Abstract

Using unique firm-level data, this paper examines the relationship between bribes and total waiting times for bureaucratic services. In each of the 8 services we examine, we find a statistically significant positive association between bribery and delays, which is robust to a wide range of empirical specifications. The additional delay associated with bribery can be substantial. Depending on the service in question, firms which face a bribe request experience a total wait that is up to two weeks longer compared to firms which are not confronted with bribery.

We further propose elementary queueing models which explain this positive association. The basic insight of our analysis is that a corrupt bureaucrat may let firms wait in the system before requesting bribes in order to extract more value from them. This leads to the positive correlation between waiting times and bribes we observe in the data. Depending on the setting, we identify the expected penalty that a government might inflict on bureaucrats for bribing and the structure of the firms' waiting costs as possible motivations for delaying a bribe request. The models also predict that a higher expected penalty for bribing is associated with a lower incidence of corruption. Additional empirical analysis provides support for this conjecture.

In short, our study reveals that corrupt practice is associated with a dual cost for the firm: the bribe amount itself, and additional waiting costs.

Keywords: Bribes, Queuing Model, Waiting Times, Corruption

Bribes and Delays: Theory and Evidence

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1. Introduction

Corruption is widely regarded as a major economic and social problem. In opinion surveys, managers regularly report it as being a serious obstacle to doing business ((Transparency International 2008), (PwC 2008) and (Control Risks 2006).) When it comes to accessing public services, however, bribery may be beneficial from the individual firm perspective. The reason is that with excess demand for public services or cumbersome government regulations, bribery gives firms the opportunity to expedite service and thereby avoid costs associated with having to wait in a queue.

This common presumption is also a central feature of most queueing models of bribery and congestion. These models typically find, often implicitly, that firms paying bribes for service experience shorter waiting times than those that do not pay bribes. To date, this theoretical prediction has not received empirical scrutiny. The first contribution of this paper is to fill this gap by addressing the empirical question of whether firms confronted with bribery experience shorter delays in obtaining bureaucratic services than firms which are not confronted with it. We find that there is a *positive* association between bribery and waiting times, i.e. the time between service request and delivery. Our second contribution is to build a new queueing model which offers a theoretical explanation for this finding.

Our empirical analysis exploits a new survey on bribery from Transparency International (TI) covering over 2,700 businesses across 26 countries ((Transparency International 2008)). These data have exceptionally rich information regarding firms' experiences with corruption. They are uniquely suited to our question of interest since the survey poses questions regarding (i) whether firms requested different types of bureaucratic services, (ii) the actual delay experienced in each case, and (iii) whether a bribe request was made by public officials in order to expedite the service. This is the only survey of which we are aware that has information on both bribe experiences and associated service delays. We consistently find a positive relationship between bribes and total waiting times. Even a simple comparison of average total waiting times indicates that in 7 of the 8 services we consider, firms engaged in bribery wait longer. Depending on the service this increase amounts to 2 to 15 additional days.

The positive relationship found in the raw data is economically as well as statistically significant for all services in our econometric analysis. It is robust to the inclusion of firm characteristics, sector fixed effects, and country characteristics (including, in different specifications, business and economic indicators and country fixed effects). It is also robust to different econometric specifications, which account for the particularities of waiting times. Tobit estimates, which account for the fact that waiting times are censored, indicate that bribes are associated with a 20-70% increase in waiting time. Semi-parametric Cox regression model estimates, which account for non-normality of the error term, indicate that firms facing bribe requests face a hazard 70-80% greater (i.e. a much lower "risk of receiving service") than firms which do not encounter such a request.

Our empirical finding that bribery is associated with longer total waiting times is striking in view of the extant theoretical queuing literature on bribes and congestion. However, it is consistent with the long-standing notion, famously expounded by the Nobel prize-winning economist Gunnar Myrdal 1968, that rather than demanding bribes in order to speed things up, corrupt bureaucrats may exploit delays in order to attract bribes. We therefore build a new queueing model which, by capturing Myrdal's basic intuition, yields predictions which are consistent with our empirical findings.

In our model, firms request service from a single bureaucrat. Without bribery, the system corresponds to a standard M/M/1 queue. The bureaucrat can, however, solicit bribes which buy firms priority in the queue. In particular, the bureaucrat decides on the amount and timing of a bribe request. Given the bureaucrat's choice, firms decide whether to pay the bribe to purchase priority. Because a firm's decision affects the delay experienced by others in the system, this situation gives rise to a game among firms.

The bureaucrat is an expected profit maximizer. His bribe decisions determine his expected revenue. However, when engaging in bribery he risks detection and government sanction. In keeping with the public economics literature, we model this as an expected penalty inflicted by the government each time the bureaucrat engages in bribery. (See, for example, (Mookherjee and Png 1995) and (Polinsky and Shavell 2001).)

We show that as the expected penalty for corruption imposed by the government increases, the bureaucrat requires larger bribe amounts to cover this risk, which he extracts from the firms by delaying the bribe request. Indeed, the longer a firm waits in the system, the longer the queue length, and thus the higher the additional waiting cost of being given low priority. In particular, the bureaucrat always delays the request for a bribe, as long as the expected penalty for corruption imposed by the government is positive. We deduce from this analysis that firms who experience longer waiting times are more likely to be hit by a bribe request. This generates the positive correlations we observe in the data.

Our model further predicts that a higher penalty for bribing is associated with a lower incidence of corruption. Our data present us a unique opportunity to empirically test this result. We find that, consistent with model's prediction, there is significantly lower prevalence of bribes to bureaucrats as well as bribes to politicians where governments are viewed as being effective at deterring corruption.

Thus, the model suggests that the expected penalty for corruption constitutes a key driver for the positive correlation between bribing and delays observed in the data. This penalty has never been considered in existing queueing models of corruption, to the best of our knowledge. However, other aspects of bribery could also theoretically predict the positive association we find in our empirical study. By way of illustration, we propose a second setting where bribes also expedite the service provision (i.e. reduce the service time). We provide conditions under which the bureaucrat delays bribe solicitation. In particular, firms need to be increasingly impatient – that is, be subject to a convex waiting cost function – in order for the bureaucrat to delay the bribe request. Alternatively, when the waiting cost is linear, our results imply that the agent always request bribes upon arrival of a firm. Hence, when bribery expedites service time, the key driver for the positive correlation between bribing and delays appears to be the structure of the waiting cost.

Although there is a large empirical as well as non-queueing theoretic literature in economics on corruption more generally (see (Bardhan 1997), (Aidt 2003) and (Svensson 2005) for excellent surveys), there has to the best of our knowledge been no empirical analysis – in economics or elsewhere – of the relationship between bribes and total waiting times. This paper constitutes a first step towards filling that gap. Our finding that bribery is positively correlated with delays is consistent with Kaufmann and Wei 2000 and Henderson and Kuncoro 2004, who have empirically documented that bribery and bureaucratic harassment is positively correlated.

Our theoretical model adds to the queueing literature on bribery and congestion, pioneered by (Kleinrock 1967). In Kleinrock's model, the server requests arriving customers to pay bribes in order to purchase relative priority in the queue. There have since been numerous extensions to this basic setting. For example, in (Ha 2001) and (Van Mieghem 2000) the provider selects a price-service menu. Others have also modified and extended Kleinrock's setup to explore priority auctions. (Balachandran 1972) for instance, analyzes a system where homogenous customers who observe the queue length upon arrival determine the bribe amount they pay for priority. (Lui 1985) and (Glazer and Hassin 1986) consider priority auctions among heterogeneous customers who do not observe the queue. (Afèche and Mendelson 2004) study an analogous setting where customer delay costs depend on their service valuations.

Our basic setting constitutes a special case of (Hassin and Haviv 2003), where the bureaucrat solicits a bribe upon arrival of a firm's request for service. (Hassin and Haviv 2003) consider firms' mixed strategies for a set-up where bribes are exogenous. By contrast, in our model bribes are endogenously determined, in the sense that the bribe amount and solicitation time are decided by the agent, as are firms' decisions to accede to the bribe request. In order to make the analysis tractable, however, we focus on pure strategies.

