Distribution Agreement

Fareed Yousif 17 April 2013

Corruption in the Market for Government Procurement Contracts

By

Fareed Yousif

Dr. Maria Arbatskaya

Adviser

Department of Economics

Dr. Maria Arbatskaya

Adviser

Dr. Skip Garibaldi

Committee Member

Dr. Grace Pownall

Committee Member

Dr. Thomas Remington

Committee Member

2013

Corruption in the Market for Government Procurement Contracts

By

Fareed Yousif

Dr. Maria Arbatskaya

Adviser

An abstract of
a thesis submitted to the Faculty of Emory College of Arts and Sciences
of Emory University in partial fulfillment
of the requirements of the degree of
Bachelor of Arts with Honors

Department of Economics

2013

Abstract

Corruption in the Market for Government Procurement Contracts

By Fareed Yousif

Bribery in Government Procurement Contracts represents a significant portion of Worldwide GDP—and can have significant costs to society. This paper examines firm behavior in the context of expending both productive efforts and corrupt efforts towards winning a government procurement contract, where a government official selects the winner. In general, firms will invest more in productive behavior and less in corrupt behavior when fines on firms and officials are increased and when complementarity in detection is increased. These results were tested empirically using firm-level data collected by the World Bank in the Business Environment and Enterprise Performance Survey. I analyzed firms' decisions to investment in productive behavior and corrupt behavior using suitable proxies for fines and complementarity. Several important results emerged. In general, higher fines and complementarity lower bribery and increase investment in productive behavior.

Corruption in the Market for Government Procurement Contracts

By

Fareed Yousif

Dr. Maria Arbatskaya

Adviser

A thesis submitted to the Faculty of Emory College of Arts and Sciences
of Emory University in partial fulfillment
of the requirements of the degree of
Bachelor of Arts with Honors

Department of Economics

2013

Acknowledgments

I would like to thank my adviser, Dr. Arbatskaya, for her support and guidance throughout the process of writing this thesis. Without her patience, encouragement, and contributions, I would not have been able to complete this project—or any project of this quality. I would also like to thank my committee members not only for their support in completion of my thesis, but also for their substantial contributions to my education while at Emory. Finally, I would like to thank my family and friends who have provided immense support and encouragement to me throughout my academic career.

Table of Contents

INTRODUCTION **1**

LITERATURE REVIEW **5**

CONSEQUENCES OF CORRUPTION: GOOD, BAD, OR NEITHER? 6

CAUSES AND PREVENTION OF CORRUPTION 8

CORRUPTION IN PROCUREMENT CONTRACTS 13

THE MODEL **13**

SOLUTION AND RESULTS 18

Case 1: $\varphi = 0$ and $A_G > 0$ *20*

Case 2: $\varphi = 0$ and $A_G < 0$ *23*

Case 3: $A_G = 0$ *25*

Case 4: $\varphi > 0$ and $A_G \neq 0$ *25*

SPECIAL CASE: SYMMETRIC FIRMS 27

COMPARATIVE STATICS 29

EMPIRICAL MODEL **31**

DATA 31

VARIABLES 35

METHODOLOGY 38

EMPIRICAL RESULTS 44

LIMITATIONS 51

CONCLUSIONS **52**

APPENDIX 1: DESCRIPTION OF VARIABLES **55**

APPENDIX 2: TABLES **56**

APPENDIX 3: GRAPHS AND FIGURES **67**

APPENDIX 4: PROOFS **70**

REFERENCES **73**

Corruption in the Market for Government Procurement Contracts

Introduction

In 2007, the Taipei City Government of Taiwan annulled a nine year, multimillion dollar contract with a large multimedia group after learning that an executive from the firm bribed government officials to win the contract. In May 2012, the 27th richest family in the world was arrested in connection with bribes to the Secretary of Civil Service in Hong Kong—the second highest position in the Hong Kong local government. Hong Kong is regarded as one of the least corrupt nations in the world—even ahead of the US and the UK—and still corrupt transactions permeate the highest levels of business and government.

In 2005, estimates of the total dollars spent on corruption transactions exceeded US$ 1 trillion—a large portion of which went towards bribery of government officials (Kaufmann, 2005). More specifically, the Organisation for Economic Co-operation and Development (OECD) estimated that public procurement contracts represent approximately 20% of member countries' GDP and are often an even greater percentage in non-member countries. Depending on the region, bribes can range from 5 to 25 percent of the total procurement contract value (Bribery in Public Procurement, 2007). Even on the low end, corrupt arrangements in government procurement transactions have tremendous importance for the global economy.

Incentives to bribe vary drastically around the world. The acts of giving and receiving bribes are outlawed in nearly every country. However, in some countries, directors are not personally liable for misconduct while in others, directors could face punishment as severe as a life sentence. In the UK, for example, recent legislation holds directors personally liable for acts of bribery committed by employees—with or without the directors' knowledge. Similar to many other countries, the only defense for directors in the UK is to prove that the company took adequate measures to prevent bribery. Singapore, which is one of the least corrupt nations in the world, has relatively modest penalties for bribery. In particular, government officials accepting bribes are required to return the amount to the state and could face several years in jail. Interestingly, Singapore also allows the briber to recover the bribe paid as civil debt if the corrupt transaction is detected. Therefore, the official could pay double what he or she received.

Countries like the UK and Singapore are different in that they have devoted substantial resources to the fight against corruption. Thus, the risk of detection in these counties is reasonably high. However, unlike Singapore, the US and the UK do not rank in the 10 least corrupt countries in the world, highlighting the fact that substantial resources and strict legislation are not enough to fight corruption. It is also interesting to note that the UK has not seen improvement in its corruption index score following the passage of its anti-bribery legislation.

Despite the effects bribery can have on the global economy, many countries do not penalize those involved in corrupt transactions as heavily as just described. In the Ukraine, for instance, penalties for giving a bribe do not involve jail time; in nations such as Uzbekistan, the penalty for giving or receiving a bribe can involve jail time and substantial monetary penalties. However, the legal provisions are inherently flawed: the corrupt parties must have entered into a transaction that was "knowingly illegal," making enforcement of corruption legislation much more difficult. Not surprisingly, both countries are some of the worst performers on the Corruption Perceptions Index.

In some sense, a firm (or its managers) will view corruption as part of everyday business; they will structure their business decisions in a way that creates the most value for themselves and their firm. So the question is what drives corrupt transactions.

Although there are many different situations where two parties will engage in a corruption transaction, the primary focus of this paper will be corruption in government procurement contracts. A firm will bribe in a way that maximizes its payoff after giving the bribe, which is a function of the value that the firm will receive from bribing, the potential fines it may face, and the bribe itself. Officials will make their decisions based on several factors including the amount of the bribe, the potential fines the officials could face, and the quality of the winning firm's work.

The official's utility can be modeled in several different ways, but it is important to include not only a measure of the bribes themselves but also a relative measure of the bribes—even though it is likely the official will receive the gross bribe regardless of the winner. It makes sense that the official will be swayed, at least in part, by the firm giving the larger bribe. It is also important to recognize that the official receiving the bribe will actually only receive a part of it and pass a portion of the bribe to his or her superiors. In this sense, it is possible to view the probability of being fined or caught as a function of how much money the official is able pass on to his or her superiors.

Not only is it important for the official to receive large bribes from firms, but also it is equally important that the bribing firm produce high quality work. As quality has a greater impact on the official's selection decision, the better the expected economic outcome. Much research, however, has pointed out the detrimental effects corruption has on economy, specifically with respect to GDP, investment, and innovation.

Firms recognize the official's decision criteria and will make a decision that maximizes their payoffs. Firms not only adjust the amount of their bribe; they can also adjust other factors that will influence the official's decision. For example, a firm can become the highest quality producer of a particular product, inevitably leading to an advantage for the firm. However, increasing quality requires investment by the firm. There is a clear tradeoff between money spent on improving quality and money spent on the bribe. Finally, the firm recognizes that other firms are facing similar decisions and will therefore adjust bribe and quality accordingly. In other words, if one firm estimates the competition's bribe and quality at a certain level, it can raise or lower its bribe so that its expected payoff is maximized.

The primary focus of this paper is to analyze the behavior of firms and officials in a government procurement contract setting, while taking into account that government officials will value the quality of the winning firm in addition to the bribes received. Limited theoretical economic research has been done to examine the problem of bribery and there is still no consensus on the determinants of corruption or optimal anti-corruption practices.

This paper will focus primarily on developing a model that explains why corruption persists, the points at which negative economic outcomes will occur, and an analysis of the optimal policy measure to reduce corruption. It is noted here, and throughout, that one size does not necessarily fit all; it may be necessary for different jurisdictions to offer different anticorruption policies in order to best serve society and reduce corruption. Corruption will be defined for the purposes of this paper as the misuse of public office for private benefit (The World Bank). As this paper relates mostly to bribery, misuse of public office will be accepting payment of some kind that influences the official's objective decision-making process.

I will begin the discussion with a review of the literature on corruption, primarily from an economic perspective. I will then develop the model motivated above followed by the derivation of testable implications of the model. The final section will empirically test these results.

Literature Review

Research on the economics of corruption has increased substantially in recent years. At this point, however, looking at corruption from an economic perspective is still relatively new, and many questions remain unanswered. Some research has focused primarily on the causes and consequences of corruption; other research has focused on developing optimal anticorruption practices. It has become accepted more recently that corruption often leads to socially undesirable outcomes, but this has not always been the case. Moreover, there are many (often contradictory) views on how best to mitigate the negative effect of corruption on an economy.

Put simply, bribery is a monetary transfer that illegally alters a government official's incentives and, therefore, decision-making process. The way bribes affect a government official's decisions can help answer many of the open economic questions. It is easy to see that corrupt behavior results in a wealth transfer, but the effect of such a transfer on social welfare has been heavily researched and a wide array of views have emerged.

Consequences of Corruption: Good, Bad, or Neither?

Economists have upheld widely different views on the effects corruption can have on the economy. Leff argued that corruption could lead to improved economic outcomes by motivating poorly paid government officials to act more efficiently (Leff, 1964). For example, entrepreneurs are able to circumvent cumbersome or unnecessary regulation in developing economies. Or more relevantly, corporations can receive necessary permits or patents more quickly. This is consistent with Tanzi's findings that increasing wages decreases corruption (Tanzi, 1998). Such arguments seem plausible: in the case of a government procurement contract, "good corruption" occurs so long as the firm receiving the contract is the socially optimal producer.

Susan Rose-Ackerman criticizes the view that bribery can have economic benefit. She notes that even though some corrupt transactions may create efficiency, there is an abundance of corruption transactions that do not: for example, tax evasion or bribery to avoid environmental regulations. Further, she notes that government officials who receive bribes have the right to "redesign their activities" by "creating scarcity, delay, and red tape to encourage bribery" (Rose-Ackerman, 1999). Thus, firms are essentially forced to bribe, but the costs to society in such a situation will be very large.

Mauro was one of the first researchers to definitively show that corruption has a negative effect on both investment and growth (Mauro, 1995). However, Wedeman criticized Mauro's study, showing that Mauro's findings hold for countries with relatively small levels of corruption; however, the correlation between investment and corruption looses significance as the level of corruption increases in a country (Wedeman, 1996). This leads to the conclusion that different levels of corruption have different effects on investment. A 1999 study substantiated this view: in countries where the "predictability" of corruption was higher, the ratio of investment to GDP was higher, controlling for a variety of other factors (Campos, 1999). The main conclusion, again, is that the "nature of corruption is crucial to its economic effects" (Lambsdorff, 2007).

Many studies have shown that GDP per capita and corruption have a strong negative correlation. However, it is clear that conclusions cannot be drawn from this (Lambsdorff, 2007). That is, wealthier countries have the resources to implement and enforce anticorruption policies but poorer countries cannot do the same. Some more recent studies have tested the impact corruption has on GDP growth. In 1999, Lambsdorff found that the absolute level of corruption does not explain GDP growth, but a change in the level of corruption does explain GDP growth.

Bribery and taxation are similar in that they both create a wealth transfer and they both have distortionary effects on an economy. Bribery, however, is regarded as having a more distortionary effect on economies. Andrei Shleifer tried to answer the question of why corruption can be much more distortionary than taxation. He argues that the governance infrastructure is an important factor is determining the total level of corruption. Moreover, he argues that the illegality of corruption creates a need for secrecy, enhancing the detrimental effects of corruption (Shleifer, 1993).

Paul Romer argued that the many costs of doing business in a developing economy—corruption being one of them—have a tremendous effect on the total output of the economy; the total number of productive activities undertaken in the economy will fall as many firms are driven out of the market. Specifically, he suggests that the extent of such costs greatly exceed the social costs from tariffs (Romer, 1994).

Causes and Prevention of Corruption

In 1968, Becker published one of the first economic analyses of crime. His approach was to analyze criminal behavior from the perspective of a rational person maximizing his or her payoff. Becker took into account the gains from criminal behavior, the costs (including detection risk) of participating in criminal behavior, and the opportunity costs of not being able to participate in legitimate activities as a result of the criminal behavior (Becker, 1968). Put simply, a perfectly rational individual will choose criminal behavior if the gains exceed the expected costs times the probability of detection (Lambsdorff, 2007).

Corruption and bribery can be modeled this way; much of the economic literature focusing on bribery has employed extensions of the basic rational choice model. Specifically, this literature generally focused on either increasing the probability of detection or increasing the expected penalties associated with corrupt behavior, with much debate on which is the optimal way to decrease corruption (Lambsdorff, 2007).

Empirical studies, however, have found rules-based approaches, as described above, unsuccessful in reducing corruption or reducing the business community's perception of the level of corruption. To substantiate the view that rules-based approaches are not successful by themselves, Voigt, Feld, and Aaken, investigated how the independence of prosecutors affected both actual and perceived corruption levels. They found strong evidence that *de jure* (formal) independence does not lead to lower levels of corruption, but *de facto* (factual) independence does lead to lower corruption.

Another entirely different, but equally developed, body of literature focuses on principles-based approaches to lowering corruption. The main idea of such literature is to gain an understanding of individuals' incentives, as much research has shown that negative incentives are a primary cause of increased corruption. However, incentive systems are difficult to implement as "there is not a yardstick that might serve as a remuneration for honesty" (Lambsdorff, 2007). Several researchers argue that a strong value system, built on integrity, is an important method to reduce corruption. Therefore, training employees in ethical behavior is important going forward (Kapstein and Wempe, 1998). This seems very clear, highlighting an important point: in theory, there are several solutions to corruption, however turning them into policies is nearly an impossible task.

Lambsdorff highlights the necessity of a rules-based system built on strong principles at preventing corruption. For example, the United States Foreign Corrupt Practices Act uses such a system. The FCPA is regarded as the most stringent anticorruption legislation in the world, yet it is unclear and relaxed in several areas. Lambsdorff argues that an understanding of the underlying principles, and being held accountable to such principles, makes the legislation stronger. For example, it is conceivable that a literal interpretation of certain rules might lead businessmen to participate in corrupt practices, while the underlying principle would not. Therefore, an understanding of principles is necessary when rules are deficient. Even still, the US is not corruption free and the success of the FCPA relies on a strong judiciary, which is not the case in the countries most affected by corruption. Moreover, many other countries are less corrupt than the US, highlighting the fact that the FCPA is not by itself sufficient to decrease US Corruption to desired levels.

