Submission Number: PET11-11-00035

Can corruption foster regulation compliance?

Fabio Mendez university of arkansas

Abstract

The legal and the economic literatures overwhelmingly support the notion that regulation compliance is always lower in the presence of corruption. This paper departs from those literatures and shows that an increase in corruption may actually foster regulation compliance. The conditions that make this possible are laid down in a theoretical model. The evidence that corroborates the theoretical modifies is provided using firm-level data for 26 transition economies.

Submitted: February 14, 2011.

Can Corruption Foster Regulation Compliance?

Fabio Méndez University of Arkansas Department of Economics Business Building Room 402 Fayetteville, AR, 72701 fmendez@uark.edu

January 3, 2011

Abstract

The legal and the economic literatures overwhelmingly support the notion that regulation compliance is always lower in the presence of corruption. This paper departs from those literatures and shows that an increase in corruption may actually foster regulation compliance. The conditions that make this possible are laid down in a theoretical model. The evidence that corroborates the theoretical findings is provided using firm-level data for 26 transition economies.

1 Introduction

Corrupt deals are designed to bypass regulations and undermine their effectiveness in a variety of contexts: individuals drive beyond the speed limit and bribe traffic officers to avoid speeding tickets; tax-payers cheat on their taxes and bribe tax-auditors to avoid penalties; businesses ignore environmental regulations and bribe inspectors to avoid the corresponding fines; etc. Thus, presumably, as corruption increases and bribing opportunities multiply, cheating gets easier and regulation compliance diminishes. Most public policies are conceived under such an assumption; and both the legal and economic literatures overwhelmingly support it (see for example Shleifer and Vishny (1993), Bardhan (1997, 2006), Acemoglu and Verdier (2000) and Aidt (2003)).

This paper departs from those literatures and shows that corruption can actually foster regulation compliance. The first part of the paper discusses the theoretical conditions that make this possible. In the model, a set of public officials monitors the actions of private firms who are subject to government regulations. Firms choose whether to comply with the regulations depending on the monitoring rate they face and the availability of corrupt officials. Public officials in turn choose their monitoring effort and their willingness to accept bribes depending on the level of regulation compliance they observe. Together, the decisions of the firms and the officials form a system of equations from which the monitoring rate, the extent of regulation compliance and the level of corruption are all endogenously determined.

The second part of the paper examines the question empirically and confirms that corruption and regulation compliance can in fact be positively correlated. The empirical analysis uses firm-level data from the World Bank's Business Environment and Enterprise Performance Survey (BEEPS). This is a survey of over 4100 firms in 26 transition countries conducted in 1999 and 2000 that examines a wide range of interactions between private firms and the state, regulation compliance among them. The survey, contains detailed information regarding bribes paid to government officials and the purposes for which they were paid, making it one of the best sources of information available on corruption at the firm level. The paper makes a contribution to the theoretical literature that studies regulation compliance and corruption. In the theoretical models that form this literature only one result is possible: regulation compliance decreases when corruption is introduced and more public officials are willing to accept bribes (see for example Chander and Wilde (1992), Mookherjee and Png (1995), Polinski and Shavell (2001), and Çule and Fulton (2005)). The model presented here, in contrast, is capable of generating an equilibrium solution in which the opposite result can be found as well. More specifically, it shows that if public officials set their monitoring efforts independently, then it is possible for corruption to foster compliance because corrupt officials have an incentive (the bribe) to monitor more often and monitoring makes it harder for firms to ignore the regulations.

The model offers several other advantages over the standard theoretical framework. First, in that public officials are treated as heterogenous agents with varying degrees of risk aversion. This assumption is not found in previous models of corruption; but it provides a natural explanation for why some officials are corrupt and some are not. It also precludes the counterintuitive solution in which bribery occurs 100% of the time, typical of models that assume a public official with monopolistic behavior. Second, in that the frequency of bribes is measured independently from the size of the bribes. This allows one to study two alternative dimensions of corruption and provides robustness to the theoretical results. As pointed out by Méndez and Sepúlveda (2010), considering multiple measures of corruption is important in theoretical models, since the results obtained may vary with the specific metric employed to quantify corruption. And third, in that corruption and compliance are simultaneously and endogenously determined in the model; so one can obtain specific guidelines for empirical testing.

The paper also makes a contribution to the empirical literature. There are very few empirical studies that address the effects of corruption on regulation compliance. In a notable exception¹, Damania, Fredriksson and Mani (2004) analyze the relationship between corruption at the coun-

¹There is a parallel literature that examines the effects of corruption on unofficial economic activity (Johnson et al. (2000), Friedman et al. (2000)). Although related, the size of the unofficial economy and the degree of regulation compliance do not necessarily go hand in hand when corruption is present and, thus, these other empirical studies are not directly comparable to the one presented here.

try level (measured by the Transparency International perception indices) and compliance with international environmental agreements also at the country level (measured by the World Economic Forum's perception index). They estimate a system of four simultaneous equations for a cross-sectional sample of countries and report a negative correlation between corruption and environmental compliance; thus reinforcing the standard notion that corruption hinders compliance.

In contrast to Damania, Fredriksson and Mani (2004), the empirical exercise in this paper examines self-reported, firm-level data of actual compliance with a specific regulation (compliance with sales taxes) and bribes paid in relation to that regulation (bribes paid in order to avoid taxes). For this particular case, corruption is shown to be positively correlated with compliance both at the firm level and at the industry level in a manner consistent with the theoretical model. The estimates are obtained using standard OLS regressions and 2SLS regressions that correct for simultaneity biases. In all specifications, the positive correlation remained significant at the 1% level after including additional control variables and both country and market fixed-effects dummies. These results stand as the sole empirical evidence available of an instance in which compliance is positively correlated with corruption .

