher private investment and growth, and to identify what key factors constrained private sector expansion. The survey data have been used to examine a wide variety of issues, including evaluating the effects of trade liberalization on firm productivity (Gauthier, 2001); assessment of the bad news principle (Svensson, 2000b); studying the effects of, and coping with, poor public service provision (Reinikka and Svensson, 2001b).

[12] The five sectors could be further classified into 14 three-digit ISIC-categories.

was chosen using employment shares as weights (Reinikka and Svensson, 2001).

The empirical strategy used to collect information on bribe payments across firms in Uganda featured the following seven components.

- An employers' association (Ugandan Manufacturers' Association) carried out the survey. In Uganda, as in many other countries, people have a deep-rooted distrust of the public sector. To avoid suspicion of the overall objective of the data collection effort, the survey was done by a body in which firms had confidence. The co-operation with the main private sector organizations had the additional advantage that most entrepreneurs felt obliged to participate in the survey.

- Questions on corruption were phrased indirectly 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?".

- Corruption-related questions were asked at the end of the interview, by which time the enumerator presumably had established credibility and trust.

- Multiple questions on corruption were asked in different sections of the questionnaire.[13]

- Each firm was typically visited at least twice by one or two enumerators (to accommodate the manager's time schedule).

- Survey experts trained the enumerators.

- Corruption related questions (and the whole survey instrument) were carefully piloted and built on existing surveys on regulatory constraints.

The data collection effort was also aided by the fact that the issue of corruption has partly been desensitized in Uganda. The past few years have seen several awareness-raising campaigns on the subject and nowadays the media regularly reports on corruption cases.[14]

[13]The survey instrument had roughly 150 questions (500 entries), and about 10 were related to corruption.

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

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 the 243 sampled. Summary statistics are reported in Apppendix 3. 27 of the 67 firms that did not respond to the main corruption question also declined to answer other sensitive questions; for example about cost, sales, and investment, while the remaining 40 firms specifically declined to answer the main question on corruption. The missing bribery data raises concern about possible selection bias. Although we do not have information on why some firms did not volunteer how much they pay in bribes (if any), we can check if the groups of responders and non-responders differ on observables. In Appendix 4, we report a set of regressions using observable firm characteristics such as firm size, profit, a measure of the capital stock, and total investment (all variables are defined in the appendix) as dependent variables. The regressor is a dummy variable taking the value 1 if a firm has missing data on corruption. As is evident, the group of firms missing information on corruption (67 firms), reported in column 1, and the group of firms only missing information on corruption (40 firms), column 2, do not differ significantly in observables (size, profit, and investment) from the group of graft-reporting firms. Thus, there is no (observable) evidence suggesting that the sample of 176 firms is not representative.[15]

Reported bribe payments (*graft*) is the main corruption variable used in the paper. However, the survey contained information on other variables (e.g., cost data on the provision of public services) that can reveal evidence of corruption. The respondents were asked for the total cost (including informal payments) of acquiring a connection to the public grid and acquiring a telephone line. As discussed in Svensson (2001), controlling for location, firms should pay the same amount to acquire these services. Thus, deviations from the given price typically reflect graft. The partial correlation (controlling for location) between connection costs and bribes is 0.67, and the correlation between excess price of telephone connections and reported bribe payments is 0.41. Thus, reported bribe payment is highly correlated with other corruption-related variables derived from the survey data. The consistent findings across measures significantly enhance the reliability of the bribe data.

[15]Although the groups of firms do not differ in observables (profit, capital etc.), the non-respondents may still differ in some unobserved dimension. They may have something to hide (thereby inducing a downward bias on the incidence number), or a non-response may simply be a "0" (thereby inducing a upward bias on the incidence number).

5. Specification

Equations (2.1) and (2.5) provide a simple 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 a vector of unobservable variables $\boldsymbol{\rho} = [\alpha \ \ \delta \ \ \bar{m}]$. To estimate (2.1), we replace the vector $\boldsymbol{\rho}$ with a random variable ν. Thus

$$p_i = \boldsymbol{\chi}'\mathbf{w}_i + \nu_i \ , \tag{5.1}$$

where $\mathbf{w}_i$ is a vector of sector and location specific variables. Since p_i is not observed the incidence equation is reformulated as a probit model,

$$\Pr(e_i = 1) = \Phi(\boldsymbol{\chi}'\mathbf{w}_i) \tag{5.2}$$

where $e_i = 1$ $[e_i = 0]$ is the event that a firm [does not] faces a corrupt bureaucrat and must pay bribes and Φ is the standard normal distribution function.

To estimate the graft level equation (2.5), we replace the unobserved $E\pi(k, l, \cdot)$ with current stock of capital (k) and labor (l) plus a forecast/measurement error ε, and the unobserved $\pi(\alpha k, \cdot)$ with a proxy of αk plus a measurement error ξ. The resulting specification is

$$g_i = \gamma_0 + \gamma_\pi \pi_i + \gamma_k k_i + \gamma_l l_i + \gamma_{\alpha k} \alpha_i k_i + \mu_i, \qquad g_i > 0 \tag{5.3}$$

where γ_0, γ_π, γ_k, γ_l, $\gamma_{\alpha k}$ are coefficients and $\mu_i = \varepsilon_i + \xi_i$. Let the vector characterizing the firm's bargaining position be denoted by $\mathbf{z} = \{\pi_i, k_i, l_i, \alpha_i k_i\}$. According to the model γ_π, γ_k, $\gamma_l > 0$ and $\gamma_{\alpha k} < 0$. That is, higher current or expected future profits or a lower alternative return on installed capital will force a firm to pay higher bribes when matched with a corrupt official.

In order to estimate equation (2.5), we need data on π_i, k_i, l_i, and α_i. 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*); i.e., 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 U.S. dollars.