Many empirical studies on the determinants of corruption are done at the country level. Svensson argues that the study of the macro-economic determinants of corruption—although it has provided interesting insights (Mauro's work, for example)—does not provide sufficient understanding of firm-level decisions. Svensson uses a Ugandan country-level survey to examine which firms pay bribes and the magnitude of these bribes. In general, he found that firms that had more unavoidable interactions with the government—for example, exporters, importers, firms receiving public services, and firms that pay higher taxes—all had a higher probability of paying bribes. In addition, he found that firms with the ability to avoid working with the government paid less in bribes, on average (Svensson, 2003). His findings were important because he was able to show that firms' decisions to participate in corruption transactions are affected by factors other than country-level variables as many other studies have suggested.

Theoretical papers have suggested implementing asymmetric penalties to the bribe giver and bribe receiver as an optimal way to decrease corruption. Nell suggests that bribe takers be penalized less for taking a bribe and more for actually carrying out an illegal action associated with receiving the bribe. The idea is that recipients of the bribe have the opportunity to report receipt of a bribe, or alternatively, the bribe giver will face more uncertainty that the corrupt favor will be received. Nell suggests the opposite logic for firms: he suggests penalizing firms heavily for transferring a bribe, but not as heavily for accepting a favor from a government official. If one of the corrupt parties in a transaction were willing to report the other because he or she faced little punishment for doing so, the entire decision making process would be disrupted for bribers.

More recently, the determinants of corruption have been viewed from the perspective of supply and demand. For example, bribes are supplied by the private sector to government officials who desire to increase their wages. The supply of bribes is determined by firms who weigh the potential benefits—often referred to as economic rents in this context—against the costs, which are made of penalties, risk of detection, and potential social stigma. Government officials are in a position to substantially increase their income by accepting bribes but must weigh the potential gains against the risk of detection, the severity of the fine, and the social costs (Elbahnasawy, 2012).

Elbahnasawy suggests that, in general, corruption is determined by a diverse range of factors, including political, sociocultural, and economic factors. He empirically estimates the effect of many of these determinants on multiple corruption indices finding surprising results. Most notable was his discovery that government wages have no effect on perceived corruption, which disproves the findings of Tanzi in 1998. Additionally, he found that openness to international trade decreased perceived corruption but noted only a small effect. He found that the level of voice held by a nation's citizens and the ability to hold government officials accountable did have a significant impact on the levels of perceived corruption (Elbahnasawy, 2012). Nonetheless, Elbahnasawy's main contribution was to dispose of some of the previously suggested determinants of corruption. There is still not a consensus among researchers on the underlying causes of corruption. It seems like that the problem of corruption, like nearly everything else, can be best understood by first understanding the incentives behind those making corrupt decisions.

Some researchers have suggested that increased competition in an economy leads to lower levels of corruption because there are less excess profits (Rents) from which to pay a bribe. However, Bliss and Tella showed that competition does not necessarily lower corruption. They found that the government official's uncertainty surrounding the firms' costs is the most important factor in determining the levels of corruption. This is because uneven cost structures of firms in competition create surplus from which the government official's can extract a bribe. Furthermore, they showed that it may be rational, in some instances, for officials to drive firms out of the market, thereby increasing the profits from which bribes can be paid by the firms left in the market.

Corruption in Procurement Contracts

This paper focuses primarily on corruption in government procurement contracts. Bribery undoubtedly has destabilizing effects on the global economy, but bribery in procurement is particularly important. Bribery in government procurement contracts occurs in nearly every country—even Singapore and the Scandinavian countries (Rose-Ackerman, 1999). In Germany, which ranked 13th in the 1996 corruptions perception index, bribes worth approximately US $1.67 million were transferred in the contract for building a new terminal at Frankfurt International Airport (Rose-Ackerman, 1999).

Obtaining an accurate estimate for total dollars spent on bribes worldwide is an impossible task, but Transparency International estimates that approximately one trillion dollars are spent on bribes annually. Of this, the estimated value of bribes exchanged in procurement contracts is 200 billion dollars—roughly 20% of total bribery (Kauffmann, 2004). Bribes in procurement contracts represent a large portion of total bribery, highlighting the importance research in this area.

The Model

The corruption game presented in this section models a situation where two firms are competing for some project of known value, $v > 0$. Only one firm can win the prize, which is determined by a government official. Each firm can influence the official's selection decision in two ways: by improving quality or by illegally transferring a bribe to the official.

The game is based on Gordon Tullock's efficient rent seeking model, where the probability of winning some prize is the ratio of one player's contributions to some factor over the sum of the contributions by each player in the game. This ratio of contributions is known as the contest success function. Traditionally, there is only one factor players can control. However, I have modified the basic model by incorporating two factors that players can control: one term to represent players' contributions towards quality, which is given by $x_i \geq 0$, and an additional term to represent players' contributions towards bribery, which is given by $b_i \geq 0$. Thus, the contest success functions for quality and bribery are given by:

$$CSF_{xi} = \frac{x_i}{x_1 + x_2}$$ **Equation 1**

$$CSF_{bi} = \frac{b_i}{b_1 + b_2}$$ **Equation 2**

The firms are allowed to have different marginal costs and the contributions to bribery and to quality do not necessarily have to cost the same amount. This is represented in the model by the inclusion of $c_i > 0$ and $d_i > 0$. I have assumed constant marginal costs of quality and bribery.

Finally, firms do not bribe without risk. I include a term for the expected fine firms will have to pay if they are caught bribing, and I assume the bribe will never be returned. The fine firms face is fixed and denoted by $f > 0$. The probability of detection is an increasing function of the bribe that firms pay, which is meant to reflect the fact that increased bribes result in a higher likelihood of detection. For simplicity, I assume that $\rho[b_i] = b_i$, where ρ is the probability of sentencing. Thus, $b_i \in [0,1]$. The individual firm's payoff function is given below:

$$\Pi_i[x_1, x_2, b_1, b_2, \alpha] := \alpha\left(\frac{x_i}{x_1 + x_2}\right) * v - c_i x_i + (1-\alpha)\left(\frac{b_i}{b_1 + b_2}\right) v - d_i b_i - b_i f \qquad \textbf{Equation 3}$$

An additional distinction between this game and the standard Tullock game is the presence of an outside government official who will choose between playing the fair game (valuing quality) and the corrupt game (valuing a bribe). I assume that the official will choose between playing one of these two games with some probability given by alpha. Inside of each game, the government official will take the likelihood of each firm winning as given by the CSF. Thus, $\alpha \in [0, 1]$, and higher alpha implies a higher propensity for the official to play the fair game. To account for this in the model, α is multiplied by the term for the value the official will receive from playing the fair game, and $(1-\alpha)$ is multiplied by the term for the value the official will receive from playing the corrupt game.

The government official receives bribes from each firm regardless of whether they win or not. However, the government official will only value the quality of the winning firm, weighted by the probability of winning with respect to bribery and quality.

Often officials share a portion of the bribes with their superiors to avoid fines. Thus, s is defined as the portion of the bribe the official keeps. In this model, s is an exogenous variable, where $s \in [0, 1]$. The business environment in which the firm operates sets the portion shared by the official: *it is out of the official's control*. One can imagine s being determined by a variety of factors including: a jurisdiction's enforcement infrastructure, wages, or even the amount of the bribe. It is easiest to leave *s* in the general model, given in Equation 5, and to derive comparative static results based solely on changes in *s*. By extension, understanding how market factors affect *s* will directly translate into understanding how market factors affect corruption.

If the government official is caught accepting a bribe, he will pay a fixed fine represented by $f_0 > 0$. Furthermore, $\rho[B, s, \varphi]$ represents the probability of sentencing (having to actually pay the fine); it is not necessarily the probability of detection, because as mentioned, the official can share a portion of the bribes received to avoid fines. There are other considerations as well, such as a corrupt legal system favoring officials or favoring firms. Additionally, there is complementarity between the two bribes in determining the likelihood of sentencing. For example, if the total bribe received amounted to 100 dollars, the likelihood of sentencing would be higher if 50 dollars came from each firm rather than 100 dollars from only one firm. In contrast, one could argue that when only one firm is corrupt, all of the other firms will report the corrupt firm. In this case, the term for complementarity in the model could be negative. Thus, The degree to which complementarity has effect on the likelihood of sentencing is given by $\varphi \in [-1, 1]$. The probability of paying the fine is increasing in B, s, and φ. For simplicity, assume that the probability of sentencing is given as follows:

$$\rho[B, s, \varphi] = (s * (b_1 + b_2 + \varphi * b_1 b_2)) \qquad \textbf{Equation 4}$$

The government official's payoff is given below:

$$\Pi_G[x_1, x_2, b_1, b_2, \alpha] = \alpha * E_x x + (1-\alpha) * E_b x + s(B_1^*(\alpha) + B_2^*(\alpha)) - (s * (b_1 + b_2 + \varphi * b_1 b_2)) * f_0 \quad \textbf{Equation 5}$$

where,

$$E_x x = \sum_{i=1}^{2} \left(\frac{x_i}{x_1 + x_2}\right) x_i \quad \textbf{Equation 6}$$

and,

$$E_b x = \sum_{i=1}^{2} \left(\frac{b_i}{b_1 + b_2}\right) x_i \quad \textbf{Equation 7}$$

$E_x x$ is the expected quality resulting from the fair game, which is determined by summing each firm's contributions to *quality* multiplied by their probability of winning the *fair* game. Similarly, $E_b x$ is the expected quality resulting from the corrupt game, which is determined by summing each firm's contributions to *quality* multiplied by their probability of winning the *corrupt* game.

It should be noted that the model may be interpreted more broadly than simply a game fair game and a corrupt game. Instead, imagine the firms are participating in two activities: productive activities, which benefit society, and unproductive activities, which provide private benefit at the expense of total social welfare. I like to consider the fair game as valuing a firm based on the benefit it can provide society either through high quality or low social cost. The importance of this broad interpretation is self-evident. For example, a firm can simply make a better product or all firms make the same quality product, but one costs less. Alternatively, all of the firms can make the same quality product, but one firm pollutes and the other firm does not.

At this point the model has been fully specified and explained. In the following section, I solve the model and discuss some implications of the model. There are several cases worth discussing. In particular, if φ = 0 (no complementarity in the likelihood of sentencing), then the optimal choice for alpha may be 0 or 1. It is important and interesting to discuss these results. However, when there is complementarity in detection, there will be an interior solution for alpha. For each case, I refer to the numerical examples in Appendix 2 to illustrate the results of the model in each case presented. For the case resulting in an interior concave down solution for alpha, I will derive comparative static results from the parameters. This will provide the basic results I wish to test empirically.

Solution and Results

When two firms are competing against each other for a contract, they will maximize their payoffs, keeping in mind that the other firm is acting in the same way. The equilibrium solutions for x_i and b_i are found by determining the critical points for x_i and b_i, which results in two equation with two unknown for quality and two equations with two unknown for bribery. Solving the individual systems of equation simultaneously for either x_i or b_i results in the equilibrium solutions for each firm's contributions to quality and bribery, which are given below:

$$X_1^*(\alpha) = \frac{c_2 v\alpha}{(c_1 + c_2)^2} \quad \textbf{Equation8}$$

$$X_2^*(\alpha) = \frac{c_1 v\alpha}{(c_1 + c_2)^2} \quad \textbf{Equation9}$$

$$B_1^*(\alpha) = \frac{(d_2 + f)v(1-\alpha)}{(d_1 + d_2 + 2f)^2} \quad \textbf{Equation10}$$

$$B_2^*(\alpha) = \frac{(d_1 + f)v(1 - \alpha)}{(d_1 + d_2 + 2f)^2}$$ **Equation11**

Substituting the solutions from Equations 8 through 11 into the official's payoff in Equation 5 gives the following payoff for the government official:

$$\Pi_G[x_1, x_2, b_1, b_2, \alpha] = \alpha E_x x + (1 - \alpha)E_b x + sB - \ (s(b_1 + b_2 + \varphi b_1 b_2))f_0$$ **Equation 12**

where,

$$B = B_1^*(\alpha) + B_2^*(\alpha) = \frac{v(1 - \alpha)}{d_1 + d_2 + 2f}$$ **Equation 13**

and,

$$E_x x = \sum_{i=1}^{2} \left(\frac{x_i}{x_1 + x_2}\right) x_i = v\alpha \frac{c_1^2 + c_2^2}{(c_1 + c_2)^3}$$ **Equation 14**

and,

$$E_b x = \sum_{i=1}^{2} \left(\frac{b_i}{b_1 + b_2}\right) x_i \ = v * \alpha * \frac{c_1 d_1 + c_2 d_2}{(c_1 + c_2)^2 (d_1 + d_2)}$$ **Equation 15**

It should be noted that the probability of winning the individual contests can be simplified to just a ratio of the opposing firm's marginal costs to the total marginal costs of all the firms in equilibrium. Thus, the firm with higher marginal costs will have a lower probability of winning that arm of the contest. The probabilities are given below:

$$Q_i = \frac{c_j}{c_1 + c_2}$$ **Equation16**

$$P_i = \frac{d_j + f}{d_1 + d_2 + 2f}$$ **Equation17**

It is useful to define gamma as

$$\gamma = \frac{\theta_x}{(1 + \theta_x)^2}$$ **Equation18**

where,

$$\theta_x = \frac{c_2}{c_1}$$ **Equation19**

The official's payoff function can be written as a quadratic equation, as shown:

$$\Pi_G[x_1, x_2, b_1, b_2, \alpha] = \alpha^2 * A_G + \alpha * B_G + C_G$$ **Equation20**

where,

$$A_G = \left(\frac{1}{c_2} - \frac{1}{c_1}\right) * (Q_2 - P_2) * \gamma * v - \frac{(d_1 + f)(d_2 + f)(f_0 * s * \varphi * v^2)}{(d_1 + d_2 + 2f)^4}$$ **Equation21**

and,

$$B_G = \left(\frac{P_1}{c_1} + \frac{P_2}{c_2}\right) * \gamma * v - \frac{v * s}{(d_1 + d_2 + 2f)}(1 - f_0) + \frac{2 * (d_1 + f)(d_2 + f)(f_0 * s * \varphi * v^2)}{(d_1 + d_2 + 2f)^4}$$ **Equation22**

and,

$$C_G = \frac{2 * s * v}{d_1 + d_2 + 2f} + \frac{(d_1 + f)(d_2 + f)(f_0 * s * \varphi * v^2 * 2)}{(d_1 + d_2 + 2f)^4}$$ **Equation23**

The official is going to select alpha so his payoff is maximized. If $\varphi = 0$, the quadratic term is only $A_G = \left(\frac{1}{c_2} - \frac{1}{c_1}\right) * (Q_2 - P_2) * \gamma$. However, if $\varphi > 0$, then the probability of sentencing will be quadratic as well. I will first consider the case where $\varphi = 0$.

$\boldsymbol{Case\ 1: \varphi = 0\ and\ A_G > 0}$

If A_G is positive, then the official's payoff is always convex implying the official will select alpha of either 0 or 1. The official's payoff, in this case, is given by:

$$\Pi_G = Max[A_G + B_G + C_G, \quad C_G]$$ **Equation24**

iff

$$\left(\frac{1}{c_2} - \frac{1}{c_1}\right) * (Q_2 - P_2) > 0 \quad and \quad \varphi = 0.$$

From above, assuming $\varphi = 0$, the official's payoff will be concave up only if the firm with the higher likelihood of winning the fair game has greater advantage in the fair game than it does in the corrupt game. The relevant question at this point is whether the official will select alpha as 0 or 1.