The remainder of the paper is organized as follows: Section 2 presents the theoretical model and the equilibrium solution. Section 3 presents the data and the results of the empirical estimations. And finally, Section 4 concludes and presents some possible directions for future research.

2 Theoretical analysis

The object of analysis is an economy in which the government issues a set of regulations on economic activities and private firms decide whether to comply with these regulations while being monitored by public officials who enforce the law. We assume there are I private firms and Jpublic officials in total. We use the letter i to index firms and the letter j to index public officials, respectively. The government instructs the officials to monitor firms and issue a fine α when they find an infraction. In exchange, officials are paid a fixed wage w. The assumption of a fixed wage reflects the reality of most countries in the sample that we analyze in the empirical section below. In fact, we expect that these countries utilize fixed wages for the remuneration of most public officials and that most policy decisions regarding regulations and law enforcement are made under such a system of remuneration. Thus, although eliminating the fixed wage assumption would enrich the theoretical discussion regarding the effects of corruption under alternative remuneration schemes, it would also curtail our ability to test the model empirically. We maintain the fixed wage assumption throughout the model and simply establish that it is possible for corruption to foster regulation compliance under such circumstances.

We think of private firms as risk-neutral businesses whose objective is to maximize net expected profits. Each firm *i* derives a gross benefit R_i from the economic activity; where R_i is drawn from a distribution with c.d.f. G(R). If the firm follows the regulations, its benefits are reduced by an amount $\bar{r} + rR_i$; where $\bar{r} > 0$ and $r \in (0, 1)$. If the firm does not follow the regulations, he avoids the costs of the regulations but risks running into a public official who might be honest or corrupt. Honest officials issue the fine α when faced with an infraction². Corrupt officials allow offenders to continue their activities in exchange for a bribe β ; which is resolved via bargaining.

In turn, we think of public officials as individuals with varying degrees of risk aversion θ_j drawn from a distribution with c.d.f. $\widetilde{G}(\theta)$. They are assumed to derive utility from wages and bribes, and to dislike effort. They are subjected to legal prosecutions with probability p. This probability is taken as exogenous throughout the model and is understood as the capacity of the courts to oversee public officials. For simplicity, we assume that if an official is found guilty of corruption, he is punished with probability 1. Public officials make a choice between honest and corrupt behavior. They also choose the level of effort they exert when monitoring. An official j may choose to monitor any number n_j of firms such that $n_j \in (\underline{n}, \overline{n})$. Where the lower limit

²The assumed structure of a fixed penalty α combined with a fixed and proportional cost of regulations ($\bar{r} + rR_i$) simplifies the mathematics and facilitates the comparison with economies where proportional fees are not used. It also allows the model to match the empirical observation that smaller firms pay higher bribes as a percentage of revenue (ERBD (1999), Safavian, Graham and Gonzalez-Vega (2001)). It can be verified, however, that the results of the paper remain unaltered when the penalties take a more general form that includes an additional proportional term (as in $\alpha + \lambda R_i$).

 \underline{n} represents the minimum quota associated with the job and the higher limit \overline{n} represents the maximum number of cases anyone can monitor.

To summarize, the policy instruments available are the wage rate w, the legal fine α , the prosecuting rate p, and the number of public officials in the payroll J. Given this set of policies, firms choose whether to comply with the regulations, and public officials choose their effort level and their type of behavior (honest or corrupt). We are interested in the equilibrium levels of corruption and regulation compliance that result from these simultaneous decisions.

2.1 The private firm's problem and the compliance equation

When facing the regulations imposed by the government on their economic activities, firms have two possible courses of action: **1.** They may comply with the regulations. **2.** They may not comply with the regulations and risk running into an official. If detected by an honest official, they are penalized with α . If detected by a corrupt official, they are allowed to continue their operations after paying the bribe β .

Because not all economic activities are monitored, firms face a probability of detection d < 1. Conditional on being detected, however, the probability of facing a corrupt official (d_c) can be different from the probability of facing an honest official (d_h) ; simply because corrupt and honest officials may monitor businesses with different frequencies. The values of d, d_c , d_h are determined endogenously in equilibrium; but firms take them as given when making their decisions.

Throughout the paper, the net expected value of following the regulations is denoted by v(1); and the net expected value of not following the regulations is denoted by v(0). The payoffs v(1)and v(0) can be described as follows:

$$v(1) = R_i - \bar{r} - rR_i$$

$$v(0) = d[d_h(R_i - \alpha) + d_c(R_i - \beta)] + (1 - d)(R_i).$$
(1)

The payoff v(1) represents the earnings derived from the economic activity minus the costs of following the regulations. This payoff is riskless since firms that follow the regulations are not

forced to pay any additional costs when detected. In turn, the payoff v(0) represents the expected earnings derived when regulations are not followed. With probability dd_h , the firm is detected by an honest official and issued the penalty α . With probability dd_c , the firm is detected by a corrupt official and is allowed to continue operations after paying a bribe. Finally, with probability (1-d), the firm is not detected and all production (R_i) becomes earnings.

When a bribe is paid, the amount is determined via Nash bargaining. The reservation value for the firm is $R_i - \alpha$ because it faces the threat of having to pay the penalty. The reservation value for the official is simply zero. Thus, assuming that the officials's bargaining power is given by $\gamma \in (0, 1)$, the amount of the bribe can be determined by solving

$$\max_{\beta} (\beta)^{\gamma} (\alpha - \beta)^{1 - \gamma}.$$
 (2)

The solution for the bribe follows a simple rule of surplus sharing between corrupt officials and private firms. The solution to (2) is the solution for the bribe: $\beta = \gamma \alpha$.