We estimate the sunk cost component, α, using data on reported capital stock values. Apart from resale values, the firms also reported how much it would cost to replace all machinery and equipment with similar new assets; i.e., the "replace value". The ratio of resale to replace values captures capital mobility, and the extent of physical depreciation; e.g., the older the capital stock, the less productive it is and the lower the resale/replace ratio. α is closely related to the former. To capture capital mobility, we regress the ratio of resale to replace values on the average age of the capital stock and a constant. Our proxy of α is the residual from this regression. The residual (α) captures the part of the divergence between the resale and replacement values of capital that is independent of age (i.e., physical depreciation); i.e., it gives us a measure of to what extent the capital stock is sunk. A negative value indicates that the capital stock is irreversible.[16]

As a starting point, we estimate the two equations (5.2) and (5.3) separately. If the error terms are uncorrelated, this will yield consistent estimates. We later allow the errors to be correlated.

The model suggests that there are two processes, captured by the vectors $\mathbf{w}_i$ and $\mathbf{z}_i$, that drive the incidence and level of bribes across firms. In discussing the conceptual framework, we have treated these processes independently, suggesting a unique set of variables determining the incidence of graft and another (unique) set of variables affecting the magnitude. However, in reality it is possible that the factors determining the likelihood of paying bribes also influence the magnitude of the bribes and vice versa. Therefore, in the baseline specification, we include both vectors ($\mathbf{w}$ and $\mathbf{z}$) of controls.

6. Results

A. Basic findings

Who must pay bribes? 33 (19%) of the 176 firms that replied to the question on graft reported that they did not have to pay bribes, while 143 (81%) reported that they did.[17] Table 1a reports a series of probit regressions, corresponding to equation (5.2). The first three columns depict the partial effects of the control rights measures. In line with the control rights hypothesis, firms receiving public services (*infrastructure services*), firms engaged in trade (*trade*), and firms paying more types of taxes (*pay tax*), face a higher probability of having to pay bribes.[18]

In Regression 4, *infrastructure services*, *trade*, and *pay tax* are entered jointly. The resulting multicollinearity problem masks the individual effects (by increasing

[16] Ramey and Shapiro [2001] derive a similar measure to estimate the cost of reallocation of capital across firms and sectors. They estimate an average discount value on capital using equipment-level data from aerospace auctions and show that the discount is a function of the specificity of capital and the thinness of resale markets.

[17] 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". This does not seem to be the case. 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.

[18] The result holds both when trade is measured as share of export (*export*) and as a dummy variable taking the value 1 if the firm either exports or imports or both and zero otherwise (*trade*).

the standard errors of the coefficients), although they are jointly significant.[19,20] To overcome the multicollinearity problem the three variables are combined into a "formal sector index" by principal components analysis. The composite variable *formal sector* is the first principal component. Regression 5 depicts the results with *formal sector* as explanatory variable. As evident, the *formal sector* enters significantly and with the predicted sign. The probit regression is illustrated in Figure 1. A firm with extensive dealings with the public sector is more likely to be under bureaucratic control and (therefore) faces a higher probability of having to pay bribes.

The baseline regression with *formal sector* and the **z**-variables as regressors is reported in Table 1b, Regression 6. There are three main findings. First, *formal sector* enters significantly positive. Second, there is no evidence that the firm's profitability or alternative return on capital influences the likelihood of having to pay bribes. The **z**-variables are both individually and jointly insignificant. Thus, even firms with low profits will be forced to pay bribes (but possibly small ones) if officials have control rights over the firms' business. This result highlights an important empirical finding: firms reporting zero graft and firms reporting positive graft do not, as a group, differ significantly in profit or alternative return (see Appendix 3). Finally, larger firms also appear to be more likely to have to pay bribes, but the estimates are not significant.[21]

Additional support for the control rights hypothesis is found by studying the relationship between the incidence of corruption and two direct measures of dealings with the public sector. As shown in Appendix 5, senior management in firms reporting that they had to pay bribes spend significantly more time dealing with government regulations (*regulation*) and have significantly higher costs for accountants and specialized service providers to deal with regulations and taxes (*accountant*). At the same time, while the two groups differ in the amount of contacts with the public sector, they are similar with respect to other observables (apart from π, k, αk). For instance, the cost of security (*security*) and the incidence of robbery and theft (*robbery*) do not differ across groups. These results suggest that while being in sectors where public officials have few control rights insulates the firm from public corruption, it is not protected from other sources of discretionary redistribution, such as theft.

We next turn to an explicit examination of the amount of bribes paid. For the

[19]The correlation between *pay tax* and *trade* is 0.56, the correlation between *pay tax* and *infrastructure services* is 0.51 and the correlation between *trade* and *infrastructure services* is 0.35.

[20]The likelihood-ratio test statistic for the H_0 that the coefficients on *pay tax, trade*, and *infrastructure services* are zero is 6.64, with a p-value of 0.084.

[21]If three outliers (i.e., firms with two standard-deviations more employees in the subsample) are dropped from the sample of non-bribing firms, the difference is significant.

firms that reported positive bribes, the average amount of corrupt payments was about US$ 8,300 (in 1997), with a median payment of US$ 1,800. These are large amounts, corresponding, on average, to US$ 88 per worker, or roughly 8 percent of total costs.[22]The distribution of bribes is depicted in Figure 2a and 2b.

Table 2 (Regression 1) reports the base specification. There are two main findings. First, consistent with the bargaining hypothesis, the **z**-variables enter significantly and with the expected signs. Reported graft is positively correlated with current and expected future profits, the latter proxied by k and l. Firms with refusal power; i.e., with a higher alternative return to capital, pay less bribes.[23] Second, the formal sector index has no explanatory power, thereby suggesting that while officials' control rights play a role in separating firms that must pay bribes from those that do not, the "degree of formality" is of no importance once the firm has been matched with a corrupt bureaucrat with the power to extract bribes.

There are two apparent outliers in the sample.[24] Regression 2 displays the same regression once these outliers have been dropped. The fit of the regression improves and the standard errors of all bargaining measures are reduced.

Summarizing the basic findings on the magnitude of graft, the more a firm can pay; i.e., the higher are its current and expected future profits, the more it must pay. The more profitable is the outside option for the firm, the less it must pay. In the following, we show that these qualitative results are robust.