Proposition 1: *Supposing the firm with an advantage in the fair game has a higher likelihood of winning the fair game than winning the corrupt game and $\varphi = 0$, then alpha will be 1 if the following condition is satisfied.*

$$A_G + B_G > 0$$ **Equation25**

One should note that the condition in Equation 25 is satisfied more easily when the fines on the firms or the official increase and when the officials shares less of his bribe. This can be shown be reducing the inequality in Equation 25 to the following relation, shown in Equation 26:

$$1 - \frac{(d_1 + d_2 + 2f)}{s}\left(\frac{c_1 - c_2 + c_2(c_1 + c_2)}{c_1^2 c_2 + c_1 c_2^2}\right) < f_0$$ **Equation26**

From Equation 26, it is clear that increasing the fine on the official increases the right-hand-side of the equation, while increasing the fine on the firm deceases the left-hand-side of Equation 26. Finally, increasing *s* increases the left-hand-side of Equation 26, which makes it less likely that the condition will be satisfied.

Proposition 1 examines the situation that results in a convex payoff function for the official. It is evident that higher fines on firms increase the likelihood that the condition in Equation 26 is satisfied, resulting in the official selecting alpha equal to

1. Thus, an essential step towards eliminating corrupt activities in an economy is to increase fines on both officials and firms. Finally, increasing s decreases the likelihood that Equation 26 will be satisfied. This also makes sense: as the official can keep more of the bribe, he or she will be more inclined to play the corrupt game.

To illustrate this result, Tables 11 and 12 in Appendix 2 show the optimal selection for alpha when the conditions from Proposition 1 hold. In particular, in Table 11, s is set to 1 and I let fines gradually increase. One can easily see that the optimal choice for alpha is 0 for low fines, and the optimal choice for alpha is 1 for higher fines. Furthermore, when total bribery falls, total expected quality rises. In contrast, Table 12 holds everything constant from Table 11 but changes s to .5. As stated, decreasing s will cause the condition in Equation 26 to be satisfied more easily, which will make it more likely that the official will select alpha equal to 1. Finally, note that $\varphi = 0$ in Tables 11 and 12, as Proposition 1 states, and the second order condition fails because the function is convex.

This concludes the analysis of a corner solution resulting from a concave up payoff function for the official. The general interpretation of Proposition 1 is that for A_G to be positive, the firm with the advantage in the fair game needs to have an even higher likelihood of winning the fair game than winning the bribing game. When this happens, alpha will be 1 or 0. As shown, alpha will be 1 when fines are sufficiently high. Clearly, in a testable sample of countries and firms, there will not be a case where corruption does not exist; however, the model suggests that if more efficient firms are present in an economy—and these firms are not as good at bribing as producing—then corruption will be driven to 0. One might consider this as the situation in which a strong firm from a developed economy with high external penalties is participating in an economy against local firms.

***Case 2*: $\boldsymbol{\varphi = 0}$ *and* $\boldsymbol{A_G < 0}$**

Proposition 2: *Supposing that $\varphi = 0$, and the firm with the advantage in the fair game has an even greater advantage in the corrupt game, the following inequality will hold:*

$$\left(\frac{1}{c_2} - \frac{1}{c_1}\right)(Q_2 - P_2) \ < 0$$

Then the official's payoff function will be concave down, and the optimal solution for alpha will be given by:

$$\alpha^*(s, f, f_0, \varphi) = \begin{cases} 0, & \dfrac{-\mathrm{B_G}}{2\mathrm{A_G}} \leq 0 \\ \dfrac{-\mathrm{B_G}}{2\mathrm{A_G}}, & 0 < \dfrac{-\mathrm{B_G}}{2\mathrm{A_G}} < 1 \\ 1, & \dfrac{-\mathrm{B_G}}{2\mathrm{A_G}} \geq 0 \end{cases} \qquad \textbf{Equation27}$$

where,

$$\frac{-\mathrm{B_G}}{2 * \mathrm{A_G}} = \frac{\dfrac{(1 - f_0) * s}{(d_1 + d_2 + 2f)} - N * \gamma}{2 * \left(\dfrac{1}{c_2} - \dfrac{1}{c_1}\right) * (Q_2 - P_2) * \gamma}$$

and,

$$N = \left(\frac{P_2}{c_2} + \frac{P_1}{c_1}\right)$$

As shown, it is possible that the optimal solution for alpha given by Equation 27 will not be in (0,1). In that case, alpha will be equal to one if and only if

$$\frac{-\mathrm{B_G}}{2\mathrm{A_G}} > 1$$

Otherwise, alpha will be 0 (i.e. $\frac{-B_G}{A_G}$<0).

This situation can be viewed as one of the primary catalysts of corruption: as the weaker firm fights to stay in business, it will resort to bribery hoping to win just enough contracts to stay in business. The government official will certainly allow the weaker firm to win on occasion so that he can receive bribes. If there are not multiple firms competing for contract, the dominant firm will never pay bribes and the official's payoff will surely be lower. The theory of the optimal level of competition from the perspective of a government official was studied by Bliss and Tella, which was discussed in the literature review.

As with Case 1, a numerical illustration of Case 2 has been provided in Table 13 found in Appendix 2. Note that firm 1 has a greater than 50% chance of winning the fair game in every case. Furthermore, in each situation, the likelihood firm one will win the corrupt game exceeds the likelihood that firm 1 will win the fair game. As discussed, the optimal selection for alpha will either be a corner solution or an interior solution depending on the parameters.

Before moving to the case where the official's payoff function will be concave in alpha, it is important to note the importance of what has been shown thus far. In some situations, the officials will select an alpha equal to 0 or 1. Sometimes, alpha will certainly be 1. In particular, alpha will be 1 when the fines are very high. More generally, as the term involving detection and risk of detection becomes insubstantial while the official's payoff is also concave up, the function shifts to the right. As the function shifts towards the right, the payoff at alpha equaling 0 rapidly increases.

***Case* 3: $A_G = 0$**

The case where $A_G = 0$ is shown here for completeness as the solutions given require division by 0. In this case, Equation 28 gives the official's utility function, which is linear in alpha.

$$\Pi_G[x_1, x_2, b_1, b_2, \alpha] = \alpha B_G + C_G \qquad \textbf{Equation28}$$

Proposition 3: *Suppose that $A_G = 0$ and $\varphi \geq 0$. The official will select alpha equal to one if B_G>0, and the official will select alpha equal to 0 if B_G<0. When B_G=0, alpha can take on any value.*

***Case* 4: $\varphi > 0$ and $A_G \neq 0$**

When $\varphi > 0$ there will be an additional quadratic term in the payoff function. Specifically, the coefficient for alpha is given below, which I will assume is negative for all parameter values. Graph 1 shows the official's payoff as a function of alpha when Equation 29 holds.

$$\left(\frac{1}{c_2} - \frac{1}{c_1}\right)(Q_2 - P_2)\,\gamma v - \frac{2(d_1 + f)(d_2 + f)(f_0 s\varphi v^2)}{(d_1 + d_2 + 2f)^4} < 0 \qquad \textbf{Equation29}$$

The first order condition for alpha in the official's payoff function is given below. The official's payoff is quadratic, thus the derivative is linear and there is a unique solution for alpha, as shown.

$$\frac{\partial \Pi_G[x_1, x_2, b_1, b_2, \alpha]}{\partial \alpha} = 2\alpha A_G + B_G = 0$$ **Equation30**

The second order condition is then:

$$\frac{\partial^2 \Pi_G[x_1, x_2, b_1, b_2, \alpha]}{\partial \alpha^2} = 2A_G < 0$$ **Equation31**

Proposition 4: *When* $\varphi > 0$ and $A_G \neq 0$, *there is a unique solution for alpha given by the following equation:*

$$\alpha^*(s, f, f_0, \varphi) = \frac{-B_G}{2A_G}$$ **Equation32**

which is,

$$\alpha^* = \frac{-z_1 + s - sf_0 - f_0 s\varphi v z_2}{2 * z_3 - f_0 s\varphi v z_1}$$ **Equation33**

where,

$$z_1 = \frac{c_1(d_1 + f) + c_2(d_2 + f)}{(c_1 + c_2)^2}$$ **Equation34**

and,

$$z_2 = \frac{(d_1 + f)(d_2 + f)}{(d_1 + d_2 + 2f)^3}$$ **Equation35**

and,

$$z_1 = (c_1 - c_2) * \frac{c_1(d_2 + f) - c_2(d_1 + f)}{(c_1 + c_2)^3}$$ **Equation36**

It should be noted that the denominator of Equations 32 and 33 are the second order condition, which is negative by the assumption.

I provide several numerical examples in Appendix 2 illustrating the discussion from Case 4. Table 14 shows the case where marginal costs of quality exceed the marginal costs of bribery. As fines increase, bribery decreases while expected quality increases. Table 15 shows the case where one firm has an advantage in both games. This is not to be confused with Table 13 from Case 2 where the dominant firm has a higher likelihood of winning the corrupt game than the fair. Table 15 provides examples where the dominant firm has a higher likelihood of winning the fair game than it has of winning the corrupt game.

The tables show several interesting results. One interesting observation is that when a firm becomes more dominant, the expected quality in the market goes up, suggesting firms prefer to play the fair game so long as their chance of winning is high enough. Finally, Table 16 shows four different possible combinations of marginal costs, providing a general understanding of how the parameters affect the model. One should note that every table shows examples with corner solutions for alpha. These were put in the tables intentionally to show how changes in the parameters values push alpha either 0 or 1.

Special Case: Symmetric Firms

Propositions 1, 2 and 3 require that the firms are not symmetric. More specifically, if the marginal costs of quality and bribery are equivalent across firms, then the solutions presented do not make sense, as they require division by 0. Additionally, solving the model for symmetric firms simplifies the notation and makes analysis of the model clearer. Substituting in 1 for c_1, c_2, d_1, d_2, gives the following utility function utility function for the official, in equilibrium.

$$\Pi_G^S[x_1, x_2, b_1, b_2, \alpha] = \alpha^2 A_G^S + \alpha B_G^S + C_G^S \quad \textbf{Equation37}$$

where,

$$A_G^S = -\frac{(f_0 s\varphi v^2)}{16(1+f)^2} \qquad \textbf{Equation38}$$

and,

$$B_G^S = \frac{v * (2(1+f)(1+f+2(f_0-1)s) + f_0 sv\varphi)}{8(1+f)^2} \qquad \textbf{Equation39}$$

and,

$$C_G^S = \frac{v(-8(1+f)(f_0-1)s + f_0 sv\varphi)}{16(1+f)^2} \qquad \textbf{Equation40}$$

Proposition 5: *When the marginal costs of quality and bribery are symmetric across firms, there is a unique solution for alpha given by the following equation:*

$$\alpha^{S*}(s,f,f_0,\varphi) = \begin{cases} 0, & \frac{-B_G^S}{2A_G^S} \leq 0 \\ \frac{-B_G^S}{2A_G^S}, & 0 < \frac{-B_G^S}{2A_G^S} < 1 \\ 1, & \frac{-B_G^S}{2A_G^S} \geq 0 \end{cases} \qquad \textbf{Equation41}$$

where,

$$\frac{-B_G^S}{2 * A_G^S} = 1 + \frac{2 * (f+1)(f+1-2s+2f_0 s)}{f_0 s\varphi v} \qquad \textbf{Equation42}$$

A numerical example of the case where firms have identical marginal costs is provided in Table 17 of Appendix 2. As said, the optimal selection for alpha can be 1, 0, and in between 0 and 1, depending on the parameters. Table 17 shows that the optimal selection for alpha increase as fines increase.

Comparative Statics

Proposition 6: *Increasing the fine on government officials will increase the likelihood that the official will play the fair game. This says that* $\frac{\partial \alpha^*}{\partial f_0}$ >0.

Proposition 6 says that increasing the fine imposed on officials for being convicted of accepting a bribe will increase the official's selection of alpha. When the fines waged on the government official increase, his or her payoff falls. This is because the expected payment in fines for accepting a bribe increases. To compensate, the official will favor the fair game more, thereby raising alpha. Moreover, raising alpha indirectly affects the probability of sentencing through the bribes paid. In particular, increasing alpha decreases b_1 and b_2, which decreases the probability of sentencing. A graphical illustration of this result is shown in Graph 2 of Appendix 3.

Proposition 7: *For symmetric firms, increasing the fine on government officials will increase the likelihood that the official will play the fair game. This says that* $\frac{\partial \alpha^*}{\partial f}$ >0 for symmetric firms (i.e. $c_1 = c_2 = d_1 = d_2 = y$).

I only consider the case of a symmetric firm for simplicity in illustrating the results. The general case gives a similar result. In other words, I determine how alpha will change in response to changes in fines on firms, assuming that the marginal costs for quality and bribery are the same and that the firms face the same costs. The optimal choice for alpha as a function of f is shown in Graph 3.

Proposition 8: *Increasing complementarity in detection will increase the likelihood that the official will play the fair game. This says that* $\frac{\partial \alpha^*}{\partial \varphi}$ >0.

This says that as the complementarity between fines begins to have a greater effect on the likelihood of being caught, the optimal choice for alpha will rise. This makes sense, as it essentially raises the likelihood of detection. We can think of real-world examples of how φ might vary: in an economy with weak media, φ could be very low. Also, in economies where resources spent on searching for corruption are low, φ will be low. The optimal choice for alpha as a function of φ is shown in Graph 4.

Proposition 9: *As the portion of the bribe that the official keeps to himself increases and the condition in Equation 38 holds, the official will be more likely to play the fair game. Otherwise, increases in the portion of the bribe that the official keeps will decrease the likelihood that the official will play the fair game. This says that* $\frac{\partial \alpha^*}{\partial s}$ *>0 if and only if*

$$1 < f_0 * (1 + \frac{(d_1 + f)(d_2 + f)(\varphi * v * 2)}{(d_1 + d_2 + 2f)^3}) \qquad \textbf{Equation43}$$

This result is not surprising. When the official shares less, he keeps more of the bribe, but his risk of conviction goes up. If the fines on the official are relatively low, this risk is immaterial, but the inequality above only holds for fines of reasonable magnitude. It is also clear in Equation 34 that the condition will be more easily violated for higher fines on firms. This result is not so intuitive, but it can be explained in terms of the model. As *f* increases, b_1 and b_2 decrease, which decreases the probability of sentencing function. Thus, the official will be more inclined to play the corrupt game.

The results discussed above can be tested based on real world data. The simplest result to test will be to sort countries into different samples based on the severity of fines placed on government officials for accepting bribes. We would expect far lower corruption in the economies with severe penalties placed on the officials.

Empirical Model

Data

The data needed to test the theory developed thus far comes from a variety of sources. The primary contribution of the model is to analyze firm behavior in a microeconomic setting. Although no perfect data set exists to estimate the parameters in the model, the Business Environment and Enterprise Performance Survey (BEEPS) provides substantial information about individual firms and their economic decisions. The survey has been conducted four times since 1999, with the most recent survey occurring in 2009. The 2009 BEEPS data set surveyed approximately 12,000 firms in 33 different developing market economies. In particular, the survey focuses on countries in the European Bank for Reconstruction and Development countries, which are primarily in Eastern Europe. The BEEPS survey is collected in partnership between the European Bank for Reconstruction and Development and the World Bank.

In addition to the microeconomic data collected in the BEEPS survey, I will use data collected by Transparency International. Each year since 2001, Transparency International has compiled data on relative perceptions of corruption across many countries worldwide and compiled them into an index known as the Corruption Perceptions Index (CPI). The index assigns a value to each country ranging from 0 to 10. However, in 2012, they assigned values from 0 to 100. To account for this change, I multiplied the 2001-2011 CPI by 10 so its value ranges from 0 to 100. A score of 0 implies high levels of perceived corruption. In 2012, Denmark, Finland, and New Zealand were perceived as being least corrupt with a score of 90, while Somalia was perceived as being most corrupt with a score of 8. The index includes and ranks 176 unique countries and territories—all of which are also included in the BEEPS and the AGI survey (discussed later). The variable for corruption that I use in this paper is given by Corruption = 100 – CPI. The purpose of this transformation is to make the results more intuitive.