In extant queuing models, bribes are typically requested upon arrival of customers.[1] The distinguishing feature of our model is that the agent has an incentive to delay the bribe request. In our first setting, this is driven by the introduction of an expected penalty associated with bribe detection. In our second setting, this is driven by a combination of convex costs and accelerated service time upon bribe payment.

Finally for the more technical aspects of the paper, we show in our setting that the number firms that do not bribe the server is akin to a queue where customers abandon when they wait a deterministic amount of time. Our analysis therefore draws on results from (Choi, Kim, and Chung 2001) (see also (Hassin and Haviv 1995)) who provide the corresponding distribution of the waiting time.

The paper proceeds as follows. The data are described in section 2, and section 3 presents an empirical analysis of the relationship between waiting times and bribes. In section 4, we propose a theoretical model, whose predictions are consistent with our empirical evidence. Section 5 presents empirical evidence that the incidence of bribery decreases with the government penalty for bribing. We conclude in Section 6.

2. Data

In order to examine the relationship between waiting times and bribes, we use data from 2008 Bribe Payers Survey (BPS) (see Transparency International 2008, p.14 for more detail). The survey was designed by Transparency International (TI), a civil society organization

[1](Adiri and Yechiali 1974) and (Alperstein 1988) depart from this setting by studying a system where customers purchase priority only when the queue length reach a pre-specified threshold. In this setting, however, it can be shown that at least for two customer classes, the average waiting time is the same for paying and non-paying customers.

which has extensive experience in conducting corruption surveys. Questions in the survey pertaining to corruption were carefully designed by TI, based on their ability to elicit honest responses. The 2008 BPS surveyed senior business executives in 26 low-, middle-, and high-income countries. At least 100 interviews were conducted in each of the 26 countries, amounting to a cross-sectional data set of 2,742 company-level observations. Sample coverage is described in Table 1.

The survey also captured company characteristics, including size, whether or not it is a multinational corporation (MNC), the extent of foreign capital ownership, whether it is family-owned, whether it is locally head-quartered, and its sector of operation. These firm characteristics are important because they are likely to be correlated with both waiting times and bribe requests. For example, larger firms, MNCs or foreign-owned companies may have deeper pockets and have more complicated service requests. Hence, they may more likely to be hit by a bribe request, and have longer waiting times, thereby leading to a spurious positive correlation between our two variables of interest. Similarly, family-owned or locally head-quartered companies may have less elaborate service requests, but may be easier to extort, thereby leading to spurious negative correlation between bribery and waiting times. In order to account for omitted variable bias, we control for all available company characteristics, summarized in Table 2, in our regression analysis.

One of the primary aims of the survey was to gauge companies' experiences with bribery and corruption. To these ends, in a section titled "Experiences with Corruption", the survey posed 3 related questions: (i) "Please indicate ['Yes' or 'No'] if in the last year [the company] requested in this country, any services, permits or registries from the following institutions/organisations"; (ii) "If 'yes', what was the actual delay [in days] experienced from the day you applied to the day you received the service of permit approval"; (iii) "Did public officials ever suggest that by making informal payments of gifts you could get these services or permits more quickly?". The answer to question (ii) is the total waiting time; this is our left-hand-side variable in most empirical specifications. The answer to question (iii) measures bribe requests; it is our right-hand-side variable of interest, coded as 1 if a bribe was requested and 0 otherwise.

Table 3 summarizes the responses to these questions with respect to 8 separate bureaucratic services listed in column 1: customs, sanitary inspections, police, telephone provider, electricity provider, water service provider, gas provider, and tax revenue authorities. Of the 2,742 companies in the sample, 1,798 (i.e. 65.6%) report having requested services from at least one of these institutions, and have information regarding bribe requests and waiting times. Column 3 indicates that bribe requests are ubiquitous. On average, firms in these data could expect to encounter a bribe request to expedite service at 23.1% of these 8 service providers. The pattern of corruption across different services is consistent with common intuition. In particular, bribe requests were least prevalent for essential services, which are likely to be characterized by some competition such as telephone (11%) and gas (15%), and most common for services in which government bureaucrats can exercise considerable discretion, such as police (42%) and customs (32%).

Average waiting times are depicted in column 5. Since these refer to service requests made in the last year, survey responses are not defined below 0 and censored at 365. The average waiting time across all services was approximately 26 days, ranging from two and a half weeks (for customs, telephone, water, gas) to almost one month (for police and tax authorities).

We match the 2008 BPS with 2008 World Bank country-level data on economic development and the ease of doing business. The former is important since less-developed countries tend to be characterized by higher levels of corruption as well as bureaucratic inefficiency. The latter is important since bribery is likely to be positively associated with red tape. Failure to control for economic development and ease of doing business may therefore result in a spurious positive correlation between waiting times and corruption.

Table 4 provides variable descriptions and summary statistics for the country-level controls we use in our analysis. Economic indicators include GDP per capita, employment rates, life expectancy, military expenditure, and population. These indicators proxy for income, economic activity, human capital, government spending priorities, and country size, respectively. The ease of doing business indicators include an index for the strength of legal rights, and the number of procedures needed to enforce contracts, register property, register a new business, and build a warehouse.

3. Empirical Analysis

Our main question of interest is whether bribery is associated with shorter or longer waiting times. We start examining this question in Table 5 by comparing the average waiting times companies experienced for these 8 services, in levels (columns 2-4) and logarithms(columns 5-7). We do this separately for firms which did ("Bribe") and did not ("No Bribe") face a bribe request from the service provider. The difference between these two averages is reported in columns 4 and 7. Statistical significance is denoted by stars, with two and three stars denoting statistical significance at the 5% and 1% levels, respectively.

As column 4 indicates, for all but one service (Telephone), bribe requests are associated with longer waiting times, of approximately 3-15 days. T-tests indicate that the differences in levels, reported in column 4, are only statistically significant for 3 of these services. However, this is misleading since the normality assumptions upon which the t-statistic is based is violated in the case of waiting times in our data, whose distributions are right-skewed. Columns 5-7 account for this by examining log transformations of waiting time. As column 7 indicates, without exception, bribes are associated statistically significant longer waiting times.

3.1 Censored Tobit Model

The raw data indicate that waiting times are higher for firms facing bribe requests. As discussed in section 2 however, an obvious concern is that this relationship reflects unobserved heterogeneity at the country, sector, or company level. In order to ensure that the positive correlation documented in Table 5 is robust to omitted variables, we estimate the following regression model:

$$W_i^* = \alpha + \tau B_i + \phi \mathbf{X}_i + \epsilon_i \tag{1}$$

where the latent variable W_i^* is the natural logarithm of waiting times for company i and B_i is a dummy variable equal to 1 if, having made a service request, company i was requested to pay a bribe and 0 if it was not requested to pay a bribe. Vector $\mathbf{X_i}$ contains company characteristics and sector fixed effects (see Table 2) as well as characteristics of the country in which company i operates (see Table 4); ϵ_i is the error term. Our coefficient of interest is τ, which captures the relationship between bribe requests and waiting times.

Since the dependent variable is not defined below 0 and censored at 365, we use a standard censored Tobit model to estimate equation (1) (Wooldridge 2002, p.517-520). Table 6 presents the results of this exercise. Each column represents a different regression in which the waiting time corresponds to the service listed in the column heading. In each case, we correct for country characteristics, comprising the economic environment and ease of doing business variables summarized in Table 4, as well as company characteristics sector fixed effects summarized in Table 2.