The firm's problem is to choose whether to follow the regulations in order to maximize their net expected returns from the economic activity. That is, firms choose

$$v = \max\{v(0), v(1)\};$$
(3)

given a set of values for \overline{r} , r, α , γ , d, d_h , d_c .

The solution to this problem is straightforward. From 1 and 2 one can show that whether v(1) is greater than v(0) depends directly on the value of R_i relative to $R^* \equiv \frac{d[d_c\beta+d_h\alpha]}{r} - \frac{\bar{r}}{r}$. Firms with $R_i > R^*$ choose not to follow the regulations and firms with $R_i < R^*$ choose to follow the regulations. Intuitively, firms choose not to comply when the cost of following the regulations exceeds the expected cost of not following them (in terms of bribes and penalties). Because the penalty α and the bribe β are independent of R_i but the cost of regulations increases with R_i , the result follows logically. With the value R^* at hand one can verify that, ceteris paribus, an increase in the monitoring probabilities (d, d_h, d_c) , the penalty α , or the bribe β would lead to

more regulation compliance; while an increase in the costs of regulations (r, \bar{r}) would lead to less compliance. All of these results are in line with the previous literature that follows Becker (1968).

Given the distribution function G(R), the degree of regulation compliance in this economy is completely determined by the value R^* . More specifically, compliance can be measured by the percentage of firms that comply with the regulations:

$$Compliance = G(R^*). \tag{4}$$

2.2 The public official's problem and the corruption equation

Public officials derive utility from wages and bribes; but dislike effort. Moral dispositions or any cultural elements that may determine the official's behavior are not explicitly considered. In particular, the expected utility of an official with honest behavior is assumed to take the form $U_j^h(w,n) = \frac{(w-\rho n_j)^{1-\theta_j}}{1-\theta_j}$; where $\rho > 0$ measures the monetary value of the effort exerted in monitoring each case and θ_j captures the official's attitudes towards risk.

Correspondingly, the expected utility of an official with corrupt behavior takes the form $U_j^c(w, n, \beta) = \frac{[w-\rho n_j+n_j\beta(1-G(R^*))]^{1-\theta_j}}{1-\theta_j} \cdot (1-p) + 0 p$. With probability p, the official is prosecuted and punished. It is assumed that the official's utility is reduced to zero in this case. With probability 1-p, the official is not prosecuted and he derives utility from both wages and bribes. The additional term $n_j\beta(1-G(R^*))$ constitutes the expected amount of bribes collected: The corrupt official would accept a bribe β from the n_j firms he monitors; but only a fraction $(1-G(R^*))$ of them pay it (those who did not comply with the regulations). This fraction is determined endogenously but the official takes it as given when making his decisions.

The public official's problem is to choose a level of effort $n_j \in (\underline{n}, \overline{n})$ and a type of behavior $b \in \{honest, corrupt\}$ in order to maximize expected utility. The public officials then choose

$$U(n,b) = \max\{U^{c}(n), U^{h}(n)\};$$
(5)

given the values of w, θ_j , β , p, ρ , and R^* .

The official's choice of n_j is relatively simple: An official of honest behavior always exerts the minimum amount of effort possible $(n_j = \underline{n})$ because monitoring is costly in terms of utility $(\rho > 0)$ and the wage is fixed. In contrast, an official of corrupt behavior chooses minimum effort $(n_j = \underline{n})$ only when the expected bribe income falls short of the associated monitoring costs $(\beta(1 - G(R^*)) - \rho < 0)$. Otherwise, he chooses $n_j = \overline{n}$. In what follows, these mutually exclusive cases are referred to as the "low-monitoring" and "high-monitoring" scenarios, respectively.

In turn, with respect to the official's choice between honest and corrupt behavior, one can show that whether $U^c(n_j)$ is greater than $U^h(n_j)$ depends directly on the value θ_j relative to a value θ^* . Officials with $\theta_j < \theta^*$ will choose to be corrupt and officials with $\theta_j > \theta^*$ will choose to be honest. In the high-monitoring scenario, the value of θ^* can be simplified to $\theta^* = 1 - \frac{\ln(1-p)}{\ln \frac{w-pn}{w-\rho\pi+\pi\beta(1-G(R^*))}}$. In the low-monitoring scenario, it can be simplified to $\theta^* = 1 - \frac{\ln(1-p)}{\ln \frac{w-pn}{w-\rho\pi+\pi\beta(1-G(R^*))}}$.

With the value of θ^* at hand one can verify that, ceteris paribus, an increase in either the prosecuting rate p or the wage rate w would lead to fewer corrupt officials; while an increase in either the penalty α or the officials bargaining power (γ) would lead to more corrupt officials. It also reveals that risk aversion (higher values of θ_j) makes corruption less attractive, and that lower regulation compliance $(1 - G(R^*))$ makes corruption more attractive for public officials. All of these results are also in line with the previous literature.

Given the distribution function $\tilde{G}(\theta)$, the level of corruption in this economy is completely determined by the value of θ^* . More specifically, corruption can be measured by the fraction of public officials who take bribes from private firms:

$$Corruption = \tilde{G}(\theta^*). \tag{6}$$

2.3 Equilibrium solution and comparative statics

The equilibrium solution of the model is derived from the system of simultaneous equations (4) and (6). The solution is described for both the high-monitoring scenario (for parameter values such that $\beta(1 - G(R^*)) - \rho > 0$) and the low-monitoring scenario (for parameter values such that $\beta(1 - G(R^*)) - \rho < 0)$. The analysis begins with the high-monitoring scenario.