A central part of the model is the inclusion of market-based factors such as fines and complementarity in detection on the government official. Clearly, gathering adequate data to estimate these parameters for empirical testing presented a substantial challenge. Thus, I tried to incorporate variables into the analysis that were very similar to the parameters described in the theoretical model.

In addition to the BEEPS survey, the World Bank collects a data set on actionable governance indicators (AGI). This data set, known as the Global Integrity Survey, evaluates the *presence and effectiveness* of a variety of governance indicators, particularly those that will have a substantial likelihood of deterring corruption. The data set does not estimate the levels of corruption in an economy. It consists of expert provided assessments “backed up by standardized scoring criteria, sourcing requirements, and a blind peer review process." Data exists for 2004, 2006, 2007, 2008, 2009, 2010, and 2011. Each year included in the data set does not contain a consistent cross-section of countries. Moreover, all of the countries in the BEEPS data set are not present in the AGI data set. Of the 38 countries included in the 2008 AGI data set, 17 countries are also included in the 2009 BEEPS data. Although using 17 countries is not ideal for empirical comparison, I can still make statistical inferences when firms are used as the dependent variable because I will be using a sample including well over 1000 firms.

The AGI survey provides several variables that can be used as proxies for parameters such as complementarity and fines. However, the proxies for fines included in the AGI survey do not adequately measure the severity of penalties on officials and firms. In order to ensure I am capturing the maximum effect that fines have on corrupt decisions, I created a variable that will serve as a proxy for the fines officials and firms potentially face. More specifically, I examined the relevant sections of each country's legislation regarding bribery and collected the relevant information about the punishments each country imposes on those caught giving or accepting a bribe.

Every country separates their legal code into penalties for giving a bribe and penalties for accepting a bribe. Although many countries have monetary fines, these are not comparable across countries so I chose not to use monetary penalties as a basis for the variable. Every country, however, provides a potential jail term. If the minimum sentence was not stated, I assumed it was zero. In every case where there was not a minimum sentence, the legal code seemed especially lax compared to the other nations. Additionally, many countries separated jail terms into two categories: penalties for conspiring to commit a knowing illegal act or penalties for conspiring to commit an act that was well within the government official's duties. In every case, I used the penalties associated with conspiring to commit an illegal act, as these more accurately reflect the penalties that will be faced by firms and officials in the model I have developed. For clarity, I will use penalties to describe the variables that are actually included in the empirical models, as I am not actually including monetary fines in the empirical model. Penalties are only a proxy for fines; they are not fines themselves (Nell, 2006).

The variables for fines on firms and fines on officials were created by multiplying the minimum sentence by two and adding it to the maximum sentence. I weighted the minimum sentence more heavily because I assumed countries that imposed a higher minimum sentence were more serious about penalizing corruption. Finally, I divided this value by three to allow for more straightforward interpretation of the results. Table 1 in Appendix 2 shows the countries included in the sample, the values for fines in these countries, and the Corruption for that country. One should note that the official's fines are higher on average—especially in the most corrupt nations.

In sum, the data that I will be using in the empirical model comes from four sources. The 2009 BEEPS survey consists of firm level data, capturing highly relevant information about a variety of firm-level economic decisions, as well as their perceptions of the legal system and their competitors. I will also use country-level governance indicators, to provide information about the relative strength of a variety of governance systems placed on firms in different countries. I will use the 2008 AGI survey data. To supplement this data, I compiled information about the potential jail-term officials and firms face following conviction of bribery, which I call penalties. Finally, I will use Transparency International's Corruption Perceptions Index from 2008 as the measure of corruption in each country.

The most comparable data will come from using the 2009 BEEPS survey data in conjunction with the data reported by the AGI survey for 2008. Using the 2009 data from the AGI survey would provide a sample size too small to make any reliable statistical inferences, as only 9 countries are included in both data sets. The 2008 AGI data does not present any substantial comparability issues; comparability across years is high for the data and the data in the 2009 BEEPS survey is based on responses to questions about the 2008 results. When the corruption index is used in analysis against the 2008 AGI data, I will use the CPI scores from 2008, as this is the most comparable index. The correlation across years for the CPI is approximately 95%.

Variables

The variables used in the empirical analysis come from several sources. However, they can be organized into several key groups. The motivation for the empirical work is to explain levels of corruption, bribery, and quality based on a variety of parameters. The key parameters from the theoretical analysis were fines and complementarity. One can find the variables, their exact description from the surveys, and their code in the data sets in Appendix 1.

In contrast to the country-level corruption variable, I also use two variables from the BEEPS survey that estimate the value firms pay in bribes. In 2009, firms reported the percentage of sales and the percentage of government contract value that they paid in bribes. Finally, to estimate the firms' decisions to invest in productive behaviors, I used two dummy variables: one asks if firms have an internationally recognized quality certification and the other asks if the firm contributed to R&D in the last year. Having an internationally recognized quality certification more clearly represents a firm's commitment to productive behavior than it may seem. For example, one such award is IS0 9000, which can only be achieved by implementing sufficient quality management procedures, as judged by an independent board. Receiving a recognized quality award requires substantial investment by the firm in productive activities by the firm.

To estimate fines, I used information from the AGI survey that roughly approximates the severity of the fine that firms and official's face. In some countries, government officials convicted of accepting bribes are prohibited from holding government jobs following conviction. The AGI survey includes this variable in its data set. More importantly, however, the AGI survey includes a variable for the actual effectiveness of this variable, which I call in the regression tables EmploymentProhibitedPractice. This variable can be one of 5 different values: 0, 25, 50, 75, or 100. Lower values represent the absence, or poor implementation, of law requiring employees to lose their right to work for the government following conviction of a bribe. Although use of this variable is not perfect, it certainly approximates the severity of penalties on government officials. Additionally, I will use the data in Table 1, which contains the statutory fines for government officials in each country.

Furthermore, the AGI survey includes a similar variable for firms convicted of bribing government officials in procurement contracts. Specifically, the data set contains a variable for the actual implementation of law forbidding firms convicted of bribery to participate in future government procurement contracts, which I call ProcurementProhibitedPractice in all future tables. As above, this variable can take on give values: 0, 25, 50, 75, or 100. This variable more accurately reflects the severity of fines in individual countries because it represents a source of income that cannot be replaced for many firms. Loss of a government job is not as severe as the inability to participate in future procurement contracts, as government employees can likely move to a job in the private sector. Moreover, I will use the data from Table 1 to directly estimate the effect of fines on the dependent variables.

In addition to fines, observing complementarity in detection is not possible. However, it is reasonable to assume that as the strength of the media increases, the likelihood of detection through complementarity will increase as well. Thus, strength of media is used as a proxy for corruption. The survey includes several variables for the ability of the media to report on corruption. Each of these variables should serve as good proxy variables for complementarity in detection. However, I have used an index "media" which aggregated these individual variables.

The country-level summary statistics for the variables used in models B1, B2, Q1, and Q2 are also given in Table 3 in Appendix 2 to highlight the fact that a different group of countries is used in these regressions and to show the differences in the data. Finally, the firm-level data that is used in the model is shown in Table 4 in Appendix 2. However, to provide more clear summary statistics, I provided summary statistics for the exact observations that were included in each regression, as shown in Tables 5, 6, 7, and 8.

At this point, one may question the specification of the model, as there are several variables that appear to measure similar effects. Moreover, the variables measuring different effects are still correlated, as shown in the correlation matrices in Appendices 1 and 2. Leaving out relevant variables in the model will introduce bias in the other coefficients. However, correlation in the regressors will increase the variance in the estimated coefficients. There are several reasons to justify full specification of the model. Statistically speaking, the variance of the coefficients will decrease as the sample size grows while the bias in the coefficients will not change. In several models discussed above, I will use a large enough sample size to accurately estimate the variances (Wooldridge, 2003). Furthermore, each regressor is important for understanding the determinants of corruption and the validity of the theoretical model. Thus, increased variance from correlation of the regressors is a small price to pay for increased explanatory power.

Methodology

Testable implications of the model come from understanding how changes in the parameters affect measurable variables in the economy. Cleary, alpha is not observable so using a corruption index is the only way to approximate changes in alpha. An alternative approach is to understand how parameters affect alpha, which will, by extension, have a measurable effect on quality and on bribery in an economy. More specifically, data on the percentage of sales or contract value that firms spend on bribery can be found in the BEEPS survey. In the model, the percentage of contract value spent on bribery by an individual firm is given by:

$$\frac{B_i^*(\alpha^*(s,f,f_0,\varphi))}{v} = \frac{(d_j + f)(1 - \alpha^*(s,f,f_0,\varphi))}{(d_1 + d_2 + 2 * f)^2} \quad \textbf{Equation44}$$

and the percentage of the contract spent on quality is given by

$$\frac{c_i * X_i^*(\alpha^*(s,f,f_0,\varphi))}{v} = \frac{c_i * c_j * \alpha^*(s,f,f_0,\varphi)}{(c_1 + c_2)^2} \quad \textbf{Equation45}$$

Clearly, an increase in the optimal choice of alpha will increase the amount of the contract value spent on quality and decrease the amount of the contract value spent on bribery. The 2009 BEEPS data set does not provide data on the percentage of total sales that firms invest in productive assets such as R&D, but it does provide some data points that will help distinguish between firms who are contributing more or less to different measures of quality.

One should note the importance of what is being shown in Equations 39 and 40. Not only are firms making decisions based on changes in parameters that enter *directly* into the equation—specifically, the marginal costs of each activity—but they are also changing their decisions based on changes in parameters that enter *indirectly* into their payoff function through alpha. The idea is that firms adjust their decision making process indirectly as a result of the changes in the official's decision criteria rather than by changes in the parameters that enter directly into their payoffs.

I will begin the empirical analysis by gaining an understanding of how governance indicators impact the levels of perceived corruption in an economy. To do this, I will use country level data compiled by the AGI survey and the country level penalties I coded as explanatory variables on the level of perceived corruption in each country. A total of 46 countries are included in the 2008 Global Integrity Survey. However, I was only able to find or confidently rely on corruption statutes from 38 of these countries. Thus, the sample size for this analysis is restricted to 38 countries.

Hypothesis 1: The level of corruption in each country will:

a. Decrease as the statutory fine on the official increases
b. Decrease as the statutory fine on the firms increases
c. Decrease as the degree of complementarity in detection increases

Hypothesis 1 comes directly from the comparative static results, noting that Corruption is a proxy for alpha. The empirical model I will use to test Hypothesis 1 is given as follows. Firm-level variables are denoted with a superscript F, while country-level variables are denoted with a superscript C.

$$Corruption^{C} = \beta_0 + \beta_{if} * X^{C}_{f} + \beta_{if0} * X^{C}_{f0} + \beta_{i\Psi} * X^{C}_{\Psi} + B_{ic} * X^{C}_{c} + \mu \ldots\ldots\ldots (A1)$$

X^{C}_{f} is a vector containing variables associated with the penalties a firm will face for giving a bribe, and X_{f0} is a vector of variables associated with the penalties a government official will face for accepting a bribe. X^{C}_{Ψ} contains variables related to complementarity in detection. X^{C}_{c} is a vector of control variables. Note that it is not necessary to control for country here because the variables from the AGI survey are country level variables.

In addition to understanding how different macroeconomic variables impact perceived corruption on a country level, I am interested in how firms alter their decisions with the parameters discussed in the theoretical model. A firm-level variable will be the dependent variable in each regression that follows; however, the explanatory variables will consist of firm-level and country-level variables. My approach to testing the theoretical model will be to understand how different parameters impact measures of firms' contributions to bribery and quality.

Hypothesis 2: The percentage of the total contract value that firms self-report as paying in bribes to corrupt government officials will:

a. Decrease as the fine on the official increases
b. Decrease as the fine on the firms increases
c. Decrease as the degree of complementarity in detection increases

Increasing the fine on government officials will increase alpha, which will decrease the amount of contract value firms spend on bribes, based Equation 46. In other words, there is an indirect effect through alpha. The same logic holds for Part c of Hypothesis 1. As complementarity in detection increases, alpha will fall, and firms will spend less on bribes. Part b, however, has both a direct and indirect effect on the percentage of contract value that is spent on bribes. As shown in Equation 46, higher fines on firms will rapidly decrease the amount of contract value firms spend on bribes, and this effect is strengthened by the fact that alpha will increase with increases in fines.

The empirical model for testing hypothesis two is given as follows:

$$percentBribesSales^F = \beta_0 + \beta_{if}{*}X^C_f + \beta_{if0}{*}X^C_{f0} + \beta_{i\Psi}{*}X^C_{\Psi} + B_{ic}{*}X^F_c + \mu \ldots\ldots\ldots\ldots\ldots (B1)$$

$$percentBribesContract^F = \beta_0 + \beta_{if}{*}X^C_f + \beta_{if0}{*}X^C_{f0} + \beta_{i\Psi}{*}X^C_{\Psi} + B_{ic}{*}X^F_c + \mu \ldots\ldots\ldots (B2)$$

$$P(percentBribesContract > 0)^F = G(\beta_0 + \beta_{if}{*}X^C_f + \beta_{if0}{*}X^C_{f0} + \beta_{i\Psi}{*}X^C_{\Psi} + B_{ic}{*}X^F_c + \mu) \ (B3)$$

Model B1 and B2 are identical, except model B2 looks at the percentage of government procurement contract value that firms pay in bribes. Model B3 is a probit regression, which looks at the likelihood that a firm will bribe. The motivation behind using model B3 is because nearly 80 percent of firms reported 0 bribes paid as a percentage of government contract value, which makes use of model B2 insufficient to draw conclusions.

In addition to understanding how the model discussed above affects the percentage of total sales firms pay in bribes, it is important to compare these results to measures of quality, as stated in Hypothesis 3.

Hypothesis 3: A firm's investment in productive activities:

a. Increase as the fine on the official increases
b. Increase as the fine on the firms increases
c. Increase as the degree of complementarity in detection increases

As in Hypothesis 2, the firms' decisions are altered from changes in the marginal cost parameters that enter directly into Equation 40, and indirectly from changes in alpha. Increasing the fine on the government official will increase alpha, which will increase investment in productive activities. The same logic holds for parts b and c. Interestingly, the variables of interest in the empirical models discussed below only have an *indirect* affect on measures of quality. This is because variables dealing with the costs of playing the corruption game do not have an effect on the costs of playing the fair game. Thus, the results of models Q1 and Q2 below have the ability to substantiate the role of alpha in the theoretical model.

The models to test hypothesis three are given below:

$$R\&D_i^F = G(\beta_0 + \beta_{if}*X^C_f + \beta_{if0}* X^C_{f0} + \beta_{i\Psi}*X^C_\Psi + B_{ic}*X^F_c) + \mu \text{ ....(Q1)}$$

$$qualityCertification_i^F = G(\beta_0 + \beta_{if}*X^C_f + \beta_{if0}* X^C_{f0} + \beta_{i\Psi}*X^C_\Psi + B_{ic}*X^F_c) + \mu \text{ ....(Q2)}$$

Model Q1 will help understand what affects firms' decisions to invest in R&D. In that model, R&D is a dummy variable with value 1 if the firm has spent money on R&D in any of the previous three years (0 if not). Model Q2 looks at the effect of the same explanatory variables on the likelihood that firms will have an internationally recognized quality certification.