The results are broadly consistent with the results presented in Table 5: bribes are associated with significantly higher waiting times. The point estimates presented in row 1 of Table 6 are not significantly different from the first difference results presented in column 7 of Table 5. (Only in the case of telephones is this relationship imprecisely estimated due to an unusually long right hand tail of the waiting time distribution for firms which did not face bribery.) In general, the results in Table 6 suggest that the positive relationship between waiting times and bribe requests documented earlier does not reflect omitted variables.

3.2 Cox Proportional Hazards Model

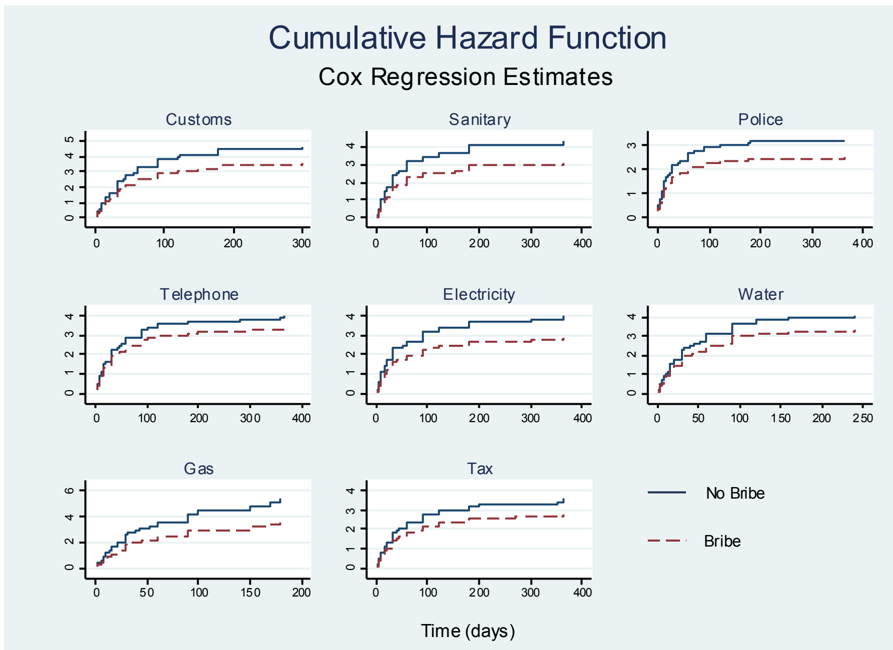
The validity of the estimates presented in Tables 5 and 6, rely crucially on the normality of the error term. As with most waiting time estimation, this assumption is likely to be violated in our application.[2] In order to abstract from distributional assumptions regarding the error term, while at the same time accounting for heterogeneity in firms, we estimate a semi-parametric Cox proportional hazards model in which the event of interest is service provision:

$$h(t|x_i) = h_0(t)\exp(x_i\beta) \tag{2}$$

where $h_0(t)$ is the baseline hazard; x_i is a vector of country, sector, and individual characteristics of firm i (as in equation 1); and $\beta \in \mathbb{R}$ is a vector of covariate effect parameters. The key advantage of this model is that it makes no distributional assumptions regarding the shape of the hazard over time.

Table C presents estimates for $\exp(\beta)$, with robust standard errors (accordingly transformed using the delta method) in parentheses. The exponentialized coefficients presented in the first row of the table have the natural interpretation of the ratio of the hazard for a 1-unit increase in bribe requests, i.e. moving from not being requested a bribe to being requested a bribe. The results are broadly consistent with those presented thus far. They indicate that bribes requests are associated with significantly longer waiting times for each of these services (including Telephones, at the 10% level). The point estimates are, moreover, remarkably consistent across the 8 specifications, indicating firms encountering a bribe

[2]This concern is confirmed with nonparametric kernel density estimates of waiting times for each of our services (not shown).



Note: This graph plots cumulative hazard functions from a Cox regression used to estimate equation (2). The regression, whose estimates are presented in Table 7, included sector fixed effects, economic indicators, and ease of doing business indicators. Waiting times in days, presented on the x-axes, are censored above at 365. The solid line pertains companies which were not requested to pay a bribe for the service, and the dashed line, to companies which were requested to pay a bribe.

Figure 1: Cumulative Hazard Function.

request face a hazard 70-80% greater than firms which do not encounter such a request.

Figure 1 depicts this difference graphically. It plots the cumulative hazard function for the fitted Cox model specified in equation (2), evaluated separately for firms that did not face a bribe requests (solid line) and firms which did (dashed line). For all 8 services, the cumulative hazard function with bribes lies below that without bribes, indicating that firms facing bribe requests have a much lower "risk of receiving service" than firms who were not asked to pay a bribe.

4. A Simple Queuing Model of Corruption

The positive correlation between bribery and delays is at odds with exiting queuing models, which typically predict the opposite. Our aim in this section, therefore, is to show how a positive correlation can naturally emerge from elementary queueing systems. Our modeling approach rests on two tenets. The first is parsimony: we seek to derive the *simplest* queuing model of bribery whose central prediction is consistent with our main empirical finding. The second is consistency with the data structure. In particular, in keeping with the wording of the questionnaire, the bureaucrat in our model should solicit a bribe; firms should not initiate bribe offers.

We offer two simple settings wherein waiting times can be positively correlated with bribery. Our approach is to show that a bureaucrat may benefit from delaying the request for a bribe, leading to a situation where firms that wait longer are more likely to bribe the agent. In the first setting, the bureaucrat does not control the speed of the service delivery, but can manipulate the order in which requests for service are processed in order to extract bribes. In the second setting, the server can also accelerate the service processing time in exchange for a bribe.

Consider, then, a single bureaucrat, or agent, processing homogeneous firms' requests for a unique service, which arrive to the system according to a Poisson process with rate λ. We denote by S the random variable corresponding to the service time, which is exponentially distributed with rate μ, so $E[S] = 1/\mu$. We also refer to $\rho \equiv \lambda/\mu$ as the offered utilization rate, where $\rho < 1$. Because of limited capacity, requests for service may accumulate and we define as $c(\cdot)$ the corresponding waiting cost. More precisely, a firm which spends w units of time in the system (including service) incurs cost $c(w)$, which is also assumed to be non-decreasing in w. When no bribery is involved, the system corresponds to a simple

M/M/1 queue and firms experience an expected delay equal to $w_0 \equiv 1/(\mu - \lambda)$.

Consistent with the wording of the TI questionnaire, the bureaucrat in our model may solicit bribes while firms may either accept or reject the bribe request. Firms know neither the current number of requests in the system nor whether their own request is being processed by the bureaucrat. However, a firm can track the time it has already spent waiting.

The agent first chooses a pair (t, b) such that each time a firm waits t units of time (even when in service), the agent solicits bribe b, where t can possibly be null as in the existing queueing literature. If the firm accepts, it receives either priority or accelerated service depending on the context. In either case, this gives rise to strategic interaction between firms. Denote by $p(t, b)$ the proportion of firms that pay a bribe at the resulting equilibrium, when it exists, such that $p(t, b)b$ corresponds to the agent's expected revenue.

For each bribe transaction, the government can catch the agent and inflict an penalty of K. The agent's problem is to determine (t, b) to maximize his expected payoff:

$$\pi(t, b) \equiv \max_{b,t \geq 0} \; p(t, b) \, (b - K) \, \lambda. \tag{3}$$

4.1 Bribing For Priority

We first study the simplest case where the agent cannot control service time S, but the priority level of firms in the system. More precisely, we assume that the agent gives low priority to firms which refuse to pay a bribe and places them at the end of the queue. Firms are served according to the FCFS policy otherwise. For the sake of clarity, we conduct the analysis for linear waiting costs where $c(w) = c \times w$. A similar approach yields the same results for more general cost functions.

Given the agent's choice, the following proposition determines when an equilibrium with bribery occurs,

Proposition 1. *For an agent's choice of b and t, a Nash equilibrium with bribery (i.e. where $p(t, b) > 0$) exists if and only if,*

$$\frac{b}{c} \leq \lambda w_0 \left(t + w_0\right). \tag{4}$$

Further, all firms that are requested a bribe accept to pay it and $p(t, b) = e^{-t/w_0}$.