B. Robustness

One concern with the results reported above is that other variables confounded with the formal sector index, profit and/or the alternative return on capital might influence the amount firms need to pay. In Table 1b, columns 7-9, and Table 2, columns 3-6, the base specification is augmented with additional controls. Regression 7 (Table 1b) and Regression 3 (Table 2) add a measure 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

[22]For comparison, the cost of fuel (which is heavily taxed) constituted on average 6.2 percent of total costs, wages constituted on average 17.9 percent.

[23]Note that although the sunk cost component is a generated regressor, the least square estimator is a consistent estimator of the true standard error of the coefficient on αk since α is a residual generated regressor (Pagan [1984]). To the extent that αk is measured with errors, $\alpha k + \epsilon$, (due to measurement errors in reported resale and replace values), the coefficient will be biased toward zero, and thus the reported coefficient is likely to provide a lower bound (in absolute terms) of the effect of αk on g.

[24]One firm reported (negative) profits 6 standard deviations below the second lowest profit value in the sample (and 7 standard deviations below the mean), and one firm reported bribe payments 9 standard deviations above the second highest value in the sample (8 standard deviations above the mean). We suspect that the outliers are due to reporting errors.

a way of reducing the returns from corrupt activities (see Rose-Ackerman [1999]). However, the competition measure adds no new information.

Regression 8 (Table 1b) and Regression 4 (Table 2) add two variables capturing firms' incentives to pay bribes: a dummy variable taking the value 1 if the firm sells part of its output to the government (*sell to government*), and an index of tax exemptions (*exemptions*). Since data on these variables is missing for some firms, we lose roughly 10 percent of the observations. In the incidence equation, *exemptions* enter significantly positive, a result consistent with the control rights hypothesis. Taxes (one component of the formal sector index) and tax exemptions are two means of regulating firms and firms appear not to be able to avoid paying bribes if such dealings are required. In the regression equation (Table 2), neither *sell to government* nor *exemptions* have any explanatory power, while the current and expected future profits and the alternative return to capital remain highly significant. By itself, this result does not exclude the possibility that firms are bribing public officials for contracts and exemptions, but it suggests that the "prices" of such favors are functions of firms' abilities to pay or their power to refuse.

We experimented with several other controls, including industrial category dummies, reported in Regression 9 (Table 1b) and Regression 5 (Table 2), regional dummies, and market share. None of these variables had any significant effect. The fact that industry is of no importance in the incidence regression may seem surprising. However, it points to a common phenomena in many poor developing countries. Sectoral classifications are less important than how firms actually organize production. Most types of goods/services (and especially goods in the categories included in the survey) are produced in both the formal and the less formal sector. It is this choice of production strategy that determines the likelihood of paying bribes, not the type of good the firm is producing.

In Regression 6, Table 2, we add the sunk cost proxy to check if the restricted specification reported in columns (1)-(5) is valid. The sunk cost proxy is insignificant and all other results are unchanged, thereby providing support for the specification derived from the model.

Another objection to the results reported in Table 2 is that they are driven by spurious correlation (all variables are correlated with size). Simply controlling for size in the regression may not overcome the problem. To check that the results are not influenced by a size-effect, we reestimated the model in rates by scaling all variables with employment size. The results are depicited in Regression 1, Table 3. 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 per employee remains significantly negatively correlated with the bribe rate.

Yet another concern is sample selection bias. In fact, it is straightforward to interpret the empirical model (5.2) and (5.3) as a standard selection model.[25] If the error terms in (5.2) and (5.3) are correlated, least-squares applied to (5.3) will yield biased results. The selection model can be estimated with maximum likelihood to yield information on both the incidence and the level of graft across firms.[26] Although the model can be identified on the basis of the (arbitrary) distributional assumption, we choose to identify the effects by restricting the incidence of graft to be a function of (only) the control rights variables ($\mathbf{w}$). Table 2 provides the empirical support for this exclusion restriction. In Table 3, column 2, we report the estimates of the regression equation.[27] The proxies for firms' current and future profitability and firms' refusal power ($\mathbf{z}$) remain significant, while *formal sector* enters insignificantly. Interestingly, we cannot reject the null hypothesis that ρ is zero, which explains why the estimates in Regression 2 are similar to the least-squares estimates reported in Regression 1.

Up until now, we have treated the technology choice (α_i) and profit (π_i) as given. However in reality, the choice of α_i may be related to expected graft and there might be a feedback from corruption to equilibrium profits.

As discussed in section 3, in the bargaining framework, low sunk costs imply that the cost of exiting becomes smaller and thus lower graft when matched with a corrupt official. Expecting high bribe demands, a firm might find it profitable to choose a "technology" yielding higher per-period operation costs and thus lower profits, but indirectly reduces the amount of bribes the firm needs to pay. This "technology-effect" would tend to mask the relationship between the alternative return, profit, and corruption, and thus would work against us. That is, a positive graft shock (ε_i) may lead the manager to choose a more reversible capital stock, even though this would reduce per-period profits, thereby biasing the coefficients on π and αk toward zero.

How would the results change if we allowed a feedback, either directly or indirectly, from corruption to profits? The rent-seeking and regulatory capture approach also predicts a positive relationship between profits and corruption. Their 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. The extortion model of Bliss and

[25] As in the standard selection model, we assume that ν and ε are distributed bivariate normal with means zero and correlation ρ.

[26] Alternatively, the model can be estimated by a two-step procedure (see Heckman [1979]) where (5.2) is estimated by probit and (5.3) with least squares, using estimates of the inverse Mills ratio from the first stage to adjust for sample selection bias.

[27] If we estimate the models in levels, with employment as additional control, the results are similar to those reported in Table 3.

Di Tella [1997] also suggests a positive association between bribes and profits. The interpretation, however, is different: profitable firms are forced to pay higher bribes but one reason why they are profitable in the first place is that other potential competitors have been driven out of the market.