In a high-monitoring scenario, the effort-related costs of monitoring are smaller than the expected value of bribes received. As a result, corrupt officials choose to monitor \overline{n} cases and honest officials choose to monitor \underline{n} cases. With these values at hand, the probabilities of detection d, d_h , d_c can be calculated as $d = \frac{J(\tilde{G}(\theta^*)\overline{n}+(1-\tilde{G}(\theta^*))\underline{n})}{I}; d_c = \frac{\tilde{G}(\theta^*)\overline{n}}{\tilde{G}(\theta^*)\overline{n}+(1-\tilde{G}(\theta^*))\underline{n}};$ and $d_h = \frac{(1-\tilde{G}(\theta^*))\underline{n}}{\tilde{G}(\theta^*)\overline{n}+(1-\tilde{G}(\theta^*))\underline{n}}.$

By substituting these probabilities into the firm's problem, one obtains an expression for R^* as a function of θ^* :

$$R^*(\theta^*) = \frac{\left[J\underline{n}\alpha(1 - \widetilde{G}(\theta^*)) + J\overline{n}\beta\widetilde{G}(\theta^*)\right]}{I \cdot r} - \frac{\overline{r}}{r}.$$
(7)

At the same time, from the solution of the officials problem, one obtains an expression for θ^* as a function of R^* :

$$\theta^*(R^*) = 1 - \frac{\ln(1-p)}{\ln\frac{w-\rho_{\underline{n}}}{w-\rho_{\overline{n}} + \overline{n}\beta(1-G(R^*))}}.$$
(8)

An algebraic solution for the system of simultaneous equations composed of (7) and (8) could be obtained for specific cumulative distribution functions $\tilde{G}(\theta)$ and $G(R^*)$. Instead, the analysis in this section offers only a qualitative analysis of the equilibrium solutions, where it is assumed that $\tilde{G}'(\theta) > 0$ and $G'(R^*) > 0$; but no assumptions are made regarding the second derivatives.

Figure 1 uses linear approximations of (7) and (8) around their equilibrium points in order to illustrate the solution of the model. Equation (8) is always represented by a downward-sloping line; where the slope is given by $\frac{\partial \theta^*}{\partial R^*} = \frac{\overline{n\beta} \ln(1-p)G'(R^*)}{w-\overline{n\rho}+\overline{n\beta}(1-G(R^*))[\ln \frac{w-\rho\overline{n}}{w-\rho\overline{n}+\overline{n\beta}(1-G(R^*))}]^2} < 0$. In turn, equation (7) is represented by an upward-sloping line in Figure 1-a and by downward-sloping lines in Figures 1-b and 1-c. The slope of equation (7) is given by $\frac{\partial R^*}{\partial \theta^*} = \frac{J\alpha}{I_r}[\overline{n\gamma} - \underline{n}]G'(\theta^*)$. When \overline{n} is sufficiently greater than \underline{n} or when the negotiating power of the official (γ) approaches 1, equation (7) has a positive slope (Figure 1-a). Otherwise, it has a negative slope which can be greater or smaller than $\frac{\partial \theta^*}{\partial R^*}$ (Figures 1-b and 1-c, respectively).



A number of interesting results emerge. In particular, the model reveals that it is possible for corruption to foster regulation compliance. To better understand this, consider the comparative statics exercise illustrated in Figure 2; where either (or both) the prosecuting rate (p) or the wage rate (w) decrease. As shown in Figure 2, a decrease in either p or w causes corrupt behavior to become relatively more attractive to the public official and the $\theta^*(R^*)$ line to shift right.

Smaller values of p or w push more officials to demand bribes, but also to monitor more often. As a result, corruption affects compliance in two ways: On the one hand, an increase in corruption encourages firms to disregard regulations and rely more on corrupt deals; which are cheaper and now easier to find. On the other hand, when the monitoring frequency increases firms are less able to circumvent the regulations without been noticed, and the incentives to comply with regulations increase. When the latter effect dominates, the slope of equation 7 is positive and corruption fosters compliance; as shown in Figure 2-a.



Another interesting result concerns the effects of anti-corruption policies. The standard result in the literature is that both the prosecuting rate (p) and the wage rate (w) should be negatively correlated with corruption. In contrast with that view, Figure 2-c shows that it is possible for the equilibrium level of corruption to be positively correlated with either p or w. In this figure, although public officials choose to demand bribes more frequently when either p or w decrease (the $\theta^*(R^*)$ shifts right), they are not able to do so in equilibrium because firms are not willing to pay bribes as often as before (firms are more compliant when monitored more often). One should notice, however, that Figure 2-c illustrates unstable equilibriums. Therefore, although it may be used to explain a positive correlation between corruption and either p or w across different economies, it cannot be used to understand the transition between equilibriums.

Finally, consider an increase in the size of the bribe caused by a change in the bargaining coefficient γ : from equations 7 and 8 one obtains that both the $\theta^*(R^*)$ and the $R^*(\theta^*)$ lines in Figure 1 would shift up. Ceteris paribus, bigger bribes encourage firms to comply with regulations (it makes non-compliance costlier); but it also encourages more officials to become corrupt (and this makes non-compliance cheaper). In equilibrium, depending on the relative size of the shifts, greater bribes generate an ambiguous effect on compliance. Thus, again one finds that it is possible for corruption to foster regulation compliance, regardless of the criteria used to measure corruption³. Interestingly, the model also illustrates how the size of the bribe is not necessarily correlated with the incidence of bribery. Depending on parameter values, bigger bribes can decrease or increase the incidence of bribery.