(All proofs can be found in Appendix A.)

Note that the situation where all firms reject the bribe can also be an equilibrium. In Appendix C, we provide necessary and sufficient conditions for the equilibrium with bribery to be unique. In any case, if the equilibrium without bribing is reached, $p(t,b)$ and hence $\pi(t,b)$ are null. In particular, the relationship between bribery and waiting time is not defined anymore and the problem is degenerated. We therefore focus our analysis to the case where bribery is observed at the equilibrium.

According to Proposition 1, the higher the value of t, the bigger the bribe amount the agent can extract from the firm. This gives the agent an incentive to delay the bribe request. At the same time, the rate at which bribes are extorted decrease with t. The following result provides necessary and sufficient conditions for the agent to wait a positive amount of time before requesting a bribe.

Proposition 2. *There exists a unique pair* (t^*, b^*) *maximizing (3) such that*

$$t^* = \frac{K}{c\lambda w_0}\,,\ b^* = K + c\lambda w_0^2.$$

In particular, $t^* > 0$ *if and only if* $K > 0$.

Hence, the main driver for the agent to postpone the request for a bribe is the expected penalty that a government might inflict upon him for engaging in bribery. In particular, when $K = 0$, the agent does not have any incentive to delay the request of a bribe, a situation which is akin to the existing queueing literature. Here, by contrast, the agent delays the bribe request because he needs to increase the bribe amount in order to cover the costs associated with a positive expected punishment. The agent provides firms an incentive to pay this larger amount by delaying the request for a bribe. Indeed, as the time spent in the system by a firm increases, the expected number of firms accumulating behind it in the queue also increases and hence too the cost of being given low priority for refusing to bribe.

Proposition 2 further indicates that the higher the load of requests (λ), the higher the solicited bribe amount, but the shorter the delay for a bribe request (since w_0 is increasing in λ). This also suggests that firms have more incentive to bribe the server when the load is low. The following result illustrates this point and states that for low values of λ, an equilibrium without bribery never exists.

Proposition 3. *There exists a threshold $\hat{\lambda}$ on the load of request such that, for all $\lambda \leq \hat{\lambda}$, the Nash equilibrium with bribery at the optimal agent's choices (t^*, b^*) is unique.*

Based on the previous analysis, we are now ready to deduce our main result:

Proposition 4.

- *Firms which pay bribes experience longer waiting times than those which do not bribe,*
- *The number of corrupt firms is lower for higher values of K.*

The first theoretical prediction corresponds to our main empirical finding. The second prediction, while intuitive, provides us with a natural check of the model's internal validity. We test this result empirically in Section 5.

4.2 Bribing for Accelerated Service

The previous model exemplifies how the presence of a government penalty for bribery induces the agent to delay bribe solicitation. This, however, may not be the main driver in all settings. In this section, we show that if the agent can also expedite the service in exchange for a bribe, then the shape of the waiting cost function might push him to delay a bribe solicitation. In particular, we show that with linear waiting costs, the agent always requests the bribe upon arrival of requests for service, but may delay the solicitation of a bribe when firms becomes increasingly impatient while waiting.

More precisely, we assume that the agent can either perform the service under normal conditions, in which case the service time corresponds to S, or expedite the service, in which case the processing time is assumed to be negligible for simplicity. As a result, a firm that agrees to bribe the agent receives the service immediately and leaves the system.

We refer to $c'(\cdot)$ and $c''(\cdot)$ as the first and second order derivatives of $c(\cdot)$, respectively. Firms become increasingly impatient when waiting so that $c(\cdot)$ is a convex function, with $c(0) = 0$.

The agent chooses a pair (t, b) such that each time a firm waits t units of time, the agent solicits bribe b to expedite the service. A firm agrees to the bribe if and only if the expected residual waiting cost exceeds b, or formally, if and only if

$$E[c(t + R_t)] - c(t) \geq b \tag{5}$$

where R_t is the residual waiting time in the system for the normal process, given that a firm has been waiting t units of time. Note in particular that the distribution of R_t depends on other firms' bribe decisions. The following result determines when an equilibrium with bribery exists for this game,

Proposition 5. *Given agent's choices b and t, a Nash equilibrium with bribery exists if and only if $E[c(t+S)] - c(t) \geq b$. At the equilibrium, all firms who are requested a bribe accept to pay and*

$$p(t,b) = \frac{(1-\rho)e^{-(\mu-\lambda)t}}{1-\rho e^{-(\mu-\lambda)t}}. \tag{6}$$

Further, when it exists, this equilibrium is the unique Nash equilibrium.

Hence, as long as $E[c(t+S)] - c(t) \geq b$, all firms bribe the server. Since $c(t)$ is convex, the left-hand side of the inequality is increasing in t such that the larger the value of t, the higher the bribe amount, b, the agent can request. In this case, the longer firms wait, the more value the server can extract from them. However, the proportion of firms which spends more than t units of time in the system, and hence the frequency at which the server requests a bribe, decreases with t.

Nonetheless, the solution to the agent's optimization problem is not unique in general. The next result provides a sufficient condition for the objective function in (3) to be unimodal.

Proposition 6. *If $c''(.)$ is positive non-increasing, then a unique pair (t^*, b^*) exists which maximizes (3). Further, $t^* > 0$ if and only if the following condition holds*

$$E[c'(S)] - c'(0) > \mu(E[c(S)] - K). \tag{7}$$

Hence a unique solution exists if the convexity of $c(\cdot)$ weakens as t increases. Further, Condition (7) determines if the agent solicits a bribe as soon as a firm enters the queue – the typical setting of the existing literature – or rather waits until the firm has spent "enough" time in the system. The following result illustrates how the shape of the cost function can affect the optimal timing of a bribe request.

Proposition 7. *When $c(\cdot)$ is a linear function, the agent engages in bribery if and only if $K > 1/\mu$. In this case, the agent always requests a bribe upon a firm request arrival ($t^* = 0$).*

When $c(\cdot)$ is quadratic of the form $c(x) = ax^2$, the agent always engages in bribery. Further, the agent always delays the bribe request ($t^* > 0$).

In other words, when the cost function is linear the agent solicits a bribe as soon as a firm joins the queue provided that K is sufficiently large. This, again, corresponds to the typical setting studied by the existing literature on queueing models with bribery. By contrast, the agent always delays the bribe request when the cost function is quadratic, for any value of K (even null) .

From this, we can deduce the same empirical prediction as stated in Proposition 4,

Proposition 8. *If $c''(.)$ is non-increasing and Condition (7) holds, then*

- *Firms which pay bribes experience longer waiting times than those which do not bribe,*
- *The number of corrupt firms is lower for higher values of K.*

Proposition 7 suggests in particular that the non-linear shape of the cost function can also explain the positive association between bribery and delays observed in the data and predicted by Proposition 8.

5. Deterrence and Corruption Incidence

Propositions 4 and 8 both predict that higher values of K are associated with a lower incidence of corruption. In addition to being interesting in its own right, this prediction provides an opportunity to test the models' internal validity.

We do so by exploiting data from the BPS 2008 pertaining to the prevalence of bribery, as well as the efficacy of government efforts in fighting corruption. In particular, the BPS asks 3 separate questions regarding the incidence of corrupt practices, namely: (i) "In this country, how often do firms like yours (e.g. similar in size), engage in bribery of senior public servants?"; (ii) "In this country, how often do firms like yours (e.g. similar in size), engage in bribery of political parties to influence government policies, laws or regulations?"; (iii) "In this country, in general, how often [does] bribery of political parties influence specific public policy outcomes?".