Not allowing a feedback from corruption to profit is, we believe, a reasonable first approximation. Most firms in the sample are small. Causal empiricism suggests that the regulatory process is not captured by these types of firms but by a set of large, politically powerful enterprises. Moreover, advanced dynamic graft-schemes that intend to maximize revenue by implicitly controlling entry and exit are likely not to work, given the inherent uncertainty of tenure for those in government posts (see Thomas [1999]). Finally, for the reverse causation argument to bias the results, it must be the case that the size of the government favor (and the resulting gain for the firm) is linked to the amount paid in bribes. Our identifying assumption is that the price of a government favor is determined by the firm's ability to pay and its power to refuse.

Despite these arguments, treating profit as exogenous is questionable. As a robustness test, we therefore experimented with instrumenting for profits, using two sets of instruments. The first set consists of firm-specific variables which we argue to be uncorrelated with both the error term in (5.3) and reported bribes, but correlated with firms' 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 previous experience from working abroad (*experience*); age of the firm (*age*); and a measure of foreign ownership (*foreign*). In a large panel of firms from five African countries, Reinikka and Svensson [2001] show that foreign ownership, age, and experience explain a large part of the variation of profits across firms. We also include the cost of security per employee (*cost of security per employee*). As discussed in Collier and Gunning [1999], risk arising from crime is an important determinant of the performance of African enterprises. The cost of security is one proxy of the cost of risk management.

We also experimented with a different set of instruments; i.e., industry-location averages of profits. 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 determining their profitability. Furthermore, we know that the industrial and regional dummies are uncorrelated with the reported level of bribe payments.

Regressions 3 and 4 report the results using instrument variables techniques. All variables continue to enter significantly. The coefficients on the profit rate are, in fact, even larger than those reported in column 1, a finding consistent with the claim that there is a "technology bias" in the non-instrumented results.

However, it is also consistent with the claim that the non-instrumented results suffer from an attenuation bias due to measurement errors in the profit term.[28] The instruments perform well. The partial R^2 (netting out the common variables) in the first-stage regression is 0.05, implying that more than half of the explained variation in the profit rate is picked up by the vector of firm-specific instruments. Moreover, we cannot reject the null hypothesis of the validity of the instruments; that is, we find no evidence that the instruments for π/l belong in the corruption regression. The results using industry-location averages as instrument are similar.

Despite the IV-results, it should be stressed that some firms may still benefit (and possibly a lot) from corruption. What this type of econometric work identifies is what is true on average, and on average the data suggest that the level and rate of grafts are influenced by the firms' abilities to pay. This result is also consistent with other preliminary work on the Uganda data set. Fisman and Svensson (2000) 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 (2001), studying the cost of obtaining connection to public services, finds that there is no significant statistical 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.

We have shown the results to be statistically robust. The estimated relationships are also economically important. In Table 4, we have calculated the effects on corruption (bribe payment) of a one standard deviation increase in the explanatory variables. The calculations show that, for example, a one-standard deviation increase in profits is associated with US$ 113 in additional bribe payments per employee (equal to a 0.82 standard deviation), while a one-standard deviation reduction in the sunk cost component, α, implies a reduction in bribes of around one-third standard deviation.[29]

7. 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

[28]Due to the lack of valid instruments we cannot also instrument for the capital stock and the alternative return. Estimating a reduced form version of Regression 4, excluding $\bar{k}$ and $\alpha\bar{k}$, gives results (for *profit*) similar to those reported above.

[29]Based on the coefficients reported in Table 3, column 3, and the sample of 117 firms.

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 a unique data set with cardinal measures of corruption and detailed financial information of surveyed firms to analyze the causes and consequences of corruption at the firm level. Despite our data collection strategy, however, cases of misreporting are likely to remain in the sample. For this reason, the paper has not focused on the level or incidence of bribes per se, 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 explanatory variables.

A simple model of bureaucratic extortion provided the analytical framework for this investigation. In the model firms can choose in what sector to invest in and sector-specific characteristics determine the extent to which dealings with the public sector are required. If a firm is forced to pay bribes in order to continue operation, the equilibrium bribe is determined as the outcome of a bargaining process. The group of graft-paying firms face the same set of rules and regulations, but they differ in profitability and choice of technology. These firm characteristics determine the bargaining outcome. Consistent with the model, we find that the incidence of corruption can be explained by the variation in policies/regulations (across industries). Specifically, the extent of required dealings with the public sector determines the likelihood of having to pay bribes. The amount firms need to pay, on the other hand, can be explained by measures capturing firms' bargaining power vis-à-vis the public sector. The more a firm can pay the more it has to pay. The more profitable outside option a firm has the less it has to pay. These findings are consistent with the view that civil servants spend time learning about their "customers" and adapt their bribe requests accordingly. In other words, prices of public services are endogenously determined in order to extract bribes. While causality is difficult to prove, we have provided two pieces of evidence suggesting that the results are not driven by the reversed mechanism. First, the level of grafts is determined not only by the ability to pay (profitability), but also by firms outside options. Second, the results remain intact when instrumenting for profits.

Our starting point was the interaction between private firms and a rent-maximizing public sector (or public officials). We have been purposefully silent on the government's role. The simplest way of reconciling the government's passive actions with those of a rational agent would be to assume that also (parts of) the government derives benefits from the collection of bribes.[30] However, the

[30]In a case study of the political economy of corruption in Sub-Sahara Africa, Thomas [1999] argues that office holders can and do demand a share of the collected bribes (c.f. Wade's [1982]

fact that we observe self-motivated public officials and firms forced to pay bribes, does not necessarily imply that the government is not benevolent. As stressed by Banerjee [1999] and Acemoglu and Verdier [2000], corruption may be an inadvertent consequence of benevolent regulation. For example, if high profits are correlated with market power (or some other market failure), a benevolent social planner may employ a larger number of public officials to monitor the firms, even if she realizes that the officials will extort bribes from the firms they monitor. It is difficult to identify the government's preferences using firm-level data. However, available data does not support the constrained social planner hypothesis. If firm characteristics (say profit) are correlated with market failures and these, in turn, are correlated with the extent of regulation, and as a side effect corruption, we should observe a close relationship between the extent of regulations and firm attributes (π, k, αk). There is no evidence of that in the data. The striking feature of the data is that there is considerable variation in reported bribes for firms facing similar policies/regulations.