Empirical models A1, B1, and B2 will be estimated using ordinary least squares. However, empirical models Q1 and Q2 contain binary dependent variables. Therefore, I will use a probit regression model. Thus, the probability of the binary outcome in each model is given by the cumulative normal distribution evaluated as a linear function of the explanatory variables included in the model. The resulting regressions will estimate the coefficients of the linear equation taken as an argument by the function G (Wooldridge, 2003).

Additionally, one should note that the dependent variables in models Q1 and Q2 are not applicable for firms in some industries. For example, it is not likely that retail firms are engaged in R&D. Similarly, firms categorized in the "transport" industry are unlikely to have a quality certification. To account for this, I excluded firms in the Garments, Wholesale, Services of Motor Vehicles, Retail, Hotel and Restaurant, and Transport industries from the regression in model Q1. I excluded firms in the Retail, Hotel and Restaurant, and Transport industries from the regression in model Q2. Clearly there is substantial subjectivity in determining which industries to exclude. However, excluding firms in these industries do not significantly impact the results.

Empirical Results

Model A1

Empirical Model A1 is designed to test Hypothesis 1, which says that perceived corruption will be negatively related to measures of fines and complementarity. The results for this regression A1 are shown in Table 18 of Appendix 2. Although several variables were insignificant, the significant variables were consistent with Hypothesis 1. The coefficient for the fine on firms was negative and significant at the 10% level, implying that increasing the penalties on firms for bribery will decrease the perceived levels of corruption in an economy. More specifically, holding other factors constant, an increase in the jail sentence by one year will decrease corruption by 2.39, on average. This is a substantial decrease, which provides evidence to support the hypothesis that increasing the fines on firms will decrease the levels of corruption in an economy.

Strong media also decreases the level of corruption in an economy. In particular, holding other factors constant, increasing the index for strength of media by 1 point will decrease the level of corruption in an economy by .41 points on average. Although media is not a perfect proxy variable, the finding supports the notion that increased complementarity in the likelihood of detection will decrease the levels of corruption in an economy.

The coefficient for firms' losing the right to participate in government procurement contracts was insignificant. But, it had a negative coefficient, which is consistent with expectations. The same is true for the penalties on officials: although the coefficient was negative, it was insignificant. However, the coefficient for government officials losing the right to hold a government job after they are convicted of bribery was significant in model A1. The magnitude of this coefficient was still relatively small, but it was significant at the 5% level. All else equal, an increase in the jail sentence by 1 year roughly corresponds to decrease in corruption by .08 points on average. A total of 38 countries were included in regression A1. Although there was substantial variability in the dependent variable, a larger sample of countries would have improved the empirical analysis.

Models B1, B2, and B3

Model A1 was designed to look at the determinants of corruption on a country-level. Empirical model B1 provided more insight into the determinant of firms' decisions regarding bribery, as it looks at individual firms' decisions to bribe. A total of 1036 firms were included in model B1. The results for empirical models B1 and B2 are shown in Table 19 in Appendix 2. Also, Figure 1 in Appendix 3 shows the distribution of firms reporting zero bribes paid versus firms that paid a bribe. Approximately 30% of firms reported paying zero bribes.

The results showed that increasing the jail sentence on directors of firms by one year will decrease the percentage of sales firms spend on bribery by .54%. This coefficient was significant at the 1% level. Furthermore, prohibiting procurement after conviction of bribery decreases the amount firms spend on bribery; this coefficient was also significant at the 1% level. In contrast to the strong evidence that penalties on firms will decrease the portion of sales that firms spend on bribes, the variables representing the penalties on government officials for accepting a bribe were insignificant. In the context of the theoretical model, this makes sense because the benefits from raising the penalties on government officials began to level off after they reached a certain point. Furthermore, this could be a result of the fact that the most corrupt nations have raised penalties on officials without a similar increase in the penalties on firms.

In addition to measures of fines, media was again significant at the 5% and negative, implying that strong media will decrease the portion of sales firms spend in bribes. This again supports the assertion that increased complementarity in detection will decrease the percentage of sales firms spend on bribes.

Similar to model A1, I included a measure of the strength of the court system. However, in B1 I used a variable measuring the individual firm's perception of the quickness and enforcement ability of the court system. In the regression, the variable for the court's enforcement ability was significant at the 1% level. For every level of increase in the court's enforcement ability, the percentage of sales firms spend on bribes will fall by .43%. The perceived quickness of the nation's court system also decreased the percentage of sales spent on bribes. This coefficient was significant at the 10% level. Finally, in model B1, there was no significant difference in the percentage of sales paid in bribes for firms that were previously government owned and firms that were not previously government owned. It would make sense that firms with a stronger relationship with the government would likely have to pay fewer bribes, which would result in a negative sign for this coefficient.

In model B2, similar effects were observed, but there were a few key differences. The purpose of including model B2 was to look directly at firms' decisions to bribe in a government procurement contract settings, as that is the focus of this paper. The sign for firms losing the right to participate in government procurement contract after conviction of bribery changed to a positive number, and this coefficient was significant at the 1% level. This is not what was expected. Higher penalties on firms should have lowered the percentage of contract value paid in bribes.

Additionally, the coefficient for the court's enforcement ability became insignificant in model B2 but retained a negative sign. The strength of the media grew in magnitude to .07 and became significant at the 1% level, which again suggests that strong media has the ability to deter corruption. The most interesting difference between model B1 and B2, however, was that the coefficient for a firm previously being government owned became significant at the 1% level, suggesting that firms previously owned by the government paid 1.25% of contract value less than firms who were not previously government owned. This is likely a result of the strong connections that exist between the managers of the previously government owned firms and government officials. Alternatively, it is possible that firms previously owned by the government have a slight advantage in winning government procurement contract. Therefore they will bribe a little less on average. This is consistent with the theoretical model: all else equal, decreasing the costs of bribery to one firm will decrease the percentage of contract value the firm pays in bribes.

One should note that the number of observations included in regression B2 was 976—the lowest sample of any firm-level regression model discussed. Furthermore, nearly 80% of these firms reported that they did not pay any portion of government contracts in bribes. This is shown in Figure 2 in Appendix 3. To account for this in the empirical analysis, regression model B3 looked at the likelihood that firms would pay any bribe greater than zero in a government procurement contract setting. The parameters were estimated using a probit model. The results are shown in Table 20 in Appendix 2. In every case, the sign and significance of the coefficients matched the results found for regressions model B2.

Model Q1 and Q2

The results for models Q1 and Q2, with standard errors in parenthesis are shown in Table 21 in Appendix 2. In contrast to models B1 and B2 where the regression were designed to gain an understanding of firms decisions to bribe, models Q1 and Q1 looks at firms' decisions to invest in productive activities. The dependent variables in both regressions are binary, thus a probit regression model was used. Rather than reporting the coefficients of the estimated regression in the table, I report the marginal effects evaluated at the means of each explanatory variable so interpretation of the results is more meaningful. One should note that the estimated regression implies diminishing marginal effects of each explanatory on the output rather than constant marginal effects, as in OLS. Regression model Q1 included a sample of 2447 firms and regression model Q2 included a sample of 4048 firms, which is substantially larger than the samples from regressions models B1 and B2.

In model Q1, the variables estimating the likelihood that firms would spend on R&D give mixed results. Increasing the fine on the firms decreases the likelihood that firms would spend on R&D, which is inconsistent with Hypothesis three. Specifically, an increase in the firms' jail sentence by one year will decrease the likelihood that firms spend on R&D by 1.8%, holding all other factors at their mean. This result is very shocking. It is well established that decreases in corruption increase R&D expenditure. Also, in model A1, we found that increases in the penalties on firms decrease corruption. Thus, we expect that increases in firm penalties will increase the likelihood that firms will spend on R&D.

Increasing the fines on officials increases the likelihood that firms spend on R&D and was significant at the 5% level. This result supports Hypothesis three—but more importantly, this result supports predictions of the model and highlights the importance of the interaction between the official's decisions making parameters and the firms' decisions, represented by alpha in the model. In contrast, prohibiting employment after conviction of bribery decreases the likelihood that firms would spend on R&D and was significant at the 1% level. Specifically, as this variable increases by one unit, the likelihood of R&D expenditure decreases by .1%--holding other factors at their means. The magnitude of this effect is extremely small, relative to observed effect for penalty on officials. Strong media, which was significant at the 1% level, increased the likelihood that firms would spend on R&D. A unit increase in the strength of the media increases the likelihood that firms would invest in R&D by .5%, holding other factors at their means. Prohibiting procurement was insignificant in model Q1.

The coefficient for the court's enforcement ability was insignificant in model Q1. However, the coefficient for the quickness of courts was significant at the 1% level and was negative, suggesting that quick courts decrease the likelihood that firms will spend on R&D. The negative effect that quickness of courts has on the likelihood is somewhat surprising; but it is not clear exactly how firms will alter behavior based on how fast courts operate. The insignificance of court enforcement, on the other hand, is shocking. At the very least, we expect that increases in the strength of courts will provide firms who are investing in R&D some protections through the use of intellectual property law. In the context of the theoretical model, though, we expect that increasing the strength of courts will increase the probability of detection, increasing alpha and thereby increasing investment in quality.

Model Q2 provided several different results than model Q1. In particular, both firms' fines and officials' fines were significant at the 1% level (only in model Q2b), and in both cases, stronger fines increase the likelihood that firms would have an internationally recognized quality certification. In particular, increasing fines on firms and on officials increased the likelihood of obtaining an internationally recognized quality certification by .026 and .024, respectively, holding other factors constant. Prohibiting employment after conviction of bribery decreases the likelihood that firms would posses a quality certification and was significant at the 1% level. Yet, its magnitude was relatively small; an increase in this variable by one unit decreases the likelihood of obtaining a quality certification by .001, holding other factors at their means. Strong media increases the likelihood that firms would possess a quality certification and was significant at the 1% level. Specifically, increasing the strength of the media by one unit increases the likelihood that firms would invest in R&D by .005, holding all other factors at their means.

The variables for the strength of the court system were insignificant for the most part. The variable for the quickness of courts was significant at the 10% level and negative in model Q2b, when Legal Status was not controlled for. This was again unexpected. Finally, being previously owned by the government did not have a statistically significant affect on the likelihood of spending on R&D or the likelihood of having an internationally recognized quality certification.

Although several results were surprising in models Q1 and Q2, there were several results that were consistent with Hypothesis three. There was significant evidence to suggest that firms alter their decision to invest in productive behaviors indirectly by changes in the parameters that affect the official's decisions. This is because measures of variables that only directly entered into the official's payoff function had an effect on the individual firms' decisions.

Limitations

Although the empirical testing helped understand the validity of the empirical model, as well as many of the determinants of corruption, there were several substantial limitations of the empirical modeling approach. The first inherent difficultly comes from the data: the BEEPS data set provides substantial, relevant information for the hypothesis I would like to test, but the firms self-report the information that is provided by the survey. In many cases, this does not present any issues. For example, firms are not likely to falsify amount such as employees, sales, or their industry. It is very likely, however, that firms will lie, modify, or note disclose the amount paid in illegal bribes, which is a central part of the analysis.

The second limitation comes from the sample sizes. Although the BEEPS survey provides data for more than 9000 different firms, it only collects information about firms in 33 different countries. Because the BEEPS data is used in conjunction with the country-level AGI survey data, I had to use a cross-section of countries that was included in both data sets. This only amounted to 17 countries in 2009, which limits the variation of country-level variables in the sample. Additionally, model A1 was limited by use of only 38 countries in the regression. This is a result of the fact that the AGI survey only collected data on 48 countries in 2008. Also, of the 48 countries in the 2008 AGI survey, I could not locate or rely on the statutory provisions of 10 of these countries. In general, these excluded countries were more corruption than the countries included in the sample.

Finally, there is likely substantial within country variability beyond what is described by the parameters included in the models. The current specifications of the regressions do not control for country-level fixed effects, which may cause the coefficients to be biased, as they are capturing some of this variability in addition to the effects that the variables are intended to measure. Future models should control for the variability across countries.

Conclusions

The theoretical model in this paper looked at corrupt transactions from the perspective of two firms competing to win a contract, with a government official selecting a winner based on the firms' contributions to productive behavior and corrupt behavior. In general, increasing the likelihood of detection through complementarity, increasing fines on firms, and increasing fines on officials should decrease the level of corruption in an economy.

These results were tested empirically. The empirical results present compelling evidence that some of the theoretical results are consistent with reality. Stronger media and higher fines on firms both lowered levels of perceived corruption in an economy—with fines on firms having the greatest affect on CPI. This suggests that increasing fines on firms is the most effective means of deterring corruption.

The empirical results shed light on necessity of a country not only having strong laws, but also having a strong legal system that can investigate, prosecute, and enforce judgment against corrupt firms. More specifically, when firms perceived courts as having more enforcement ability, they would contribute less to bribery, all else equal.

Additionally, the empirical results supported the notion that firms' decisions are indirectly altered by changes in the parameters affecting the official's decisions criteria. Specifically, fines on officials and media do not directly affect the decisions firms make, but they do indirectly affect firms' decisions through alpha. Models Q1 and Q2 found evidence that the proxies for the variables entering into the official's payoff function indirectly affected firms' decisions.

The role of strong media in deterring corruption is clear from empirical analysis. This is an important result: rather than focusing on designing a perfect regulatory environment, or raising fines, a society can stand to gain much economic ground by simply protecting the media and perpetuating freedom of the press.

The findings in this paper support the notion that corruption leads to poor economic outcomes. In theory, bribes from firms have the ability to incentivize the government official to select the less productive firm as the winner of the contract, which creates economics loss. It is clear that bribery and corruption have economic implications. Measures of penalties, enforcement, and detection all have a significant effect on firm behavior. This is consistent with the recent economic research. Bribery is not simply a wealth transfer: it adversely affects incentives of those people making economic decisions. Furthermore, there are many avenues by which corruption can lowered. Although it is likely that every society requires different reform, this paper presents several potentially strong avenues towards achieving a less corrupt society.