For each question, respondents are asked to select a number from a 5 point Likert scale, where 1="Never", 2="Seldom", 3="Sometimes", 4="Often", and 5="Almost always". We recode these responses into a dummy variable equal to one for responses 4-5, capturing a high prevalence of bribery, and 0 for a low incidence, corresponding to responses 1-3. (The results presented below are robust to alternative codings of bribery prevalence). These are our left hand side variables. In addition, respondents are asked, "How would you assess the actions of government in this country in the fight against corruption?". Responses are on a 5 point Likert scale, where 1="very ineffective" and 5="very effective". We use this categorical variable as a (right hand side) proxy for government efficacy in deterring corruption.

Table 7 provides summary statistics for these variables; 15% of respondents believe that firms often or almost always bribe public servants, and 12% believe that firms often or almost always bribe political parties to influence government policies, laws or regulations. The proportion of firms who believe that bribes to political parties often or almost always influence specific public policy outcomes is even higher, at 35%. Finally, on average, firms believe that governments are only moderately effective at fighting corruption.

In order to evaluate whether effective government deterrence of bribery is associated with a lower incidence of corruption, we estimate the following regression model:

$$Y_i = \alpha + \eta E_i + \phi \mathbf{X}_i + \epsilon_i \tag{8}$$

where the binary variable Y_i captures the prevalence of corruption. It equals, in three separate regressions, the prevalence of (i) bribes to public servants, (ii) bribes to political parties and (iii) the efficacy of bribes in affecting public policy. E_i is a categorical variable (taking values 1-5) capturing government efficacy in fighting corruption (see Table 7). $\mathbf{X}_i$ and ϵ_i are as described in equation 1. Our coefficient of interest is η.

We estimate equation (8) using a probit model. The results are presented in Table 8, where we also present the coefficient estimates of the control variables. The estimates for η are presented in the first row. The results indicate that, consistent with propositions 4 and 8, effective government corruption deterrence is associated with significantly lower prevalence of bribes to public servants (column 1) and politicians (column 2) as well as efficacy of bribes in influencing policy (column 3).

6. Conclusion

In this paper, we exploit firm-level data from TI to explore the relationship between bribes and waiting times. These data are unique in that they contain information regarding firms' *actual* bribe experiences, with respect to *specific* bureaucratic services, for each of which it also records the total waiting time. We find that bribery is positively associated with total waiting times for bureaucratic services. This statistically significant finding holds across 8 separate services, and is robust to the inclusion firm, sector, and country characteristics. It is also robust across a number of econometric specifications, which account for censored data and non-normality of the error term – both of which are pertinent to analyses of waiting times.

This suggests that managers should not expect that bribery will reduce their total wait. In fact, our data indicate that the additional total delay associated with bribery can be substantial. Depending on the service in question, firms which face a bribe request experience a total wait that is up to two weeks longer compared to firms which are not confronted with bribery. Corrupt practice, in essence, is associated with a dual cost for the firm: the bribe amount itself, and additional waiting costs.

Many of the services we study in this paper are likely to be essential services, for which delays can be extremely costly especially in a global business context. For example, we estimate that bribery is associated with an additional 11 day delay in procuring customs service. This delay can amount to a substantial increase in lead times and thereby disrupt global supply chains.

The theoretical queueing literature has, to date, treated bribes as a means of obtaining priority in queues, with the result that bribes are associated with shorter total waiting times. The fact that our data finds the opposite relationship highlights a need to revisit the theoretical treatment of bribes.

It seems to us that one fundamental difference between priority purchasing and priority bribery is that latter activity is typically illegal. This has been overlooked in queueing theory to date. When incorporated, as we have for instance by including an expected penalty for bribe detection, the model's predictions are consistent with the data. Financial penalties are a common way of dealing with corruption, but there may be others, for example, being fired or incarcerated. Modeling the consequences of such alternative risks of engaging in corruption is an interesting area of future research. Even if bribery were akin to (legal) priority pricing, there may be other reasons why profit-maximizing bureaucrats delay bribe requests. We illustrate one such circumstance, wherein waiting costs are non-linear and bribes accelerate service.

The key mechanism in both of our theoretical models is that the cost to the firm of bribe refusal is increasing in the time spent in the system at the point of bribe solicitation. The bureaucrat exploits this by extorting larger bribes. This captures the basic intuition of anti-corruption advocates such as (Myrdal 1968), that instead of demanding bribes in order to speed things up, corrupt bureaucrats may exploit delays in order to attract bribes.

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A. Proofs

A.1 Proof of Proposition 1

The second part of the result holds when an equilibrium with bribery exists since we focus on pure strategies. In particular, when all firms accede to the server's bribe request, the system corresponds to an M/M/1 queue and the proportion of corrupt firms corresponds to the probability of waiting more that t units of time which is equal to e^{-t/w_0}.

For the first part of the result, all firms pay a bribe when requested to do so at the equilibrium if and only if a tagged firm does not have an incentive to reject the bribe. The expected cost if the tagged firm bribes the server is equal to $cw_0 + b$. On the other hand, if the tagged firm refuses to bribe the server, it will receive low priority. Given that the firm has been waiting t units of time when it is requested a bribe, the expected number of firms that are behind in the queue is equal to λT. Further according to Lemma 1 (in Appendix B), the expected number of requests in front of the tagged firm does not depend on t in an M/M/1 queue and is therefore equal to λw_0 by Little's law. Hence, the expected number of firms in the system (including the tagged firm) given that the firm has waited t units of time, is equal to $N(t) \equiv \lambda(t + w_0) + 1$. Since all firms pay a bribe, the tagged firm has low priority and the resulting total waiting time corresponds to the time it takes the server to empty the queue, that is $N(t)$ times the sojourn time, which is equal to w_0 for an M/M/1 queue. It follows that the tagged firm pays a bribe if and only if $cw_0 + b \leq cN(t)w_0$, which yields the result .

A.2 Proof of Proposition 2

From Proposition 1, the agent's objective function becomes,

$$\pi(t, b) \equiv \max_{t \geq 0} \; e^{-t/w_0} \left(c\lambda w_0(t + w_0) - K\right) \lambda.$$

which is log concave. The first order condition yields $t^* = K/(c\lambda w_0)$, from which we deduce $b^* = c\lambda w_0(t^* + w_0)$.

A.3 Proof of Proposition 3

The only other possible equilibrium is when no firm accedes to the server's bribe request. From Lemma 2 (in Appendix C), this equilibrium exists if and only if $\bar{W} - t < b/c + 1/\mu$, where $\bar{W}$ is given by (23). We consider next the following condition,

$$\lambda w_0 (t + w_0) + 1/\mu < \bar{W} - t \tag{9}$$

which implies that no equilibrium without bribery exists if (4) holds. We have,

$$\begin{aligned} \bar{W} - t > \lambda w_0 (t + w_0) + \frac{1}{\mu} \quad &\Leftrightarrow \quad \bar{W} - \frac{t}{1-\rho} > \lambda w_0^2 + \frac{1}{\mu} \\ &\Leftrightarrow \quad \bar{W} - \frac{t}{1-\rho} > w_0 \left(1 + \frac{\rho^2}{1-\rho}\right). \end{aligned} \tag{10}$$

From (23), we deduce after some algebraic manipulation that,

$$\bar{W} - \frac{t}{1-\rho} \quad = \quad w_0 \left(1 + \frac{1 - (1 + t/w_0)e^{-t/w_0}}{1 - \rho e^{-t/w_0}}\right)$$

so that (10) is equivalent to, for $t = t^*$,

$$\phi(\lambda) \equiv \frac{1 - (1 + u(\lambda))e^{-u(\lambda)}}{1 - \rho e^{-u(\lambda)}} - \frac{\rho^2}{1-\rho} \quad > \quad 0 \tag{11}$$

where $u(\lambda) \equiv K/(c\lambda w_0^2)$ is decreasing in λ. Note then that the numerator of the first term of $\phi(\cdot)$ is increasing in $u(\lambda)$ and hence decreasing in λ. We have $\phi(0) = 1$ and $\lim_{\lambda \to \mu} = -\infty$. The result holds by taking $\hat{\lambda}$ equal to the smallest value of λ such that $\phi(\lambda) = 0$.