In the model, corruption has potentially two adverse consequences: it discourages investment in sector a and shifts production to sector b, and 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 (see Appendix 1). Evaluating the cost of corruption (and the mechanisms) using micro data, is an important agenda for future research.

These results have clear policy implications (see Svensson [2001]). If the bribe a firm needs to pay is an outcome of a bargaining process and given that corruption is not simply an inadvertent consequence of benevolent regulation, collective action 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. 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 the individual firms' ability to commit to non-bribery; and recognizing those who are doing a good work by resisting corruption, are examples of such measures.

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account of the distribution of water and contracts in India). These findings are consistent with Djankov et al.'s [2002] cross-country findings on the regulation of entry of start-up of firms.

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Appendix 1: The allocation and technology effects

A. 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 the allocation effect note that we assume that firms take into account the corrupt bureaucrats' behavior when choosing where to locate. Substituting (2.5) into the firm's value function yields,

$$V(k,\eta \mid a) = \sum_{t=1}^{\infty} \beta^{t-1} E_0 \left[\pi(k,\theta_t,\cdot \mid a) - pg_i^*(\theta_t) \right] =$$

$$\frac{(1-p)}{(1+\beta p)(1-\beta)} E_0 \pi(k,\theta_t,\cdot \mid a) + \frac{p\beta}{(1+\beta p)(1-\beta)} \pi(\alpha k,\cdot \mid b), \tag{7.1}$$

and

$$V(k \mid b) = \frac{1}{(1-\beta)} \pi(k,\cdot \mid b) \,. \tag{7.2}$$

A firm will invest in sector a provided that $V(k \mid a) \geq V(k \mid b)$. Since $V(k \mid a)$ is an increasing function of η, it follows that the share of entrepreneurs locating in sector a is $1 - G(\overline{\eta})$, where the cutoff value $\overline{\eta}$ is implicitly defined by equating (7.1) and (7.2).

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

$$\overline{\pi}(k;\underline{\eta} \mid a) - \pi(k,\cdot \mid b) = 0 \tag{7.3}$$

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

$$\frac{d\underline{\eta}}{d\alpha} < 0, \qquad \frac{d\underline{\eta}}{d\rho} > 0 \tag{7.4}$$

A less reversible capital stock raises the firm's potential loss of exiting sector a and, everything else equal, results in higher bribe payments and lower profits in equilibrium. Lower net profits in sector a 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 and reduces expected net profits. As a result, fewer firms will invest in sector a.

B. Technology 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. A less sunk capital stock implies that the cost of exiting becomes smaller, and from equation (2.5), 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 (7.1). 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 $k < k^*$. Specifically, let $k = k(\alpha)$, where $k'(\alpha) < 0$ for $\alpha > \alpha^*$. Differentiate the value function with respect to α and evaluate the expression in $\{k^*, \alpha^*\}$. Yields,

$$\frac{dV(k, \mid a)}{d\alpha} = \varphi_k \frac{d\pi(k^*, \cdot | a)}{dk} k'(\alpha^*) + \varphi_\alpha \left[\frac{d\pi(\alpha^* k^*, \cdot | b)}{dk} k'(\alpha^*) + \frac{d\pi(\alpha^* k^*, \cdot | b)}{d\alpha} \right] \tag{7.5}$$

If $dV(k, \mid a)/d\alpha > 0$, then it is optimal to choose a less productive but more reversible capital stock. Clearly, the sign of (7.5) depends on the composite coefficients φ_k and φ_α. Note that φ_k $[\varphi_\alpha]$ is a decreasing [increasing] function of ρ. In Figures 3a and 3b, 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.

APPENDIX 2: DATA DESCRIPTION

Variable name	Definition
Age	Age of the firm.
Alternative return	Capital stock*sunk cost component.
Capital stock:	Resale value of plant and equipment.
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 logarithms)
Cost of security	Annual cost of security (in logarithms)
Employment	Total employment.
Exemption	Index (0-2) of tax exemptions. The index is the sum of two variables indicating exemptions from corporate tax and import duties (exemption = 0 if no exemptions, 1 = partial exemptions, and 2 = full exemptions).
Experience	Binary variable taking the value 1 if the owner/manager has had previous experience from working abroad or in a foreign-owned firm.
Foreign	Foreign ownership in percent.
Formal sector	First principal component derived from a principal components analysis of the variables "trade", "pay tax"', "infrastructure service".
Graft	Reported bribe payment.
Infrastructure service	Index (0-5) of availability of public services. The index is the sum of five dummy variables indicating if electricity, water, telephones, waste disposal, and paved roads are available (service dummy =1 if available, 0 otherwise).
Investment	Total investment in machinery and equipment.
Pay tax	Log of (1 + tax index).
Profit	Gross sales less operating costs and interest payments.
Regulations	Percentage of senior management's time spent dealing with government regulations each month (in logarithms)
Robbery	Incidence (1,0) of robbery and theft
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 index	Index (0-6) reflecting types of taxes the firm pays. The index is the sum of six dummies indicating if import duty, import commission, withholding tax, excise tax, VAT, corporate tax are paid (tax dummy =1 if tax paid 0 otherwise).
Trade	Binary variable taking the value 1 if the firm either exports or imports itself or both and zero otherwise.
University	Binary variable taking the value 1 if the owner/manager has a University diploma.

a. All monetary units are in 1997 US$.