The results illustrated in Figures 1 and 2 correspond to the high-monitoring scenario, but they can also be used to illustrate the equilibrium solutions of the low-monitoring scenario. In a low-monitoring scenario, the income that a corrupt official expects to perceive in the form of bribes is smaller than the effort-related costs incurred in monitoring. As a result, both corrupt and honest officials choose to monitor \underline{n} cases. The probabilities of detection d, d_h , d_c can then be calculated as $d = \frac{J(\tilde{G}(\theta^*)\underline{n}+(1-\tilde{G}(\theta^*))\underline{n})}{I}$, $d_c = \frac{\tilde{G}(\theta^*)\underline{n}}{\tilde{G}(\theta^*)\underline{n}+(1-\tilde{G}(\theta^*))\underline{n}}$, and $d_h = \frac{(1-\tilde{G}(\theta^*))\underline{n}}{\tilde{G}(\theta^*)\underline{n}+(1-\tilde{G}(\theta^*))\underline{n}}$; and the equilibrium system of equations can be reduced to the following:

$$R^*(\theta^*) \equiv \frac{\left[J\underline{n}\alpha(1-\tilde{G}(\theta^*)) + J\underline{n}\beta\tilde{G}(\theta^*)\right]}{I \cdot r} - \frac{\overline{r}}{r}; \qquad \theta^*(R^*) = 1 - \frac{\ln(1-p)}{\ln\frac{w-\rho\underline{n}}{w-\rho\underline{n}+\underline{n}\beta(1-G(R^*))}}.$$

If the solution was illustrated graphically as before, the corresponding graphs would be identical to the ones already discussed in Figure 1; except that it is now impossible for the $R^*(\theta^*)$ line to have a positive slope and the type of equilibrium solution illustrated in Figure 1-a is ruled out. Besides that, the low-monitoring scenario does not add any additional insights to the analysis.

3 Empirical evidence

The possibility of a positive correlation between corruption and regulation compliance could be dismissed as a mere theoretical curiosity. The empirical evidence presented in this section, however, suggests that such a pattern might also be found in every-day life. The analysis relies on firm-level data from the World Bank's Business Environment and Enterprise Performance Survey (BEEPS). This is a survey of over 4100 firms in 26 transition countries conducted in 1999-2000.

³See Méndez and Sepúlveda (2010) for a discussion on the difficulties of using alternative corruption measures to settle a question. See Mookherjee and Png (1995) for an alternative model in which an increase in the value of the bribe generates an ambiguous effect on compliance.

The BEEPS survey looks at many areas of interaction between the state and private businesses, but our empirical analysis concentrates only on the specific case of compliance with sales taxes. This is done because "sales taxes" is the only area of interaction where information on both the degree of compliance and the extent of related corruption is recorded simultaneously. Fortunately, reporting sales is an activity where the likelihood of being monitored depends heavily on the effort exerted by public officials (and the bribes they may accept) and, thus, it is ideal for the purposes of this paper.

When asking sensitive information regarding corruption and non-compliance episodes, the BEEPS survey avoids questions that may incriminate the specific firm or manager in the interview. Instead, questions are posed in reference to the behavior of "firms like yours" or "firms in your area of activity"; which encourage the respondents to cooperate without any direct implications of wrongdoing. In particular, question 48a asks the firms "what percentage of the sales of a typical firm in your area of activity would you estimate is reported to the tax authorities?" The respondents provide an actual percentage number that is coded in 5% intervals in the original survey. Their answer is used in here to obtain measures of tax regulation compliance: the more sales that are reported, the higher the compliance with the law.

Similarly, question 28tax asks "how often do firms like yours need to make extra, unofficial payments to public officials to deal with taxes and tax collection?" The respondents chose among the alternative answers: "always", "mostly", "frequently", "sometimes", "seldom", and "never". In here, these answers are used to obtain frequency measures of corruption. They were assigned numerical values in the following manner: "always" = 100%, "mostly" = 80%, "frequently" = 60%, "sometimes" = 40%, "seldom" = 20% and "never" = 0%.

These types of indirect survey questions can be regarded as an effective way of procuring information about corrupt or illegal acts committed by the respondents and have been used as such in previous studies by, for example, Safavian, Graham and Gonzalez-Vega (2001), Svensson (2003), and Fisman and Svensson (2007). Admittedly, however, there is no guarantee that the answers to these questions correspond to the actual individual behavior of the firms interviewed. Instead, as literally stated in the questions, the respondents might simply be offering their assessment of the level of corruption or compliance prevalent in "their main area of activity".

In the empirical analysis that follows we take this matter seriously and explore both interpretations. First, we interpret the firms' answers as an assessment of the degrees of corruption and compliance prevalent in their "market" or main area of activity. Where the main area of activity is determined by question S3 in the survey. In this question firms self-classify into 11 different areas of activity, such as mining, manufacturing, retail, and others. In here, some of these areas were eliminated and some were aggregated because of insufficient observations (mining and quarrying was merged with farming, fishing and forestry; building and construction was merged with power generation; and business services were merged with financial services).

Then, in order to obtain market-level measures of corruption and compliance, we take the average level of corruption and the average level of compliance reported by firms within the same market for each particular country. On average, each area of activity is composed by approximately 19 firms. Thus, using the 4100 firms in the survey to generate information for 8 markets in each of the 26 countries, yields a total of 208 market-level observations with which we conduct the empirical tests.