A.4 Proof of Proposition 4

From Propositions 1, $t^* > 0$ when $K > 0$. It follows from Proposition 2 that a firm bribes the agent at the equilibrium if and only if it spends at least $t^* > 0$ units of time in the system, which establishes the first point. The second point holds since $p(t, b)$ decreases in t while t^* increases in K.

A.5 Proof of Proposition 5

Assume that at the equilibrium, all firms bribe the server if they spend t units of time in the system. Because the discipline is FCFS, a firm can only leave the system when it is in service. Indeed, if there were still a firm ahead in the system, it would have arrived earlier and therefore waited for longer than t units of time, which is a contradiction. Further, service times are exponentially distributed and thus memoryless. It follows that $R_t = S$ almost surely. Hence, we deduce from (5) that $E[c(t+S)] - c(t) \geq b$. The conversion is immediate following a similar approach.

For the second part of the result, at the equilibrium, the system corresponds to an M/M/1//t queue where customers are impatient with deterministic abandonment time t. The term $p(t, b)$ corresponds then to the probability of loss which is equal to the right hand side of (6) (see for instance (Choi et al. 2001)).

For the last part of the result, the only other possible equilibrium is when none of the firms accede to the server's bribe request. In other words, no firm leaves the system before receiving the service and the queue corresponds to a simple M/M/1. Thus, the waiting time (including service) experienced by a firm is exponentially distributed with rate $1/w_0$. Denote by W this waiting time. It follows that $R_t = W$ almost surely and we must have from (5) that $E[c(t+W)] - c(t) < b$. Note, however, that W has first-order stochastic dominance over S. Thus we have,

$$b > E[c(t+W)] - c(t) > E[c(t+S)] - c(t)$$

which excludes the previous equilibrium where all firms bribe the server.

A.6 Proof of Proposition 6

For feasible choices of (t, b), $E[c(t+S)] - c(t) \geq b$, and from Proposition 5 the firm always agrees to the bribe when asked. The system then becomes a queue with abandonment, where customers leave as soon as they spend t units of time in the system and equation (3) is equivalent to,

$$\pi(t) = \max_{t \geq 0} \frac{(1-\rho)e^{-t/w_0}}{1-\rho e^{-t/w_0}} (b(t) - K) \tag{12}$$

where $b(t) \equiv E[c(t+S)] - c(t)$. In particular, since $c(\cdot)$ is convex, $b(t)$ is non-decreasing in t. Consider further $b'(\cdot)$ and $b''(\cdot)$ the first and second order derivatives of $b(\cdot)$, respectively.

Since $c''(\cdot)$ is positive non increasing, we deduce that $b'(\cdot) \geq 0$ and $b''(\cdot) \geq 0$. It follows that the first order derivative of $\pi(\cdot)$ satisfies,

$$\pi'(t) \geq 0 \quad \Leftrightarrow \quad \phi(t) \equiv b'(t)(1 - \rho e^{-(\mu-\lambda)t}) - (\mu - \lambda)(b(t) - K) \geq 0, \tag{13}$$

where $\phi'(\cdot)$, the first order derivative of $\phi(\cdot)$ is such that, with $\rho < 1$,

$$\phi'(t) \geq 0 \quad \Leftrightarrow \quad b''(t) - (\mu - \lambda)b'(t) \geq 0. \tag{14}$$

Since $c''(\cdot)$ is non-increasing, $b''(\cdot) \leq 0$ and $\phi'(\cdot) \leq 0$. It follows that $\pi'(\cdot)$ is a non-increasing function. Further, $\lim_{t\to+\infty} \phi(t) < 0$, since $b'(t)$ is a non-negative non-decreasing function and therefore approaches zero as t goes to infinity. On the other-hand we have $\phi(0) = (1-\rho)(b'(0) - \mu(b(0) - K))$. Hence if $\phi(0) > 0$, which is equivalent to (7), a unique t^* exists such that $\pi'(t^*) = 0$. In this case, $b(t^*) - K$ and hence $\pi(t^*)$ are positive from (13), so that the agent engages in bribery. If $\phi(0) \leq 0$, that is if (7) does not hold, then the maximum is achieved for $t^* = 0$.

A.7 Proof of Proposition 7

For linear and quadratic costs, $c''(\cdot)$ is non-increasing and Proposition 6 applies. For the linear case, Condition (7) is equivalent to $K > E[c(S)]$. This is however also equivalent to $b < K$ since $b = E[S]$ from (5) with $R_t = S$. According to (3), $b < K$ implies that the agent's profit is negative and the agent does not engage in bribery altogether and the first part of the result follows.

When $c(x) = ax^2$, The left hand side of Condition (7) is equivalent to

$$(E[c'(S)] - c'(0))\ E[S] - E[c(S)] = 2aE[S]^2 - aE[S^2] = 0,$$

since S is exponentially distributed with $Var[S] = E[S]^2$. It follows that t^* is positive for all values of K^*.

A.8 Proof of Proposition 8

The proof of the first part is similar to the proof of Proposition 4. For the second point, taking the derivative of π with respect to K, we obtain $d\pi/dK = -p(t)$ which is increasing in t. In other words, π is supermodular in t and K. It follows that t^* is increasing in K, which implies that $p(t^*)$ is decreasing in K.

B. Residual Number of Customers in an M/M/1 Queue

Consider a classical M/M/1 with arrival and service rates equal to λ and μ, respectively. Tag a customer. We are interested in evaluating the queue length in front of the tagged customer (including service). More formally, let N_r be the remaining number of jobs in front of the tagged customer. We wish to evaluate $E[N_r|T \geq t]$, where T is the time spent by the tagged customer in the system. The following lemma states that $E[N_r|T \geq t]$ does not depend on t.

Lemma 1.

$$E[N_r|T \geq t] = \lambda w_0.$$

Proof: We have,

$$E[N_r|T \geq t] = \frac{\sum_{n=0}^{+\infty} nP(N_r = n; T \geq t)}{P(T \geq t)}. \tag{15}$$

Denote by L the total number of customers in the system seen by a tagged customer when she joins the queue. We deduce that

$$\begin{aligned} P(N_r = n; T \geq t) &= \sum_{l=n}^{+\infty} P(N_r = n; T \geq t; L = l) & (16) \\ &= \sum_{l=n}^{+\infty} P(C(t) = l - n)P(L = l) & (17) \end{aligned}$$

where $C(t)$ is a Poisson process with rate μ. In other words, for n customers to be in front of the tagged customer, $l - n$ service completions must have occurred in t units of time. It follows then that, from the PASTA property

$$\begin{aligned} P(N_r = n; T \geq t) &= \sum_{l=n}^{+\infty} P(C(t) = l - n)\rho(1-\rho)^l & (18) \\ &= \rho(1-\rho)^n \sum_{n=0}^{+\infty} e^{-\mu t} \frac{(\mu t \rho)^k}{k!} & (19) \\ &= \rho(1-\rho)^n e^{-t/w_0} & (20) \end{aligned}$$

where the first equality follows from a change of variable and the last one holds with $1/w_0 = \mu(1-\rho)$. Hence, we deduce after some algebraic manipulations that

$$\sum_{n=0}^{+\infty} nP(N_r = n; T \geq t) \quad = \quad \frac{\rho}{1-\rho} e^{-t/w_0} \tag{21}$$

where $\rho/1-\rho = \lambda w_0$. The result follows then from (15) where $P(T \geq t) = e^{-t/w_0}$ for an M/M/1.

C. Unicity of the Equilibrium with Bribery

We present in the following conditions under which an equilibrium without bribery exists. We deduce then necessary and sufficient conditions for which the equilibrium with bribery is unique.