APPENDIX 3: SUMMARY STATISTICS

	All firms reporting graft	Firms reporting graft > 0	Firms reporting graft = 0	Firms missing graft data
Graft - mean	6,727	8,279		
- median	455	1,818		
- std	17,049	18,582		
Graft per employee	71.4	87.9		
	18.2	32.3		
	127	135		
Employment	129	133	114	109
	37	38	32	20
	274	283	236	215
Profit per employee	3,759	3,923	3,079	2,527
	742	770	605	946
	13,358	14,090	9,901	11,098
Capital per employee	5,900	5,065	9,400	7,638
	1,855	1,951	1,653	1,460
	11,416	8,256	19,655	14,756
Sunk cost component (α)	-4.9e-5	-5.8e-4	-2.7e-3	-1.3e-4
	0.010	0.011	0.008	0.005
	0.032	0.034	0.026	0.028
Formal sector	4.7	4.8	4.2	3.8
	4.9	5.0	4.3	3.6
	1.6	1.6	1.7	2.4
Number of obs.	176	143	33	67

a. In each column, for each variable, the mean, median, and standard deviation are reported in consecutive rows. The number of observations (last row) is the maximum number in the subsample.

APPENDIX 4: COMPARISON OF FIRMS REPORTING AND NOT-REPORTING BRIBE DATA

Dependent variable *[no. observations]*	Firms missing corruption data	Firms only missing corruption data
Firm size [no. 243]	-19.9 (33.4) [.552]	-39.9 (33.9) [.240]
Profit [no. 219]	-34,199 (696,442) [.961]	529,658 (795,730) [.506]
Capital stock [no. 220]	1,145,134 (978,374) [.243]	1,466,153 (1,388,074) [.292]
Investment [no. 191]	3,502 (199,960) [.986]	-24,758 (220,432) [.911]

a. The dependent variable in the left column with the number of observations in brackets.

b. Coefficient estimates from OLS regressions in the second and third columns on missing variable dummy taking the value 1 if corruption data is missing and 0 otherwise, with standard errors in parenthesis and p-values in brackets. Explanatory variables in left column.

APPENDIX 5: COMPARISON OF FIRMS REPORTING ZERO AND POSITIVE GRAFT

Dependent variable *[no. observations]*	OLS Regressions
Regulation [no. 175]	0.523 (.201) [.010]
Accountant [no. 161]	1.44 (.578) [.013]
Security [no. 220]	0.260 (.505) [.607]
Robbery [no. 176]	0.093 (.095) [.329]

a. The dependent variable is in the left column with the number of observations in brackets.

b. Coefficient estimates from OLS regressions on incidence of graft dummy in second column, with standard errors oin which takes the value 1 if the firm reported positive bribe payments and 0 otherwise.

TABLE 1a

PROBIT REGRESSIONS ON THE INCIDENCE OF CORRUPTION

Specification	(1)	(2)	(3)	(4)	(5)
Constant	0.203	0.647	0.428	-0.010	0.179
	(.342)	(.155)	(.276)	(.393)	(.331)
	[.554]	[.000]	[.121]	[.979]	[.588]
Employment	8.4E-5	-7.9E-5	-8.2E-5	-1.5E-4	-1.2E-4
	(4.3E-4)	(4.4E-4)	(4.4E-4)	(4.5E-4)	(4.4E-4)
	[.848]	[.857]	[.852]	[.736]	[.784]
Infrastructure	0.192			0.156	
service	(.094)			(.102)	
	[.041]			[.124]	
Trade		0.430		0.292	
		(.238)		(.265)	
		[.070]		[.271]	
Pay tax			0.374	0.153	
			(.220)	(.256)	
			(.089)	[.549]	
Formal sector					0.151
					(.073)
					[.038]
Industry	-	-	-	-	-
Observations	176	167	173	167	167

a. Dependent variable "incidence of graft" takes the value 1 if the firm reported positive bribe payments and 0 otherwise.

b. Standard errors in parenthesis and p-values in brackets.

c. Industry is the likelihood-ratio test statistic for the H_0 that the industry effects are equal.

TABLE 1b

PROBIT REGRESSIONS ON THE INCIDENCE OF CORRUPTION

Specification	(6)	(7)	(8)	(9)
Constant	0.254	0.206	-0.090	
	(.356)	(.467)	(.461)	
	[.476]	[.659]	[.846]	
Employment	0.001	0.001	0.001	0.001
	(.001)	(.001)	(.001)	(.001)
	(.280)	(.278)	(.477)	(.380)
Formal sector	0.140	0.141	0.213	0.200
	(.082)	(.083)	(.099)	(.074)
	[.088]	[.087]	[.032]	[.007]
Profit	-2.6E-9	-4.0E-9	1.7E-8	2.4E-9
	(4.8E-8)	(4.8E-8)	(4.9E-8)	(5.3E-8)
	[.957]	[.935]	[.730]	[.964]
Capital stock	-3.2E-7	-3.1E-7	-4.2E-7	-3.4E-7
	(2.5E-7)	(2.6E-7)	(2.5E-7)	(2.8E-7)
	[.199]	[.224]	[.090]	[.224]
Alternative	-8.8E-7	-7.6E-7	2.4E-7	-6.3E-7
return	(1.1E-5)	(1.1E-5)	(1.1E-5)	(1.1E-5)
	[.934]	[.884]	[.983]	[.956]
Competition		0.003		
		(.018)		
		[.884]		
Sell to			-0.337	
government			(.272)	
			[.216]	
Exemption			0.515	
			(.216)	
			[.017]	
Industry	-	-	-	5.09
				[.885]
LR(***z***)	6.15	5.84	7.05	4.86
	[.104]	[.119]	[.070]	[.183]
Observations	149	148	134	149

a. Dependent variable “incidence of graft” takes the value 1 if the firm reported positive bribe payments and 0 otherwise.

b. Standard errors in parenthesis and p-values in brackets.

c. Industry is the likelihood-ratio test statistic for the H_0 that the industry effects are equal.

d. LR(**z**) is the likelihood-ratio test statistic for the H_0 that the coefficients on the bargaining measures (profit, capital stock, alternative return) are zero.