Appendix 1: Description of Variables

Variable Name	Exact Variable Description or Question from Survey	Code
% Contract Informal Payments	When establishments like this one do business with the government, what percent of the contract value would be typically paid in informal payments or gifts to secure the contract?	j6
% Sales, Informal Payments	On average, what percent of total annual sales, or estimated total annual value, do establishments like this one pay in informal payments or gifts to public officials for this purpose?	j7a
Age	Self calculated as 2009-Year Established.	-
Year Established	In what year did this establishment begin operations? Year Establishment began operations	b5
Corruption (CPI)	Self-Calculated as 100 - CPI = Corruption	-
CourtsEnforce	For each statement, please tell me if you Strongly disagree, Tend to disagree, Tend to agree, or Strongly agree: "The court system is able to enforce its decisions".	ECAj1c
CourtsQuick	For each statement, please tell me if you Strongly disagree, Tend to disagree, Tend to agree, or Strongly agree: "The court system is quick".	ECAj1b
Employees	At the end of fiscal year 2007, how many permanent, full-time employees did this establishment employ? Please include all managers and employees	l1
EmploymentProhibitedPractice	In practice, civil servants convicted of corruption are prohibited from future government employment.	HU2
FirmPenalty	Self calculated by determining minimum and maximum jail sentences from the statutes of individual countries. The minimum sentence was multiplied by two and added to the maximum sentence. This number was then divided by three.	-
Media	Variable from the AGI survey representing the overall strength of the media in each country. It measures factors such as the medias ability to report on corruption.	I-2
OfficialPenalty	Self calculated by going through the legal code. The minimum sentence was multiplied by two and added to the maximum sentence. This calculated number was then divided by three.	-
PreviousGov	How was this firm established? 1. Privatization of a state owned firm 2. Originally private, from time of start up 3 .Private subsidiary of a formerly state-owned firm 4. Joint venture with foreign partner(s) 5. State-owned firm 6. Other	ECAq5
ProcururmentProhibitedPractice	In practice, companies guilty of major violations of procurement regulations (i.e. bribery) are prohibited from participating in future procurement bids.	JG2
Quality Certification	Does this establishment have an internationally-recognized quality certification?	b8
ResearchAndDevelopment	In fiscal year 2007, did this establishment spend on research and development activities, either in- house or contracted with other companies (outsourced)?	ECAo3

Appendix 2: Tables

Table 1: Penalties for Corruption by Country

Country	Corruption	FirmPenalty	OfficialPenalty
Argentina	71	2.67[1]	2.67[2]
Azerbaijan	81	1.67	4.67
Bangladesh	79	1.00	1.00
Belarus	80	4.00	4.00
Bosnia and Herzegovina	68	2.00	4.00
Bulgaria	64	3.00	3.33
Cambodia	82	1.67	5.00
Cameroon	77	3.33	3.33
Canada	13	5.33	5.33
China	64	6.67	6.67
Ecuador	80	1.67	1.67
Egypt	72	0.33	5.00
Ethiopia	74	0.08	0.33
Georgia	61	5.00	5.00
Ghana	61	3.33	3.33
Hungary	49	2.33	4.00
Indonesia	74	2.33	8.00
Iraq	87	1.67	1.67
Italy	52	2.67	4.00
Japan	27	1.00	2.33
Kazakhstan	78	1.67	4.33
Kyrgyz Republic	82	1.00	1.00
Lithuania	54	1.67	3.67
Macedonia (FYROM)	64	2.00	2.00
Moldova	71	3.00	3.00
Montenegro	66	2.00	5.33
Nepal	73	1.83	1.83
Nigeria	73	2.33	1.00
Pakistan	75	1.00	2.33
Poland	54	4.00	4.00
Romania	62	2.33	7.00
Russia	79	1.67	4.33
Serbia	66	5.33	2.00
Somalia	90	1.00	1.00
South Africa	51	6.33	6.33
Turkey	54	6.67	6.67
Uganda	74	3.33	3.33
Yemen	77	1.00	1.00

---

1 Self-calculated by determining minimum and maximum jail sentences from the statutes of individual countries. The minimum sentence was multiplied by two and added to the maximum sentence. This number was then divided by three.

2 Self-calculated by going through the legal codes of each country. The minimum sentence was multiplied by two and added to the maximum sentence. This calculated number was then divided by three.

Table 2: Country-Level Summary Statistics

Variable	Observations	Mean	Standard Deviation	Min	Max
Corruption	38	67.34	15.43	13.00	90.00
FirmPenalty	38	2.63	1.71	0.08	6.67
OfficialPenalty	38	3.57	1.92	0.33	8.00
ProcurementProhibitedPractice	38	37.50	31.70	0.00	100.00
EmploymentProhibitedPractice	38	51.97	36.01	0.00	100.00
Media	38	71.21	16.28	35.00	93.00

Table 3: Country-level Summary Statistics for Data used in B1, B2, Q1, Q2

Variable	Observations	Mean	Standard Deviation	Min	Max
FirmPenalty	17	2.63	1.71	0.08	6.67
OfficialPenalty	17	3.56	1.92	0.33	8.00
Media	17	74.11	13.06	44.00	90.00
ProcurementProhibitedPractice	17	33.82	34.17	0.00	100.00
EmploymentProhibitedPractice	17	50.00	38.53	0.00	100.00

Table 4: Firm-Level Summary Statistics – Entire Sample

Variable	Observations	Mean	Standard Deviation	Min	Max
% Sales, Informal Payments	1715	3.94	7.17	0	60
% Contracts, Informal Payments	1893	2.23	7.09	0	100
QualityCertification	11174	0.27	0.44	0	1
SpendOnR&D	11269	0.24	0.43	0	1
CourtsQuick	10178	1.91	0.92	1	4
CourtsEnforce	10019	2.56	0.98	1	4
Age	11141	16.40	15.39	1	184
Employees	11010	121.39	574.76	4	37772

Table 5: Firm-Level Summary Statistics for Variables in Regression B1

Variable	Observations	Mean	Standard Deviation	Min	Max
% Sales, Informal Payments	1036	3.33	6.47	0	60
Media	1036	72.15	9.87	44	90
CourtsQuick	1036	1.92	0.94	1	4
CourtsEnforce	1036	2.62	1.01	1	4
Age	1036	16.89	14.83	1	150
Employees	1036	141.26	898.53	4	20843

Table 6: Firm-Level Summary Statistics for Variables in Regression B2

Variable	Observations	Mean	Standard Deviation	Min	Max
% Contracts, Informal Payments	976	2.41	7.38	0	100
Media	976	73.37	10.99	44	90
CourtsQuick	976	1.87	0.90	1	4
CourtsEnforce	976	2.62	1.00	1	4
Age	976	19.01	17.49	2	166
Employees	976	170.64	617.55	4	12000

Table 7: Firm-Level Summary Statistics for Variables in Regression Q1

Variable	Observations	Mean	Standard Deviation	Min	Max
SpendOnR&D	2447	0.32	0.47	0	1
Media	2447	74.34	10.18	44	90
CourtsQuick	2447	1.90	0.89	1	4
CourtsEnforce	2447	2.66	0.97	1	4
Age	2447	18.68	17.47	2	166
Employees	2447	159.69	581.94	4	20843

Table 8: Firm-Level Summary Statistics for Variables in Regression Q2

Variable	Observations	Mean	Standard Deviation	Min	Max
Quality Certification	4048	0.35	0.48	0	1
Media	4048	74.02	10.40	44	90
CourtsQuick	4048	1.92	0.90	1	4
CourtsEnforce	4048	2.64	0.98	1	4
Age	4048	17.68	16.24	1	166
Employees	4048	136.44	358.47	4	8500

Table 9: Correlation Matrix for Country-Level Variables

	Corrupt ion	Firm Penalty	Official Penalty	Procurement Prohibited Practice	Employment Prohibited Practice	Media
Corruption	1					
FirmPenalty	-0.4327	1				
OfficialPenalty	-0.3332	0.527	1			
ProcurementProhibitedPractice	-0.3335	0.2433	0.2998	1		
EmploymentProhibitedPractice	-0.3903	0.1188	0.245	0.1998	1	
Media	-0.5754	0.2083	0.1485	0.1964	0.3255	1

Table 10: Correlation Matrix for Firm-Level Variables

	% Sales, Bribe	% Contract, Bribe	Quality Cert.	R&D	Firm Penalty	Official Penalty	Proc. Proh. Prac.	Emp. Proh. Prac.	Media	Court Quick	Court Enforce	Age	Employees	Prev. Gov.
% Sales, Informal Payments	1													
% Contract, Informal Payments	0.4359	1												
Quality Cert.	-0.0317	-0.2079	1											
R&D	0.0832	0.0092	0.1254	1										
FirmPenalty	-0.4018	-0.2962	0.0541	-0.0036	1									
OfficialPenalty	-0.2977	-0.1876	0.0463	-0.0274	0.6996	1								
Procurement Prohibited Practice	-0.1839	-0.0881	0.1315	-0.0459	0.2336	0.2913	1							
Employment Prohibited Practice	-0.186	-0.1684	0.0364	-0.026	0.248	0.3236	0.0991	1						
Media	-0.2052	-0.1206	-0.0286	-0.0103	0.2061	0.3277	0.1071	0.5408	1					
CourtQuick	-0.1145	-0.0969	0.1406	-0.126	0.0451	0.0709	0.2541	0.2047	0.1777	1				
CourtEnforce	-0.1344	-0.1659	0.1158	-0.0414	0.2588	0.1954	0.0767	-0.0249	-0.0114	0.299	1			
Age	-0.0537	-0.0618	-0.028	0.134	0.0933	0.0664	0.1446	-0.0259	0.0769	-0.0733	0.0054	1		
Employees	-0.0575	-0.0983	0.1335	0.1592	0.1362	0.119	0.01	0.01	0.0237	0.0302	0.1935	0.2577	1	
PreviousGov	0.0011	-0.0401	-0.0008	0.0781	-0.2312	-0.2576	0.0036	-0.1054	0.0294	-0.0049	0.0275	0.4401	0.1652	1

Table 11

Numerical Illustration of Case 1: High s																							
c_1	c_2	d_1	d_2	V	s	**f**	**f_0**	**δ**	SOC?	Interior?	α*	B_1	B_2	X_1	X_2	CSF_{x1}	CSF_{b1}	E_bX	E_xX	E[X]	B	ΠG	Π1
0.8	1.2	0.8	0.7	1	1.0	**0.3**	**0.3**	**0**	NO	NO	0.00	0.23	0.25	0.00	0.00	0.60	0.48	0.00	0.00	0.00	0.48	0.3	0.23
0.8	1.2	0.8	0.7	1	1.0	**0.4**	**0.4**	**0**	NO	YES	0.00	0.21	0.23	0.00	0.00	0.60	0.48	0.00	0.00	0.00	0.43	0.3	0.23
0.8	1.2	0.8	0.7	1	1.0	**0.5**	**0.5**	**0**	NO	NO	1.00	0.00	0.00	0.30	0.20	0.60	0.48	0.14	0.26	0.26	0.00	0.3	0.36
0.8	1.2	0.8	0.7	1	1.0	**0.6**	**0.6**	**0**	NO	NO	1.00	0.00	0.00	0.30	0.20	0.60	0.48	0.14	0.26	0.26	0.00	0.3	0.36
0.8	1.2	1.2	0.8	1	1.0	**0.3**	**0.3**	**0**	NO	YES	0.00	0.16	0.22	0.00	0.00	0.60	0.42	0.00	0.00	0.00	0.38	0.3	0.18
0.8	1.2	1.2	0.8	1	1.0	**0.4**	**0.4**	**0**	NO	NO	1.00	0.00	0.00	0.30	0.20	0.60	0.43	0.13	0.26	0.26	0.00	0.3	0.36
0.8	1.2	1.2	0.8	1	1.0	**0.5**	**0.5**	**0**	NO	NO	1.00	0.00	0.00	0.30	0.20	0.60	0.43	0.13	0.26	0.26	0.00	0.3	0.36
0.8	1.2	1.2	0.8	1	1.0	**0.6**	**0.6**	**0**	NO	NO	1.00	0.00	0.00	0.30	0.20	0.60	0.44	0.13	0.26	0.26	0.00	0.3	0.36

Table 12

Numerical Illustration of Case 1: Low s																							
c_1	c_2	d_1	d_2	V	s	**f**	**f_0**	**δ**	SOC?	Interior?	α*	B_1	B_2	X_1	X_2	CSF_{x1}	CSF_{b1}	E_bX	E_xX	E[X]	B	ΠG	Π1
0.8	1.2	0.8	0.7	1	0.5	**0.3**	**0.3**	**0**	NO	NO	1.00	0.00	0.00	0.30	0.20	0.60	0.48	0.14	0.26	0.26	0.00	0.3	0.36
0.8	1.2	0.8	0.7	1	0.5	**0.4**	**0.4**	**0**	NO	NO	1.00	0.00	0.00	0.30	0.20	0.60	0.48	0.14	0.26	0.26	0.00	0.3	0.36
0.8	1.2	0.8	0.7	1	0.5	**0.5**	**0.5**	**0**	NO	NO	1.00	0.00	0.00	0.30	0.20	0.60	0.48	0.14	0.26	0.26	0.00	0.3	0.36
0.8	1.2	0.8	0.7	1	0.5	**0.6**	**0.6**	**0**	NO	NO	1.00	0.00	0.00	0.30	0.20	0.60	0.48	0.14	0.26	0.26	0.00	0.3	0.36
0.8	1.2	1.2	0.8	1	0.5	**0.3**	**0.3**	**0**	NO	NO	1.00	0.00	0.00	0.30	0.20	0.60	0.42	0.13	0.26	0.26	0.00	0.3	0.36
0.8	1.2	1.2	0.8	1	0.5	**0.4**	**0.4**	**0**	NO	NO	1.00	0.00	0.00	0.30	0.20	0.60	0.43	0.13	0.26	0.26	0.00	0.3	0.36
0.8	1.2	1.2	0.8	1	0.5	**0.5**	**0.5**	**0**	NO	NO	1.00	0.00	0.00	0.30	0.20	0.60	0.43	0.13	0.26	0.26	0.00	0.3	0.36
0.8	1.2	1.2	0.8	1	0.5	**0.6**	**0.6**	**0**	NO	NO	1.00	0.00	0.00	0.30	0.20	0.60	0.44	0.13	0.26	0.26	0.00	0.3	0.36

Table 13

Numerical Illustration of Case 2																							
c_1	c_2	d_1	d_2	V	s	**f**	**f_0**	**δ**	SOC?	Interior?	α*	B_1	B_2	X_1	X_2	CSF_{x1}	CSF_{b1}	E_bX	E_xX	E[X]	B	ΠG	Π1
0.9	1.1	0.7	1.1	1	1	**0.1**	**0.1**	**0**	YES	NO	0.00	0.30	0.20	0.00	0.00	0.55	0.60	0.00	0.00	0.00	0.50	0.5	0.36
0.9	1.1	0.7	1.3	1	1	**0.1**	**0.1**	**0**	YES	NO	0.00	0.29	0.17	0.00	0.00	0.55	0.64	0.00	0.00	0.00	0.45	0.4	0.4
0.9	1.1	0.7	1.1	1	0.6	**0.1**	**0.1**	**0**	YES	NO	0.00	0.30	0.20	0.00	0.00	0.55	0.60	0.00	0.00	0.00	0.50	0.3	0.36
0.9	1.1	0.7	1.3	1	0.6	**0.1**	**0.1**	**0**	YES	NO	1.00	0.00	0.00	0.28	0.23	0.55	0.64	0.18	0.25	0.25	0.00	0.3	0.3
0.9	1.1	0.7	1.1	1	0.4	**0.1**	**0.1**	**0**	YES	NO	1.00	0.00	0.00	0.28	0.23	0.55	0.60	0.17	0.25	0.25	0.00	0.3	0.3
0.9	1.1	0.7	1.3	1	0.4	**0.1**	**0.1**	**0**	YES	NO	1.00	0.00	0.00	0.28	0.23	0.55	0.64	0.18	0.25	0.25	0.00	0.3	0.3