The main focus here is the effect of corruption on compliance. In this respect, the theoretical model from the previous section provides specific guidelines. After combining equations (4) and (7) from the model, the level of compliance in any given market can be expressed as a function of corruption as follows:

$$G(R^*(\theta^*)) = G\left[\left(\frac{J\underline{n}\alpha - \frac{\overline{r}}{r}}{I \cdot r}\right) + \left(\frac{(J\overline{n}\beta - J\underline{n}\alpha)}{I \cdot r}\right)\widetilde{G}(\theta^*)\right];$$

where the term $G(R^*(\theta^*))$ represents the level of regulation compliance observed in a market and the term $\widetilde{G}(\theta^*)$ measures the extent of corruption in that market, as defined by equation (6).

The exact form of the distribution function G is unknown and beyond the scope of this paper.

One may consider a quadratic function or a higher degree polynomial among the many possibilities. For the purposes of this paper, however, it is enough to continue utilizing a linear specification that simply allows one to test the sign of the correlation between the two variables after controlling for other determinants. We thus adopt this simplification and estimate the following relationship:

$$Compliance_{i,j} = \alpha_1 + \beta_1 Corruption_{i,j} + \beta_2 \overrightarrow{X_{i,j}} + \varepsilon.$$
(9)

Where $Compliance_{i,j}$ is the level of tax-compliance observed in market *i* of country *j*, $Corruption_{i,j}$ is the extent of tax-related bribery in that market, and $\overrightarrow{X_{i,j}}$ represents a control vector of market characteristics not specified in the model but that may influence the firm's compliance decision. This vector includes the fraction of firms in that market which belonged to a trade or *lobby* group, the fraction that are partially owned by a *foreign* entity, the fraction that reported using international accounting standards (*acc*), and the fraction that circulated annual financial statements reviewed by an external auditor (*audit*).

When estimating equation (9) across different markets in a single country, the effects of countrylevel characteristics such as the cost of regulations (r, \bar{r}) , the severity of the laws (α) , and the monitoring capacity established (J, I) are captured by the constant coefficient α_1 ; because these do not change at the country level. When looking at a sample of countries such as the one used here, however, these country-level characteristics might be correlated with corruption or compliance at the aggregate level and could potentially bias the results. Thus, to address this problem, we sometimes include a set of country fixed-effects dummies in the estimation.

As a first step, equation (9) was estimated using OLS. The results are presented in Table 1: the estimates presented in columns 1 and 2 do not include country fixed-effects; those in columns 3 and 4 do. Otherwise, the only difference across columns in the number of explanatory variables included. Robust standard errors that account for potential heteroskedasticity are estimated in all regressions. Due to space constraints, the estimated coefficients for the country fixed effects are not reported.

	Without Country Fixed-Effects		With Country Fixed-Effects		
	(1)	(2)	(3)	(4)	
Corruption	$\underset{(4.12)}{0.379}$	$\underset{(4.45)}{0.387}$	$\underset{(4.11)}{0.413}$	$\underset{(4.45)}{0.402}$	
foreign		-15.7 (-2.67)		-11.09 $_{(-1.9)}$	
lobby		$\underset{(-1.64)}{-6.69}$		-5.1 (-1.00)	
acc		$\underset{(1.13)}{5.04}$		$\underset{(0.84)}{6.03}$	
audit		$\underset{(2.06)}{11.33}$		-1.6 (-0.29)	

Table 1. OLS Regressions at the Market Level*

* Tax-compliance is the dependent variable; t-statistics for robust standard errors in parentheses.

As shown in Table 1, corruption and regulation compliance at the market level were always positively correlated and that relationship was always significant at the 1% level. On average, a 1-point increase in the reported frequency with which firms pay bribes is associated with a 0.39 increase in the percentage of sales reported. Regarding the effects of the control variables, an increase in the fraction of foreign firms is found to decrease the percentage of sales taxes reported, and the fraction of firms that circulated audited statements is found to increase it; but these relationships are not statistically significant when controlling for country fixed-effects.

Given the simultaneous specification of the model as determined by equations (7) and (8), however, the results in Table 1 are likely to be biased. The direction of this bias is difficult to obtain in general; but in the simplified linear version of the model that we used here, one can show that this bias actually under-estimates the effect of corruption on compliance. More specifically, consider the case in which the level of corruption faced by the firms is linearly related to their compliance and to a vector \vec{Y}_i of independent variables that determine the equilibrium level of corruption in the market, as follows:

$$Corruption_{i,j} = \alpha_2 + \gamma_1 Compliance_{i,j} + \gamma_2 \overrightarrow{Y_{i,j}} + \varepsilon_2.$$
(10)

In this case, the bias in the OLS estimators for β_1 has the same sign as $\gamma_1/(1-\gamma_1\beta_1)$ (see Wooldridge (2003)). Therefore, if the coefficient γ_1 takes on a negative value as predicted by the model (see

Figure 1-a), then the OLS estimates should be biased downwards.

In an attempt to capture this simultaneity bias, a 2SLS instrumental variable estimation was conducted. The estimations rely on two questions from the BEEPS survey as valid instruments for corruption: question 26a and question 25. Question 26a asks respondents whether the size of the additional payment "firms like theirs" pay is known in advance. We expect that knowing in advance the amount to be paid would influence the degree to which firms are willing to engage in corruption, but not their willingness to comply with taxes (other than the influence exerted through corruption). Question 25 asks how common is it for "firms in their line of business" to pay bribes for any reason and not necessarily to avoid taxes in particular. We expect the degree of corruption for purposes not related to tax collection to be positively correlated with corruption in the collection of sales taxes, but uncorrelated with the decision to pay taxes itself (other than the influence exerted through tax-related corruption).