Lemma 2. *Given agent's choices b and t, a Nash equilibrium without bribery exists (i.e. $p(t,b) = 0$) if and only if,*

$$\bar{W} - t < \frac{b}{c} + \frac{1}{\mu}. \tag{22}$$

with

$$\bar{W} \equiv \frac{w_0}{(1-\rho)\left(1-\rho e^{-t/w_0}\right)} \left((2-(1+\rho)e^{-t/w_0})(1-\rho) + (1-e^{-t/w_0})\frac{t}{w_0} \right) \tag{23}$$

Proof: When all firms refuse to bribe, all firms are moved to the end of the queue if they wait t units of time. This is an equilibrium if and only if a tagged firm does have incentive to accept the bribe.

If the firm accepts to bribe, its request is processed right away and the corresponding expected total cost is then $c/\mu + b$. On the other hand, if the firm refuses to bribe the expected waiting cost corresponds to the remaining waiting time in the system, given that the firm has waited more than t. Denote by $W(t)$ this waiting time and $p(t)$ the probability that a firm waits more than t units of time in the system. Similarly, we define by $\bar{W}(t)$ the expected waiting time given that the firms wait less than t. From the conservation of flow, we deduce that $w_0 = p(t)\bar{W}(t) + (1-p(t))W(t)$ which is equivalent to,

$$\bar{W}(t) = \frac{w_0 - (1-p(t))W(t)}{p(t)}. \tag{24}$$

Note that $p(t)$ and $W(t)$ correspond then to the probability of loss and the expected waiting time, respectively, of an M/M/1//t queue where customers balk after t units of time. For this system, the probability of loss is equal to (6), while $f(\cdot)$, the density of the waiting time distribution is equal to,

$$f(x) = \frac{1}{1-\rho e^{-t/w_0}} \frac{e^{-x/w_0}}{w_0}$$

from which we deduce that

$$W(t) = \int_0^t f(x)dx = \frac{w_0 - (t+w_0)e^{-t/w_0}}{1-\rho e^{-t/w_0}}.$$

It follows then from (24) that

$$\bar{W}(t) = \frac{w_0\left((1-\rho e^{-t/w_0})^2 - (1-e^{-t/w_0})\left(1-(t/w_0+1)\,e^{-t/w_0}\right)\right)}{(1-\rho)(1-\rho e^{-t/w_0})e^{-t/w_0}}.$$

The expected remaining waiting time given that the firm has waited t units of time is then equal to $W(t) - t$ from which the result follows.

Finally, we can then deduce that a Nash equilibrium with bribery exists and is unique if and only if(i.e. $p(t,b) = 0$) if and only if,

$$\frac{b}{c} \leq \min\left[\bar{W} - t - \frac{1}{\mu},\ \ \lambda w_0\,(t+w_0)\right]. \tag{25}$$

(1) Country	(2) Obs.	(3) Percent
Argentina	109	3.98
Brazil	100	3.65
Chile	100	3.65
Czech Republic	100	3.65
Egypt	103	3.76
France	100	3.65
Germany	100	3.65
Ghana	104	3.79
Hungary	104	3.79
India	117	4.27
Indonesia	100	3.65
Japan	100	3.65
Malaysia	100	3.65
Mexico	100	3.65
Morocco	151	5.51
Nigeria	108	3.94
Pakistan	100	3.65
Philippines	100	3.65
Poland	109	3.98
Russia	101	3.68
South Africa	101	3.68
South Korea	100	3.65
Senegal	106	3.87
Singapore	100	3.65
UK	100	3.65
USA	129	4.70
Total	2,742	100

Table 1: Sample Coverage. Source: BPS 2008. At least 100 interviews were conducted with senior executives in each country listed in column 1. Column 2 indicates the number of completed responses.

(1) Variable .	(2) Mean	(3) Std. Dev.
Small (5-49 employees)	0.532	0.499
Medium (50-99 employees)	0.176	0.381
Large (100+ employees)	0.292	0.455
Multi-National Corporation	0.290	0.454
Foreign ownership (20%+ of capital)	0.204	0.403
Family-owned	0.659	0.474
Locally headquartered	0.762	0.426
Sector	Obs.	Percent
Agriculture	59	2.15
Defense	8	0.29
Banking & finance	191	6.97
Civil. aero	13	0.47
Fisheries	15	0.55
Forestry	10	0.36
Telecom	76	2.77
Transport	121	4.41
Pharma	129	4.70
Heavy manufacturing	149	5.43
IT	140	5.11
Light manufacturing	492	17.94
Mining	18	0.66
Oil	42	1.53
Real estate	93	3.39
Power	20	0.73
Pub. works. & constr.	132	4.81
Hotels	151	5.51
Utilities	60	2.19
Other	823	30.01
Total	2,742	100

Table 2: Firms: Summary Statistics. Source: BPS 2008. No missing observations

(1)	(2)	(3)	(4)	(5)	(6)
		Bribe Requests		Waiting time	
Server	Obs.	Prop. of Firms	Std. Dev.	Average No. Days	Std. Dev.
Customs	722	0.321	0.467	19.11	47.29
Sanitary Inspections	505	0.275	0.447	23.25	60.66
Police	604	0.417	0.494	28.60	81.03
Telephone	1019	0.109	0.312	18.76	52.20
Electricity	843	0.204	0.403	24.11	64.63
Water	626	0.160	0.367	17.68	50.64
Gas	369	0.154	0.362	18.21	50.16
Tax Revenue Authorities	1087	0.236	0.425	29.61	70.11
Any service	1798	0.231	0.359	26.17	57.52

Table 3: Bribe Requests and Waiting Times. Source: BPS 2008. Column 2 denotes the number of firms who, in the previous year, requested a service from the server listed in column 1 and report both whether or not a bribe was requested and waiting times. Column 3 denotes the proportion of firms (listed in column 2) who faced a bribe request in order to expedite service. Column 5 denotes the average waiting time (in days) for the service listed in column 1.

Variable	Description	Mean	Std. Dev.
Economic Indicators			
GDP	GDP per capita (constant 2000 US$)	10352.0	12336.8
Employment	Employment rate (%)	41.9	10.8
Life Expectancy	Life expectancy at birth, total (years)	71.4	9.3
Military Expenditure	Military expenditure (% of GDP)	2.1	1.1
Population	Population, total (millions)	130.2	226.4
Ease of Doing Business Indicators			
Legal Rights	Strength of legal rights index (0=weak to 10=strong)	6.0	2.4
Contract enforcement	Procedures to enforce a contract (number)	36.0	6.2
Property registration	Procedures to register property (number)	6.2	2.6
Business registration	Start-up procedures to register a business (number)	8.7	3.5
Warehouse construction	Procedures to build a warehouse (number)	22.0	11.0

Table 4: Country Characteristics. Source: World Bank World Development Indicators and Global Development Finance (GDF), available at *http://databank.worldbank.org*.

Service	Waiting Times With and Without Bribes					
	Number of Days			Log(Number of Days)		
(1)	(2) Bribe	(3) No Bribe	(4) Difference	(5) Bribe	(6) No Bribe	(7) Difference
Customs	26.78	15.48	11.31**	2.453	1.962	0.491***
	(4.022)	(1.736)	(4.384)	(0.079)	(0.053)	(0.095)
Sanitary Inspections	33.77	19.25	14.52**	2.382	2.005	0.377***
	(6.834)	(2.641)	(7.334)	(0.115)	(0.066)	(0.133)
Police	31.22	26.72	4.506	2.090	1.662	0.428***
	(5.017)	(4.368)	(6.658)	(0.091)	(0.078)	(0.120)
Telephone	15.82	19.12	-3.298	2.157	1.880	0.277**
	(2.114)	(1.816)	(2.789)	(0.109)	(0.043)	(0.117)
Electricity	36.12	21.04	15.09**	2.464	1.870	0.593***
	(6.017)	(2.318)	(6.452)	(0.107)	(0.052)	(0.119)
Water	21.64	16.93	4.710	2.332	1.777	0.555***
	(4.594)	(2.243)	(5.117)	(0.115)	(0.056)	(0.128)
Gas	25.98	16.79	9.197	2.454	1.799	0.655***
	(7.069)	(2.798)	(7.613)	(0.160)	(0.071)	(0.175)
Tax Revenue Authorities	31.54	29.01	2.533	2.559	2.121	0.437***
	(4.131)	(2.473)	(4.817)	(0.078)	(0.051)	(0.094)

Table 5: Average Waiting Time With and Without Bribes. Source: BPS 2008. This table presents the average number of days waited for the service mentioned in column 1 for firms which were (columns 2 & 5) and were not (columns 3 & 6) requested a bribe, in levels (columns 2-3) and logarithms (columns 5-6) as well as their respective first differences (columns 4 & 7); Huber-White standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, * $p < 0.1$.