Table 14

Increasing Penalties when the Marginal Cost of Quality Exceeds the Marginal Cost of Bribery																								
c_1	c_2	d_1	d_2	V	s	f	f_0	δ	SOC?	Interior?	α*	B_1	B_2	X_1	X_2	CSF_{x1}	CSF_{b1}	E_bX	E_xX	E[X]	B	ΠG	Π1
1.1	1.1	0.9	0.9	1	1	**0.2**	**0.2**	1	YES	NO	0.00	0.23	0.23	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.45	0.4	0.25
1.1	1.1	0.9	0.9	1	1	**0.3**	**0.3**	1	YES	NO	0.00	0.21	0.21	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.42	0.3	0.25
1.1	1.1	0.9	0.9	1	1	**0.35**	**0.35**	1	YES	NO	0.00	0.20	0.20	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.40	0.2	0.25
1.1	1.1	0.9	0.9	1	1	**0.4**	**0.35**	1	YES	YES	0.12	0.17	0.17	0.03	0.03	0.50	0.50	0.03	0.03	0.03	0.34	0.2	0.25
1.1	1.1	0.9	0.9	1	1	**0.35**	**0.4**	1	YES	YES	0.60	0.08	0.08	0.14	0.14	0.50	0.50	0.14	0.14	0.14	0.16	0.2	0.25
1.1	1.1	0.9	0.9	1	1	**0.4**	**0.4**	1	YES	YES	0.88	0.02	0.02	0.20	0.20	0.50	0.50	0.20	0.20	0.20	0.05	0.2	0.25
1.1	1.1	0.9	0.9	1	1	**0.45**	**0.4**	1	YES	YES	0.68	0.06	0.06	0.15	0.15	0.50	0.50	0.15	0.15	0.15	0.12	0.2	0.25
1.1	1.1	0.9	0.9	1	1	**0.4**	**0.45**	1	YES	NO	1.00	0.00	0.00	0.23	0.23	0.50	0.00	0.00	0.23	0.23	0.00	0.2	0.25
1.1	1.1	0.9	0.9	1	1	**0.45**	**0.45**	1	YES	NO	1.00	0.00	0.00	0.23	0.23	0.50	0.00	0.00	0.23	0.23	0.00	0.2	0.25

Table 15

One Dominant Firm - Firm 2																							
c_1	c_2	d_1	d_2	V	s	f	f_0	δ	SOC?	Interior?	α*	B_1	B_2	X_1	X_2	CSF_{x1}	CSF_{b1}	E_bX	E_xX	E[X]	B	ΠG	Π1
1	1	1	1	1	1	**0.3**	**0.3**	1	YES	YES	0.13	0.17	0.17	0.03	0.03	0.50	0.50	0.03	0.03	0.03	0.33	0.3	0.25
1.1	1	1.1	1	1	1	**0.3**	**0.3**	1	YES	NO	0.00	0.18	0.19	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.37	0.2	0.23
1.2	1	1.2	1	1	1	**0.3**	**0.3**	1	YES	NO	0.00	0.17	0.19	0.00	0.00	0.00	0.46	0.00	0.00	0.00	0.36	0.2	0.22
1.2	0.9	1.2	0.9	1	1	**0.3**	**0.3**	1	YES	YES	0.16	0.14	0.17	0.03	0.04	0.43	0.44	0.04	0.04	0.04	0.31	0.2	0.2
1.2	0.8	1.2	0.8	1	1	**0.3**	**0.3**	1	YES	YES	0.59	0.07	0.09	0.12	0.18	0.40	0.42	0.15	0.15	0.15	0.16	0.3	0.17

Table 14

Asymmetirc Marginal Costs																							
c_1	c_2	d_1	d_2	V	s	f	f_0	δ	SOC?	Interior?	α*	B_1	B_2	X_1	X_2	CSF_{x1}	CSF_{b1}	E_bX	E_xX	E[X]	B	ΠG	Π1
1.2	1.1	1	0.9	1	1	**0.4**	**0.4**	1	YES	YES	0.84	0.03	0.03	0.17	0.19	0.48	0.48	0.18	0.18	0.18	0.06	0.2	0.23
1.1	1.2	0.9	1	1	1	**0.4**	**0.4**	1	YES	YES	0.84	0.03	0.03	0.19	0.17	0.52	0.52	0.18	0.18	0.18	0.06	0.2	0.27
1	0.9	1.2	1.1	1	1	**0.4**	**0.4**	1	YES	NO	1.00	0.00	0.00	0.25	0.28	0.47	0.00	0.00	0.26	0.26	0.00	0.3	0.22
0.9	1	1.1	1.2	1	1	**0.4**	**0.4**	1	YES	NO	1.00	0.00	0.00	0.28	0.25	0.53	0.00	0.00	0.26	0.26	0.00	0.3	0.28

Table 17

Symmetric Firms - Increasing Penalties																							
c_1	c_2	d_1	d_2	V	s	f	f_0	ϕ	SOC?	Interior	α*	B_1	B_2	X_1	X_2	CSF_{x1}	CSF_{b1}	E_bX	E_xX	E[X]	B	ΠG	Π1
1	1	1	1	1	1	**0.2**	**0.2**	1	YES	NO	0.00	0.21	0.21	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.42	0.3	0.25
1	1	1	1	1	1	**0.3**	**0.3**	1	YES	YES	0.13	0.17	0.17	0.03	0.03	0.50	0.50	0.03	0.03	0.03	0.33	0.3	0.25
1	1	1	1	1	1	**0.35**	**0.3**	1	YES	YES	0.55	0.08	0.08	0.14	0.14	0.50	0.50	0.14	0.14	0.14	0.17	0.3	0.25
1	1	1	1	1	1	**0.3**	**0.35**	1	YES	YES	0.94	0.01	0.01	0.23	0.23	0.50	0.50	0.23	0.23	0.23	0.02	0.3	0.25
1	1	1	1	1	1	**0.4**	**0.4**	1	YES	NO	1.00	0.00	0.00	0.25	0.25	0.50	0.00	0.00	0.25	0.25	0.00	0.3	0.25

Table 18: Determinants of Country-Level Corruption

	A1
Regression Type:	**OLS**
Dependent Variable:	**Corruption**
FirmPenalty	-2.39
	(1.24)*
OfficialPenalty	-0.36
	(0.83)
ProcurementProhibitedPractice	-0.07
	(0.05)
EmploymentProhibitedPractice	-0.08
	(0.04)**
Media	-0.41
	(0.14)***
Constant	110.31
	(10.38)***
Adjusted R-Squared:	0.4125
N:	38

1) *Significant at 10%, **Significant at 5%, ***Significant at 1%
2) Robust Standard Errors in Parenthesis

Table 19: Determinants of Firm-Level Bribery

	B1	**B1b**	**B2**	**B2b**
Regression Type:	**OLS**	**OLS**	**OLS**	**OLS**
Dependent Variable:	% Sales, Informal Payments	% Sales, Informal Payments	% Contract Informal Payments	% Sales, Informal Payments
FirmPenalty	-0.54 (0.14)***	-0.54 (0.12)***	-0.53 (0.17)***	-0.60 (0.15)***
OfficialPenalty	0.04 (0.16)	-0.01 (0.16)	-0.02 (0.23)	0.10 (0.21)
ProcurementProhibitedPractice	-0.04 (0.01)***	-0.04 (0.01)***	0.02 (0.01)***	0.03 (0.01)***
EmploymentProhibitedPractice	0.01 (0.01)	0.01 (0.01)	0.00 (0.01)	0.00 (0.01)
Media	-0.05 (0.02)**	-0.05 (0.02)**	-0.07 (0.03)***	-0.06 (0.03)**
CourtsQuick	-0.43 (0.22)*	-0.50 (0.21)**	-0.61 (0.18)***	-0.56 (0.17)***
CourtsEnforce	-0.64 (0.23)***	-0.57 (0.22)**	-0.29 (0.32)	-0.33 (0.31)
PreviousGov	-0.71 (0.67)	-0.33 (0.64)	-1.25 (0.44)***	-1.81 (0.41)***
Age	0.02 (0.02)	0.02 (0.01)	0.00 (0.01)	0.00 (0.01)
Employees	0.00 (0)*	-0.00016 (0.00009)*	0.00 (0)*	0.00 (0)**
Constant	11.62 (1.89)***	13.2235 (1.62)***	10.38 (2.77)***	9.4077 (2.38)***
LegalStatus Included	Yes	No	Yes	No
Industry Included	Yes	No	Yes	No
Adjusted R-Squared:	0.1034	0.0998	0.0452	0.0458
N:	1036	1036	976	976

1) *Significant at 10%, **Significant at 5%, ***Significant at 1%
2) Robust Standard Errors in Parenthesis

Table 20: Probit Regression for Determinants of Firm-Level Bribery

	B3
Regression Type:	**Probit**
Dependent Variable:	% Contract, Informal Payments
FirmPenalty	-0.06 (0.01)***
OfficialPenalty	0.01 (0.01)
ProcurementProhibitedPractice	0.00 (0)***
EmploymenttProhibitedPractice	0.00 (0)
Media	-0.01 (0)***
CourtsQuick	-0.08 (0.02)***
CourtsEnforce	0.02 (0.01)
PreviousGov	-0.11 (0.04)***
Age	0.00 (0)**
Employees	0.00 (0)*
LegalStatus Included:	Yes
Industry Included:	Yes
Psuedo R-Squared:	0.1662
Log-Liklihood:	-431.96
Degrees of Freedom:	31
Wald Chi-Squared:	116.49
N:	976

1)*Significant at 10%, **Significant at 5%, ***Significant at 1%

2) Delta-Method Standard Error in Parenthesis

3) The coefficients reported are the marginal changes at the means of each variable

Table 21: Determinants of Firm-Level Productive Behavior

	Q1	**Q1b**	**Q2**	**Q2b**
Regression Type:	Probit	Probit	Probit	Probit
Dependent Variable:	R&D Expenditure	R&D Expenditure	Quality Certification	Quality Certification
FirmPenalty	-0.018 (0.006)***	-0.021 (0.006)***	0.026 (0.005)***	0.020 (0.005)***
OfficialPenalty	0.020 (0.009)**	0.021 (0.009)**	0.024 (0.007)***	0.033 (0.007)***
ProcurementProhibitedPractice	0.001 (0)***	0.001 (0)***	-0.001 (0)***	-0.001 (0)**
EmploymentProhibitedPractice	-0.002 (0)***	-0.002 (0)***	0.000 (0)	0.000 (0)
Media	0.005 (0.001)***	0.005 (0.001)***	0.006 (0.001)***	0.005 (0.001)***
CourtsQuick	-0.031 (0.012)***	-0.031 (0.012)***	-0.014 (0.009)	-0.017 (0.009)*
CourtsEnforce	0.001 (0.011)	0.001 (0.011)	0.006 (0.009)	0.006 (0.009)
PreviousGov	0.000 (0)	-0.039 (0.027)	-0.012 (0.025)	0.028 (0.024)
Age	-0.060 (0.029)**	0.003 (0.001)***	0.002 (0.001)***	0.002 (0.001)***
Employees	0.003 (0.001)***	0.000 (0)	0.000 (0)***	0.000 (0)***
LegalStatus Included	Yes	No	Yes	No
Psuedo R-Squared:	0.0399	0.036	0.0964	0.083
Log-Liklihood:	-1476.97	-1483.02	-2377.67	-2413.08
Degrees of Freedom:	14	10	14	10
Wald Chi-Squared:	107.88	93.28	283.7	209.5
N:	2447	2447	4048	4048

1)*Significant at 10%, **Significant at 5%, ***Significant at 1%
2) Delta-Method Standard Error in Parenthesis
3) The coefficients reported are the marginal changes at the means of each variable

Appendix 3: Graphs and Figures

Figure 1: Percentage of Government Contract Value Paid in Bribes

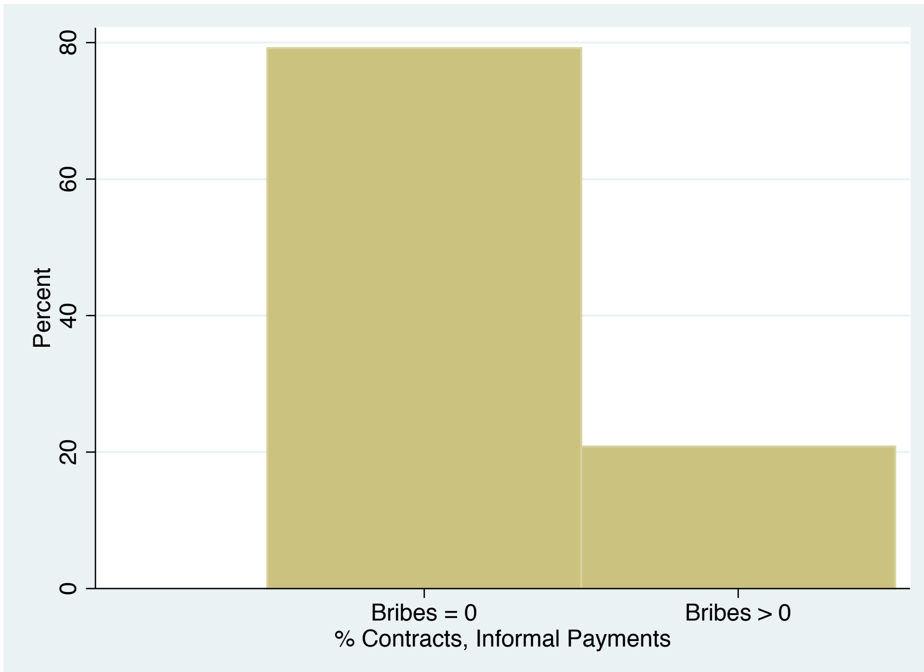
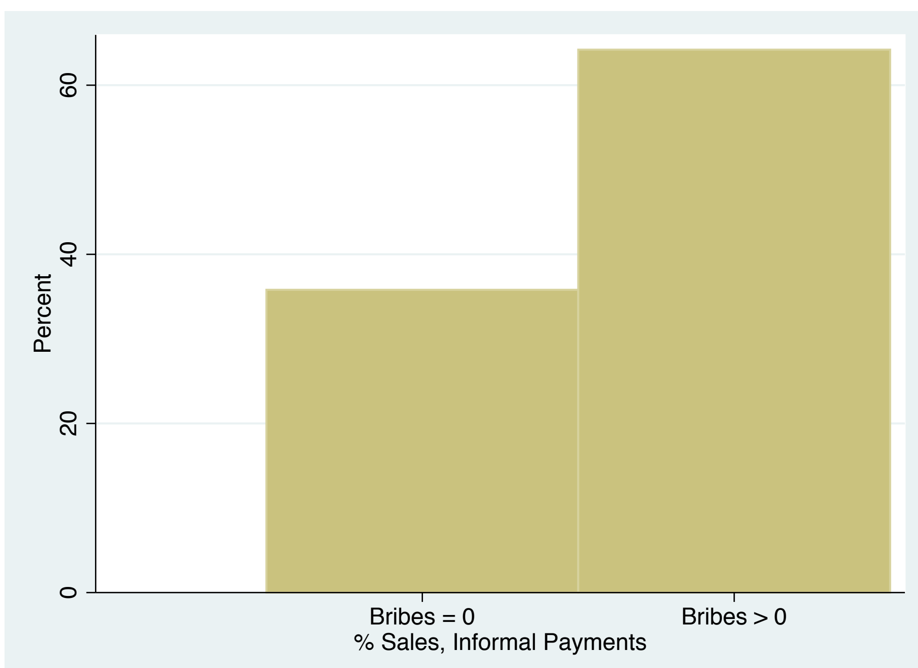
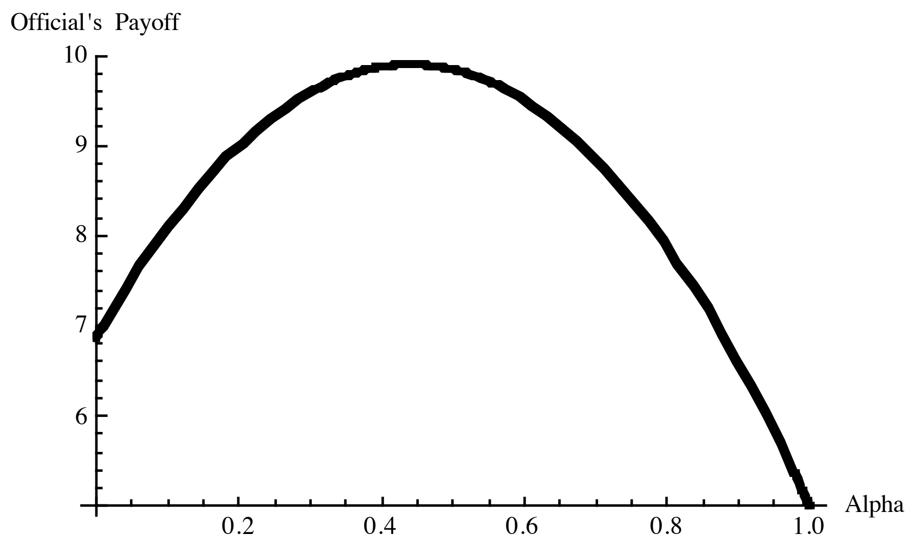