TABLE 2

CORRUPTION REGRESSIONS

Specification	(1)	(2)	(3)	(4)	(5)	(6)
Constant	484.9	-1244	-1407	-510		484.9
	(5457)	(3546)	(4818)	(4553)		(5457)
	[.929]	[.726]	[.929]	[.911]		[.929]
Profit	0.0033	0.0037	0.0037	0.0036	0.0034	0.0033
	(.0014)	(.0011)	(.0011)	(.0011)	(.0011)	(.0014)
	[.026]	[.001]	[.001]	[.001]	[.003]	[.026]
Capital stock	0.0072	0.0060	0.0060	0.0062	0.0050	0.0072
	(.0033)	(.0023)	(.0024)	(.0023)	(.0027)	(.0033)
	[.032]	[.012]	[.015]	[.009]	[.065]	[.032]
Employment	16.4	10.7	10.7	10.3	10.2	16.4
	(7.53)	(5.01)	(5.17)	(4.88)	(5.53)	(7.53)
	[.031]	[.038]	[.041]	[.037]	[.069]	[.031]
Alternative return	-0.309	-0.259	-0.260	-0.274	-0.261	-0.309
	(.122)	(.091)	(.092)	(.089)	(.097)	(.122)
	[.012]	[.005]	[.006]	[.003]	[.008]	[.012]
Formal sector	924.8	951.9	958.8	872.8	1568	924.8
	(1144)	(744)	(763)	(847)	(888)	(1144)
	[.421]	[.203]	[.212]	[.305]	[.080]	[.421]
Competition			9.61			
			(178.5)			
			[.957]			
Sell to government				-1847		
				(2345)		
				[.433]		
Exemption				320.6		
				(1709)		
				[.852]		
α						0.977
						(17.2)
						[.955]
Industry	-	-	-	-	12.4	
					[.412]	
LR(**z**)[c]	16.2	25.5	25.2	27.5	21.4	
	[.000]	[.000]	[.000]	[.000]	[.000]	
Observations	119	117	116	105	117	

a. Dependent variable is graft in US$.

b. Least-squares estimates with standard errors in parenthesis and p-values in brackets.

c. Specification (1) includes two outliers.

d. Industry is the likelihood-ratio test statistic for the H_0 that the industry effects are equal.

e. LR(**z**) is the likelihood-ratio test statistic for the H_0 that the coefficients on the bargaining measures (profit, capital stock, employment, alternative return) are zero.

TABLE 3

ROBUSTNESS REGRESSIONS

Specification *Method*	(1) ols	(2) heckit	(3) IV	(4) IV
Constant	14.2 (35.9) [.694]	20.0 (47.1) [.672]	-7.31 (46.6) [.876]	6.82 (37.7) [.857]
Formal sector	9.61 (7.22) [.186]	9.14 (7.52) [.224]	11.4 (8.47) [.182]	10.6 (7.41) [.157]
Profit per employee	0.0040 (.0008) [.000]	0.0040 (.0007) [.000]	0.0076 (.0039) [.054]	0.0051 (.0017) [.004]
Capital stock per employee	0.0043 (.0022) [.062]	0.0043 (.0022) [.054]	0.0036 (.0027) [.177]	0.0040 (.0023) [.089]
Alternative return per employee	-0.239 (.093) [.012]	-0.239 (.091) [.009]	-0.267 (.104) [.012]	-0.247 (.095) [.010]
LR(***z***)	30.1 [.000]	30.6 [.000]		
F(***z***)			3.18 [.027]	4.95 [.003]
ρ		-0.084 [.854]		
Hausman			3.04 [.551]	
Observations	117	117	114	117

a. Dependent variable is graft in US$ per employee.

b. Standard errors in parenthesis and P-values in brackets.

c. Instrument vector in Regression 3 consists of the variables *university, experience, foreign, age, cost of security per employee*, and the covariates in Regression 3.

d. Instrument vector in Regression 4 consists of industry-location averages of the profit rate and the covariates in Regression 4.

e. LR(z) is the likelihood-ratio test statistic for the H_0 that the coefficients on the bargaining measures (profit, capital stock, alternative return) are zero.

f. F(z) is the F-statistic for the H_0 that the coefficients on the bargaining measures (profit, capital stock, alternative return) are zero.

h. ρ is the correlation between errors in selection and regression equation.

i. Hausman is the TR^2-test statistic for the null hypothesis of no overidentifying restrictions.

TABLE 4

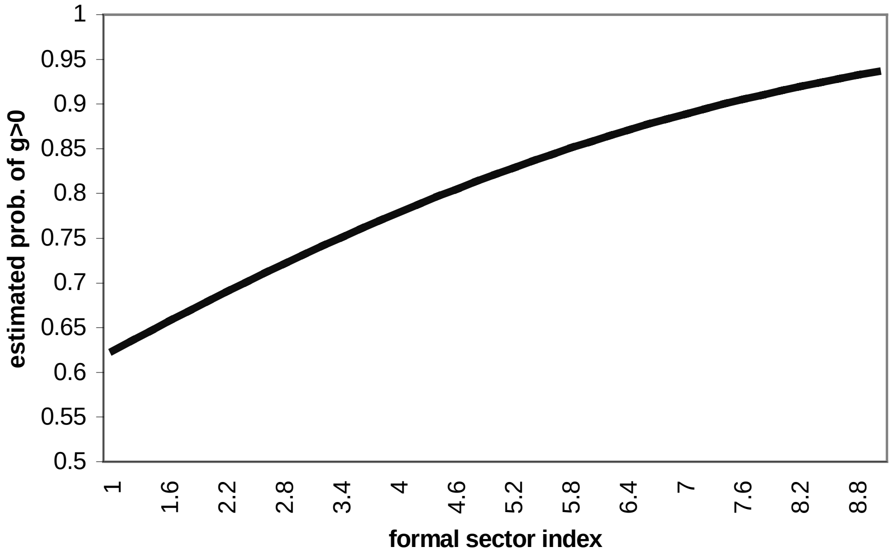
EFFECTS ON CORRUPTION OF CHANGES IN FIRM CHARACTERISTICS

Equation	(1)
	Change in bribe payment per employee US$ (st.d.) due to a one standard deviation increase in
Capital stock per employee	25.6 (0.19)
Profit per employee	113.3 (0.82)
Reversibility index	-42.0 (-0.30)

a. Calculations based on Regression 3, Table 3.
b. Standard deviation change in parenthesis.