Variables	(1) Customs	(2) Sanitary	(3) Police	(4) Telephone	(5) Electricity	(6) Water	(7) Gas	(8) Tax
Bribe request	0.446***	0.583***	0.556***	0.324**	0.565***	0.469***	0.667***	0.698***
	(0.125)	(0.138)	(0.148)	(0.129)	(0.135)	(0.163)	(0.246)	(0.112)
Country Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Economic Environment	NO	NO	NO	NO	NO	NO	NO	NO
Ease of Business	NO	NO	NO	NO	NO	NO	NO	NO
Company Characteristics	YES	YES	YES	YES	YES	YES	YES	YES
Sector Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	722	505	604	1019	843	626	369	1087
Pseudo R-squared	0.0978	0.108	0.0772	0.0997	0.0812	0.102	0.0911	0.0891
Log pseudo likelihood	-1071	-777.5	-1026	-1572	-1377	-962.7	-567.3	-1800
Bribe request	0.293**	0.512***	0.429***	0.209	0.487***	0.302*	0.656***	0.465***
	(0.116)	(0.148)	(0.151)	(0.134)	(0.136)	(0.167)	(0.24)	(0.114)
Country Fixed Effects	NO	NO	NO	NO	NO	NO	NO	NO
Economic Environment	YES	YES	YES	YES	YES	YES	YES	YES
Ease of Business	YES	YES	YES	YES	YES	YES	YES	YES
Company Characteristics	YES	YES	YES	YES	YES	YES	YES	YES
Sector Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	722	505	604	1019	843	626	369	1087
Pseudo R-squared	0.0521	0.0642	0.0547	0.0584	0.0544	0.0736	0.11	0.053
Log pseudo likelihood	-1125	-816.1	-1051	-1644	-1417	-992.7	-555.4	-1872

Table 6: Tobit regression. Dependent variable = log(waiting time). This table presents regression results from a standard censored Tobit model in which the dependent variable is the natural log of waiting time for the service mentioned in the column headings. Each column pertains to a different regression. The dependent variable is censored above at 365 days. "Bribe request" is a dummy variable equal to 1 if a bribe request was made and 0 otherwise. The bottom of the table mentions control variables included (but not reported) in each of the regressions: "Economic environment" includes GDP per capita, employment rates, life expectancy, military expenditure, and population; "Ease of business" includes an index for the strength of legal rights, and (separately) the number of procedures needed to enforce contracts, register property, register a new business, and build a warehouse (summarized in Table 4). "Firm characteristics" include dummy variables for firm size, MNCs, foreign-ownership, family-ownership, and local headquarters (summarized in Table 2). ***$p < 0.01$, **$p < 0.05$, * $p < 0.1$. Huber-White standard errors in parentheses.

Variables	(1) Customs	(2) Sanitary	(3) Police	(4) Telephone	(5) Electricity	(6) Water	(7) Gas	(8) Tax
Bribe request	0.769***	0.715***	0.779***	0.841*	0.721***	0.814**	0.678**	0.791***
	(0.063)	(0.074)	(0.067)	(0.075)	(0.065)	(0.085)	(0.104)	(0.058)
Economic Environment	YES	YES	YES	YES	YES	YES	YES	YES
Ease of Business	YES	YES	YES	YES	YES	YES	YES	YES
Company Characteristics	YES	YES	YES	YES	YES	YES	YES	YES
Sector Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	687	475	557	930	770	558	348	1010
Log pseudo likelihood	-3832	-2449	-2933	-5461	-4338	-2987	-1680	-5964

Cox Regression Hazard Ratio Estimates. This table presents estimates for the Cox proportional hazard model, with right censoring at 365, where the event is service provision. Each column pertains to a different regression for the service mentioned in the column heading. "Bribe request" is a dummy variable equal to 1 if a bribe request was made and 0 otherwise. The coefficient associated with this variable, presented in the first row, is the hazard ratio, which is equal to $\exp(\hat{\beta})$ from equation 2, with robust standard errors in parentheses calculated obtained by applying the delta method to the standard error of $\hat{\beta}$. The bottom of the table mentions control variables included (but not reported) in each of the regressions, as described in the note to Table 6. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}\ p < 0.1$.

Variable	Description	Obs	Mean	Std. Dev.	Min	Max
Public Servants	Firms often or almost always bribe public servants (dummy)	2611	0.154	0.361	0	1
Political Parties	Firms often or almost always bribe political parties (dummy)	2496	0.120	0.325	0	1
Policy Outcomes	Bribes often or almost influence public policy outcomes (dummy)	2505	0.349	0.477	0	1
Anti-corruption	The government is effective at fighting corruption (Likert)	2708	2.248	1.236	1	5

Table 7: Corruption: Prevalence and Deterrence. Source: BPS 2008.

VARIABLES	(1) Public Servants	(2) Public Policy	(3) Bribe Efficacy
Govt. Anti-Corruption Efficacy	-0.178***	-0.131***	-0.227***
	(0.034)	(0.035)	(0.026)
GDP p.c. (2000 $)	-0.000***	-0.000	0.000**
	(0.000)	(0.000)	(0.000)
Employment	-0.022***	-0.014***	-0.015***
	(0.004)	(0.005)	(0.004)
Life Expectancy	-0.007	-0.003	-0.017***
	(0.007)	(0.008)	(0.006)
Military Expenditure	0.086*	0.089**	0.019
	(0.045)	(0.044)	(0.032)
Population (mils.)	-0.001***	-0.000	-0.001***
	(0.000)	(0.000)	(0.000)
Legal Rights	-0.008	-0.014	-0.049***
	(0.021)	(0.022)	(0.018)
Contract Enforcement	0.040***	0.028**	0.019**
	(0.012)	(0.012)	(0.009)
Property Registration	-0.115***	-0.096***	-0.010
	(0.019)	(0.019)	(0.014)
Business Registration	0.047***	0.067***	0.042***
	(0.014)	(0.016)	(0.012)
Warehouse Construction	0.000	-0.004	0.005
	(0.004)	(0.004)	(0.003)
Small	-0.127	-0.085	0.146*
	(0.096)	(0.106)	(0.078)
Medium	0.047	0.002	0.145
	(0.109)	(0.118)	(0.090)
MNC	-0.045	0.004	-0.082
	(0.100)	(0.100)	(0.081)
Foreign Ownership	0.124	0.131	0.225**
	(0.122)	(0.132)	(0.100)
Family Owned	0.026	-0.023	0.113*
	(0.079)	(0.084)	(0.065)
Locally Headquartered	0.360***	0.323***	0.085
	(0.105)	(0.117)	(0.086)
Sector Fixed Effects	YES	YES	YES
Observations	2576	2464	2482
Pseudo R-squared	0.160	0.122	0.090
Log pseudo likelihood	-932.5	-796.2	-1462

Table 8: Corruption Deterrence and Bribery. This table presents regression results from a Probit model, where the binary dependent variables as well as the key explanatory variable of interest in the column headings are as defined in Table 7. The remaining covariates are as defined in earlier tables. ***$p < 0.01$, **$p < 0.05$, * $p < 0.1$. Huber-White standard errors in parentheses.