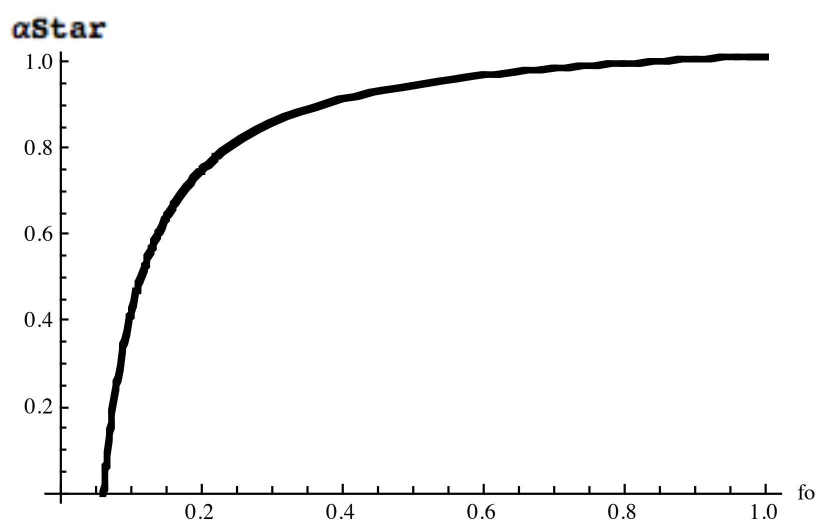
Figure 2: Percentage of Sales Paid in Bribes



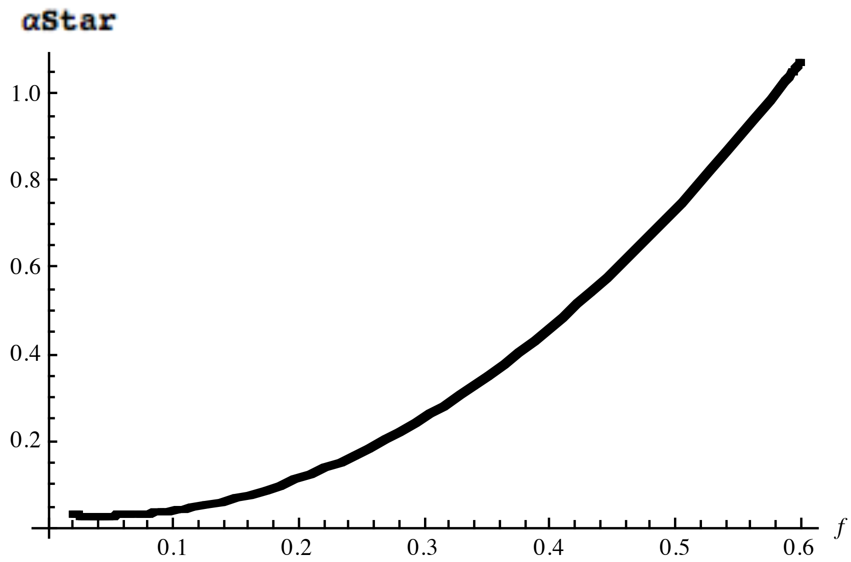
Graph 1: Official's Utility as a Function of Alpha



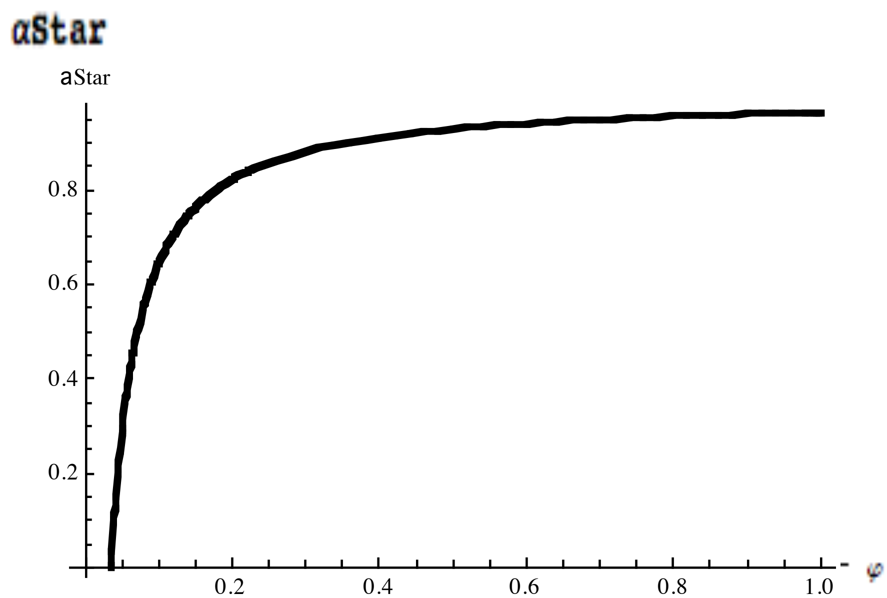
Graph 2: Optimal Selection for Alpha as a Function of the Official's Fine



Graph 3: Optimal Selection for Alpha as a Function of Firms' Fines



Graph 4: Optimal Selection of Alpha as a Function of Complementarity



Appendix 4: Proofs

Proof of Proposition 1

If the firm with an advantage in the fair game has a higher likelihood of winning the fair game than winning the corrupt game, this implies that $Q_i > Q_j$ and $Q_i > P_i$, where Firm i is the firm with the advantage in the fair game. In this case $\left(\frac{1}{c_i} - \frac{1}{c_j}\right) * \left(Q_j - P_j\right) > 0$, which implies $A_G > 0$. Thus, Equation 24 gives the official's payoff. For alpha to equal to one,

$$A_G + B_G + C_G > \quad C_G$$

which is the same as,

$$A_G + B_G > 0 \blacksquare$$

The second order condition for the optimization problem is

$$\frac{\partial^2 \Pi_G[x_1, x_2, b_1, b_2, \alpha]}{\partial \alpha^2} = 2 * A_G < 0 \qquad \textbf{Equation46}$$

Equation 38 shows that A_G is negative for all choices of the parameters, thus the second order condition holds and the solution given in Equation 41 for $0 < \alpha^{S*} < 1$ is a maximum. Symmetric firms do not avoid corner solutions, however. If the solution given by Equation 42 is less than zero, alpha will be 0 because the function is concave down. If the solution given in Equation 42 is greater than or equal to 1, alpha will be 1. ■

Proof of Proposition 6

$$\frac{\partial \alpha^*}{\partial f_0} = \frac{2 * A_G * \left(\frac{-s*v}{d_1+d_2+2f} - \frac{(d_1+f)(d_2+f)(s*\varphi*v^2*2)}{(d_1+d_2+2f)^4}\right) - (-B_G) * \left(-\frac{(d_1+f)(d_2+f)(s*\varphi*v^2*2)}{(d_1+d_2+2f)^4}\right)}{(2*A_G)^2}$$

$$= \frac{2 * A_G * (-(1) - (2)) - (-B_G) * (-(2))}{(2 * A_G)^2}$$

The denominator of $\frac{\partial \alpha^*}{\partial f_0}$ is positive because it is a squared term. The numerator is also positive. The term left of the subtraction is positive because the second order condition is negative by assumption; (-(1)-(2)) is negative because all the parameters have positive value. The term to the right of the subtraction is positive. The numerator must be negative because the alpha is positive and the denominator is negative. But since the term left of the subtraction is larger in magnitude than the term to the right of the subtraction, the numerator of $\frac{\partial \alpha^*}{\partial f_0}$ is positive, making the entire function positive. ■

Proof of Proposition 7

Suppose $c_1 = c_2 = d_1 = d_2 = y$. Then, $\alpha^* = 1 + \frac{2*(f+y)*(f+(1-2s+2sf_0)y)}{f_0 svy\varphi}$ and

$$\frac{\partial \alpha^*}{\partial f} = \frac{4 * (f + (1 - s + sf_0)y)}{f_0 svy\varphi}$$

which is positive iff $(f + (1 - s + sf_0)y) > 0$. This is the same as,

$$f_0 > \frac{-f - y + sy}{sy} = -\frac{f}{sy} - \frac{1}{s} + 1 \qquad \textbf{Equation47}$$

The left hand side is always positive because $f_0 > 0$. The right hand side is always negative because $-\frac{1}{s} + 1$ <0, as $s \in [0, 1]$, and $-\frac{f}{sy}$ < 0 as f, s, y are all negative. ■

Proof of Proposition 8

$$\frac{\partial\alpha^*}{\partial\varphi}$$

$$= \frac{2 * A_G * \left(- \frac{(d_1 + f)(d_2 + f)(s * f_0 * v^2 * 2)}{(d_1 + d_2 + 2f)^4}\right) - (-B_G) * \left(- \frac{(d_1 + f)(d_2 + f)(s * v^2 * 2)}{(d_1 + d_2 + 2f)^4}\right)}{(2 * A_G)^2}$$

$$= \frac{(2 * A_G - (-B_G)) * \left(- \frac{(d_1 + f)(d_2 + f)(s * f_0 * v^2 * 2)}{(d_1 + d_2 + 2f)^4}\right)}{(2 * A_G)^2}$$

The denominator of $\frac{\partial\alpha^*}{\partial\varphi}$ is positive. The second order condition is more negative than the *numerator*. Thus, $\frac{\partial\alpha^*}{\partial\varphi}>0$. ■

Proof of Proposition 9

$$\frac{\partial\alpha^*}{\partial s}$$

$$= \frac{2 * A_G * \left(\frac{v}{d_1 + d_2 + 2f} - \frac{f_0 * v}{d_1 + d_2 + 2f} - \frac{(d_1 + f)(d_2 + f)(\varphi * f_0 * v^2 * 2)}{(d_1 + d_2 + 2f)^4}\right) - (-B_G) * \left(- \frac{(d_1 + f)(d_2 + f)(\varphi * f_0 * v^2 * 2)}{(d_1 + d_2 + 2f)^4}\right)}{(2 * A_G)^2}$$

The term to the left of the subtraction is larger in magnitude than the term to the right of the subtraction. ■

References

Aaken, Anne, Lars Feld, and Stefan Voigt. "Power over Prosecutors Corrupts Politicians: Cross Country Evidence Using a New Indicator." *MAGKS Papers on Economics* 200801 (2008): n. pag. *IDEAS*. Web. 21 Oct. 2012.

[Actionable Governance Indicators Data Portal]. The World Bank. (2011, July 12). Unpublished raw data.

Becker, Gary S. "Crime and Punishment: An Economic Approach." *Journal of Political Economy* 76.2 (1968): 169. Print.

Bliss, Christopher, and Rafael Tella. "Does Competition Kill Corruption?" Journal of Political Economy 105.5 (1997): 1001-023. JSTOR. Web. 10 Jan. 2013.

Bribery in Public Procurement. Paris: OECD, 2007. OECD. Web. 10 Jan. 2013. <http://www.oecd.org/investment/anti-bribery/anti-briberyconvention/44956834.pdf>.

Campos, J. E., D. Lien and S. Pradhan (1999), "The Impact of Corruption on Investment: Predictability Matters", World Development, Vol. 27 (6): 1059-1067.

[EBRD-World Bank Business Environment and Enterprise Performance Survey 2009 (BEEPS)]. (2011, April 3). Unpublished raw data.

Elbahnasawy, N. G. and Revier, C. F. (2012), The Determinants of Corruption: Cross-Country-Panel-Data Analysis. The Developing Economies, 50: 311–333.

Kaptein M. and Wempe J. (1998), “Twelve Gordian Knots When Developing an Organizational Code of Ethics”, Journal of Business Ethics, Vol. 17 (8), June 1998 , pp. 853-869.

Lambsdorff, Johann. The Institutional Economics of Corruption and Reform: Theory, Evidence, and Policy. Cambridge, UK: Cambridge UP, 2007. Print.

Lambsdorff, J. Graf and M. Nell (2007): "Fighting Corruption with Asymmetric Penalties and Leniency." CeGe-Discussion Paper No 59, February, University of Göttingen.

Leff, Nathaniel H. ''Economic Development through Bureaucratic Corruption.'' American Behavioral Scientist 8 (November 1964): 8–14.

Lockard, Alan A., and Gordon Tullock. Efficient Rent-seeking: Chronicle of an Intellectual Quagmire. Boston: Kluwer Academic, 2001. Print.

Mauro, Paulo. "Corruption and Growth." *The Quarterly Journal of Economics* 110.3 (1995): 681-712. *Jstor*. Web. 12 Oct. 2012.

Nell, Mathias. "Corruption – Where We Stand and Where to Go." *The Corruption Monster: Ethik, Politik and Korruption* (2006): n. pag. *Internet Center for Corruption Research*. Web. 17 Nov. 2012.

Nell, Mathias (2006): "Corruption: Where We Stand and Where to Go", in: Kreutner, M. (Ed.): "The Corruption Monster: Ethik, Politik und Korruption", Czernin Verlag, Vienna.

Nell, Mathias. (2007): "Strategic Aspects of Voluntary Disclosure Programs for Corruption Offences: Towards a Design of Good Practice", Discussion Paper No. V-52-07, December 2007, University of Passau

Romer, Paul, 1994. "New goods, old theory, and the welfare costs of trade restrictions," *Journal of Development Economics*, Elsevier, vol. 43(1), pages 5-38, February.

Rose-Ackerman, S. (1999). *Corruption and government: Causes, consequences, and* *reform.* New York, NY: Cambridge University Press.

Shleifer, Andrei, and Robert W. Vishny 1993. "Corruption," *Quarterly Journal of Economics* 108: 599-617.

Svensson, J. (2003). Who Must Pay Bribes and How Much? Evidence from a Cross Section of Firms. *The Quarterly Journal of Economics*, 118(1), 207-230. doi: 10.1162/00335530360535180

Tanzi, Vito. "Corruption Around the World: Causes, Consequences, Scope, and Cures." Palgrave Macmillan Journals 45.4 (1998): 559-94. JSTOR. Web. 10 Jan. 2013.

[Transparency International's Corruption Perceptions Index]. (2008, August 19). Unpublished raw data.

Wedeman, Andrew. "Looters, Rent-Scrapers, and Dividend-Collectors: Corruption and Growth in Zaire, Korea, and the Philippines." *The Journal of Developing Areas* 31.4 (1997): *Jstor*. Web. 21 Oct. 2012.

Wooldridge, J. M. (2003*). Introductory Econometrics: A Modern Approach*. Australia: South-Western College Pub.

Kaufmann, D. (2004, April 8). Six Questions on the Cost of Corruption with World Bank Institute Global Governance Director Daniel Kaufmann. News and Broadcast. Retrieved April 12, 2013, from http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:20190295~menuPK:34457~pagePK:34370~piPK:34424~theSitePK:4607,00.html