The statistical validity of the instruments was confirmed. First, the tax-related corruption measure was regressed on the two instrumental variables. As expected, both knowing the amount to be paid in advance and the general level of corruption were positively and significantly (at the 1% level) associated with corruption. The combined first-stage F- statistic was 49.37. Second, the level of compliance was regressed on corruption alone and the corresponding predicted error was obtained. The predicted error was then regressed on the instruments and no significant relationship was found. The combined F-statistic for this regression was 0.89.

The results of the 2SLS regressions are presented in Table 2; again with and without country fixed-effects. As shown in this table, the estimated coefficient for corruption remains positive and significant at the 1% level for most regressions. It also becomes much greater than the OLS estimates of Table 1 and in the direction predicted by the theoretical model: a 1-point increase in the reported frequency with which a firm pays bribes is now associated with 0.45 increase in

the percentage of sales reported.

	Without Country Fixed-Effects		With Country Fixed-Effects	
	(1)	(2)	(3)	(4)
Corruption	$\underset{(1.96)}{0.294}$	$0.495 \\ (3.84)$	$\underset{(3.33)}{0.479}$	$\underset{(3.73)}{0.531}$
foreign		-12.75 (-2.18)		-6.12 $_{(-1.19)}$
lobby		$\underset{(-1.01)}{-4.63}$		$\underset{(-0.7)}{-3.56}$
acc		$\underset{(0.17)}{0.69}$		-1.45 (-0.25)
audit		15.8 (2.87)		1.82 (0.36)

Table 2. 2SLS Regressions at the Market Level*

* Tax-compliance is the dependent variable; t-statistics for robust standard errors in parentheses.

3.1 Firm level regressions

As mentioned before, there is reason to believe that the responses to indirect survey questions regarding illegal behavior are representative of the firm's actual experiences and not merely representative of the behavior of "firms in their area of activity". In this regard, Donchev and Ujhelyi (2010) go even further and affirm that the BEEPS's questions are the "most likely to reflect (corruption) experience" among existing measures, and that their indirect nature is "specific enough that a senior executive would base her answer on her own experience..., rather than venture a general guess".

We now consider this possibility and conduct empirical tests with firm-level data. The econometric specification used is the following:

$$Compliance_i = \alpha_1 + \beta_1 Corruption_i + \beta_2 Sales_i + \beta_3 \overrightarrow{X_i} + \varepsilon.$$
(11)

This econometric specification is very similar to the one used before, but it is not identical. In the theoretical model, the firm's compliance decision is based on the firm's revenue R_i relative to the equilibrium value R^* that is described in equation 8: a firm with greater sales is less likely to comply with regulations than a firm with smaller sales. Thus, when estimating these regressions at the firm (i) level, a measure of the firm's total annual sales (Sales_i) was also included. The survey reports Sales_i measured in US dollars, we use Sales_i/100000. The corresponding OLS regressions are shown in Table 3. The only difference across columns is the number of explanatory variables and the presence of country and market fixed effects. The results obtained again reveal a positive correlation between corruption and compliance at the firm level. Furthermore, the results reveal a negative correlation between sales and compliance, as predicted by the model. This correlation is always significant at the 1% level.

2001	0 01 0 20 2008-			
	(1)	(2)	(3)	(4)
Corruption	$0.185 \\ (10.55)$	0.186 (10.93)	0.172 (10.33)	$0.164 \\ (9.76)$
Sales	-0.002 (-3.47)	$\underset{(-2.42)}{-0.001}$	-0.001 (-2.59)	-0.001 (-2.39)
foreign		$\begin{array}{c} -7.11 \\ \scriptscriptstyle (-5.07) \end{array}$	-5.0 (-3.76)	-4.85 (-3.6)
lobby		$rac{-1.07}{(-1.02)}$	-1.49 (-1.38)	-1.32 $_{(-1.21)}$
acc		$\underset{(0.1)}{0.1}$	-2.12 (-1.98)	-2.41 (-2.24)
audit		-0.34 (-0.36)	-3.15 (-3.30)	-2.9 (-3.02)
Country fixed effects	No	No	Yes	Yes
Market fixed effects	No	No	No	Yes

Table 3. OLS Regressions at the Firm Level*

*Tax-compliance is the dependent variable; t-statistics for robust standard errors in parentheses

The estimations were also conducted using 2SLS regressions that correct potential endogeneity biases. The 2SLS estimation in this case relied again on question 26a as a valid instrument for corruption. For the firm level, however, question 25 did not prove to be a valid instrument. Instead, question 26c was used. Question 26c asked the respondent whether the service is usually delivered as agreed, if a firm pays the required "additional payments". We expect this question to be correlated with corruption at the firm level, but not with their tax compliance (other than its effect via corruption). The statistical validity of the instruments was confirmed as before.

The results of the 2SLS estimations is shown in Table 4; where the only difference across columns is the number of explanatory variables and the presence of country and market fixed effects. As shown in Table 4, the estimated coefficient for corruption remains positive and significant at the 1% level. These coefficients are greater than the OLS estimates of Table 3. On average, a 1-point increase in the reported frequency with which a firm pays bribes is associated with an increase of at least 0.18 in the percentage of sales reported.