FIGURE 1

ESTIMATED PROBABILITY OF HAVING TO PAY BRIBES



a. Based on Regression 5, Table 1, with employment evaluated at the mean.

FIGURE 2A

DISTRIBUTION OF FIRMS ACCORDING TO BRIBE PAYMENTS (LOG)

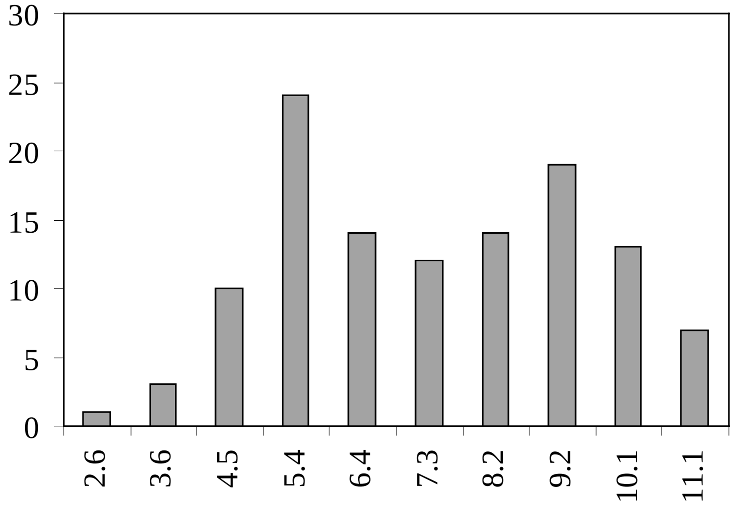


FIGURE 2B

DISTRIBUTION OF FIRMS ACCORDING TO BRIBE PAYMENTS

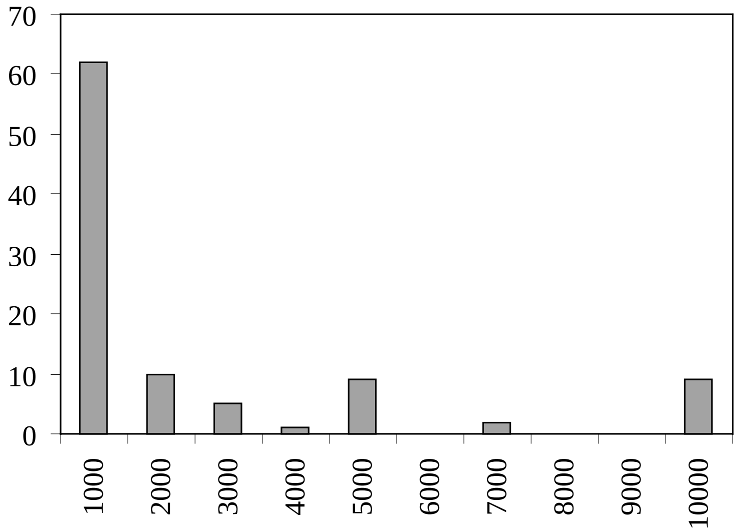


FIGURE 3A
THE TECHNOLOGY EFFECT

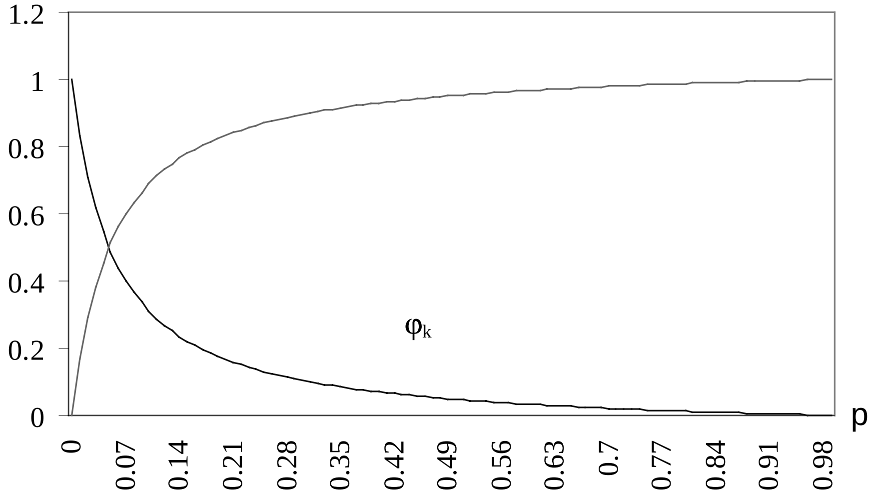
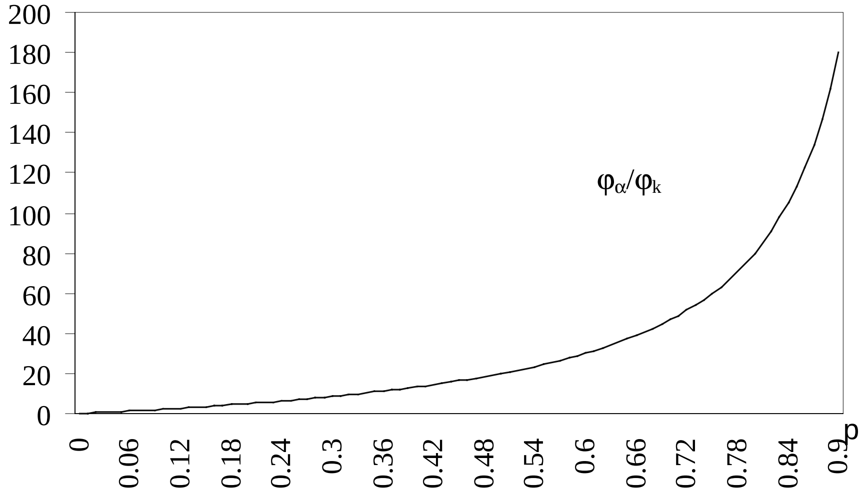


FIGURE 3B
THE TECHNOLOGY EFFECT



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