Table 4. 2SLS Regressions at the Firm Level*				
	(1)	(2)	(3)	(4)
Corruption	$\underset{(3.09)}{0.253}$	$\substack{0.258\ (3.05)}$	$\underset{(1.94)}{0.179}$	$\underset{(2.03)}{0.192}$
Sales	-0.002 (-1.59)	-0.001 $_{(-1.04)}$	-0.001 (-1.26)	-0.001 (-1.27)
foreign		-8.47 (-4.73)	-7.2 (-4.19)	-7.11 (-4.07)
lobby		$ \begin{array}{c} 0.82 \\ (0.58) \end{array} $	-0.79 (-0.54)	-0.63 (-0.42)
acc		-0.78 (-0.57)	-1.58 $_{(-1.05)}$	-2.06 (-1.35)
audit		-1.88 (-1.39)	-4.17 (-3.15)	-3.92 (-2.94)
Country fixed effects	No	No	Yes	Yes
Market fixed effects	No	No	No	Yes

*Tax-compliance is the dependent variable; t-statistics for robust standard errors in parentheses

4 Conclusions

The legal and the economic literatures overwhelmingly support the notion that the degree of compliance with established regulations is always greater in the absence of corruption. The theoretical models have no room for a different conclusion and the empirical evidence available to date show no evidence against that notion. As a result, the policy decisions made regarding regulations and law enforcement are often made under such an assumption.

This paper provides theoretical arguments and empirical evidence suggesting that this is not necessarily true for certain cases: an increase in corruption may actually foster regulation compliance whenever public agents control the monitoring intensity. The conditions that make this possible are laid out in a theoretical model. Empirical evidence was provided for the case of compliance with sales taxes and related bribery both at the market-level and at the firm-level.

Finally, one must notice that none of the results presented here bear any implications for the effects of corruption in general and do not necessarily contradict the findings in Damania, Fredriksson and Mani (2004). The point of the paper is not that corruption fosters regulation compliance always; but that it can, under certain circumstances and for specific types of regulations.

5 References

Acemoglu, Daron and Thierry Verdier (2000). The choice between market failures and corruption. American Economic Review, vol. 90, no. 1, pp. 194-211.

Aidt, Toke S. (2003). Economic Analysis of Corruption: A survey. The Economic Journal, vol. 113, no. 491, pp. F632-F652.

Bardhan, P. (2006). The Economist's Approach to the Problem of Corruption. World Development, vol. 34, no. 2, pp. 341-348.

Bardhan, P. (1997). Corruption and development: A review of issues. Journal of Economic Literature, vol. 35, no. 3, pp. 1320-1346.

Becker, G. (1968). Crime and punishment: an economic approach. Journal of Political Economy, vol. 76, no. 2, pp. 169-217.

Chander Parkash and Louis Wilde (1992). Corruption in tax administration. Journal of Public Economics, vol. 49, pp. 333-349.

Çule, Monika and Murray Fulton (2005). Some implications of the unofficial economybureaucratic corruption relationship in transition countries. Economics Letters, vol. 89, pp. 207-21.

Damania, Richard, Per. G. Fredriksson and Muthukumara Mani (2004). "The persistence of corruption and regulatory compliance failures: Theory and evidence." Public Choice, vol.121, no. 3-4, pp.363-390.

Donchev, Dilyan and Gergely Ujhelyi (2010). What do corruption indices measure? Mimeo ERBD (1999). Transition Report, 1999: Ten years of transition. London: European Bank for Reconstruction and Development.

Fisman, Raymond and Jakob Svensson (2007). Are corruption and taxation really harmful to

growth? Firm level evidence. Journal of Development Economics, vol. 83, no. 1, pp. 63-75

Friedman, Eric, Simon Johnson, Daniel Kaufmann and Pablo Zoido-Lobaton (2000). Dodging the grabbing hand: the determinants of unofficial activity in 69 countries. Journal of Public Economics, vol. 76, pp. 459-93.

Johnson, Simon, Daniel Kaufmann, John McMillan, and Christopher Woodruff (2000). Why do firms hide? Bribes and unofficial activity after communism. Journal of Public Economics, vol. 76, pp. 495-520.

Méndez, Fabio and Facundo Sepúlveda (2010). "What Do We Talk About When We Talk About Corruption?" Journal of Law, Economics and Organization, forthcoming, doi:10.1093/jleo/ewp003.

Mookherjee Dilip, and I.P.L. Png (1995). Corruptible Law Enforcers: How Should They Be Compensated? The Economic Journal, vol. 105, no. 428, pp. 145-159.

Polinski, A. Mitchell and Steven Shavell (2001). Corruption and optimal law enforcement. Journal of Public Economics, vol. 81, no. 1, pp. 1-24.

Safavian, Mehnaz S., Douglas H. Graham and Claudio Gonzalez-Vega (2001). Corruption and Microenterprises in Russia. World Development, vol. 29, no. 7, pp. 1215-1224.

Shleifer, Andrei and Robert W. Vishny (1993). Corruption. The Quarterly Journal of Economics, vol. 108, no. 2, pp.599-617.

Svensson, Jakob (2003). Who must pay bribes and how much? Evidence from a cross section of firms. The Quarterly Journal of Economics, vol. 118, no. 1, pp. 207-230.

Wooldridge, Jeffrey M. (2003). Introductory econometrics: A modern approach. Thomson Learning.

6 Acknowledgements

I would like to thank Amy Farmer, Toke Aidt, Jeffrey Wooldridge, Gary Ferrier, and Raja Kali for helpful comments and suggestions. I would also like to thank seminar participants at the ESC Brest-Bretagne. All errors are mine.