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Corruption and Firm Tax Evasion

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Corruption and Firm Tax Evasion

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Abstract: Although corruption and tax evasion are distinct and separate problems, they can easily become intertwined and reinforcing. A society that is more corrupt may enable more tax evasion as corrupt officials seek more income via bribes; conversely, higher levels of tax evasion may drive corruption by offering more opportunities for bribes. While a large body of work on each subject separately has emerged, the relationship between the two problems has remained a largely unexplored area. In particular, there is no theoretical work that examines the relationship between corruption and firm tax evasion, focusing on how the potential for bribery of tax officials affects a firm's tax evasion decisions, and there is no empirical work that examines these linkages. This paper develops a theoretical model that incorporates the potential for bribery in a firm's tax reporting decisions, and then tests the main results of the theory using firm level information on reporting obtained from the World Enterprise Survey and the Business Environment and Enterprise Performance Survey. Estimation methods include both instrumental variable methods and propensity score matching methods, and also control for potential endogeneity of evasion and corruption. Results demonstrate that it is corruption that largely drives higher levels of evasion; that is, corruption of tax officials is a statistically and economically significant determinant of tax evasion. Tax inspectors who request bribes result in reduction of sales reported for taxes of between 4 and 10 percentage points. Additionally, larger bribes result in higher levels of evasion, at least up to some point. These results indicate that governments seeking to increase their tax revenues must work first to ensure an honest tax administration.

Keywords: Tax compliance; corruption.

JEL Classification Codes: H26; H32; D7.

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1. Introduction

Corruption and tax evasion are not new problems, and both are significant problems facing today's economies. While these issues are distinct and can exist without each other, they can easily become intertwined and reinforcing. A society that is more corrupt may enable more tax evasion as corrupt officials seek more income via bribes; conversely, higher levels of tax evasion may drive corruption by offering more opportunities for bribes. While a large body of work on each subject separately has emerged, the relationship between the two problems has remained a largely unexplored area. In particular, there is no theoretical work that examines the relationship between corruption and firm tax evasion, focusing on how the potential for bribery of tax officials affects a firm's tax evasion decisions, and there is no empirical work that examines these linkages. This paper develops a theoretical model that incorporates the potential for bribery in a firm's tax reporting decisions, and then tests the main results of the theory using unique firm level information on reporting. Empirical tests that control for potential endogeneity of evasion and corruption demonstrate that it is corruption that largely drives higher levels of evasion.

It is useful at the start to clarify terms. Governments have a natural monopoly over the provision of many publicly provided goods and services, and a selfless and impartial government official would provide these services efficiently at their marginal cost. However, it has long been recognized that public officials are often self-seeking, and such officials may abuse their public position for personal gain. These actions include such behavior as demanding bribes to issue a license, awarding contracts in exchange for money, extending subsidies to industrialists who make contributions, stealing from the public treasury, and selling government-owned commodities at black-market prices. In their entirety, these actions can be characterized as abusing public office for private gain, or "corruption" (Shleifer and Vishny, 1993). However,

despite the widespread recognition of corruption, it is only recently that systematic analyses of its causes and its effects have been undertaken.[1]

"Tax evasion" is a related but clearly different concept, and refers to illegal and intentional actions taken by individuals to reduce their legally due tax obligations. Individuals can evade income taxes by underreporting incomes; by overstating deductions, exemptions, or credits; by failing to file appropriate tax returns; or even by engaging in barter. Most often these actions are viewed through the lens of individuals via the individual income tax, and in fact most all theoretical and empirical work on tax evasion has focused on the individual income tax. However, these types of action can clearly be taken in other taxes. For example, in the corporate income tax, firms can underreport income, overstate deductions, or fail to file tax returns, just as individuals do in the individual income tax. Similarly, indirect taxes like the value-added tax (VAT) present numerous opportunities for evasion; indeed, firms can simply fail to register for the VAT, underreport sales, or they can present fraudulent invoices that allow them to understate their tax liabilities. However, with some exceptions (Wang and Conant 1987; Crocker and Slemrod 2005; Goerke and Runkel 2006), the basic Allingham and Sandmo (1972) model used in nearly all research on tax compliance has focused on the individual, and not the firm. For obvious reasons, empirical work has proven to be quite challenging, given the lack of reliable

[1] See Rose-Ackerman (1978, 1999), Klitgaard (1988), Bardhan (1997) Fiorentini and Zamagni (1999), and Jain (2001) for earlier discussions of the causes and the consequences of corruption; more recent discussions are in Svensson (2005) and Banerjee, Mullainathan, and Hanna (2012). There is now a large literature that examines the various effects of such corruption. For example, there is some work that suggests that corruption "greases the wheels" of commerce as bribers grow into entrepreneurs who spur development (Leys 1965; Bardhan 1997). There is other work that argues that corruption creates serious inefficiencies in the economy, resulting in a wide range of adverse effects (Shleifer and Vishny 1993). Empirical work largely supports the latter view of corruption, confirming that it can result lower growth and investment (Mauro 1995; Goodspeed, Martinez-Vazquez, and Zhang 2013). There is also work on such issues as the determinants of corruption (Treisman 2000; Mocan 2008), the effects of corruption on government revenue (Mookherjee 1997; Tanzi and Davoodi 1997, 2001; Johnson and Kaufman 1999; Sanyal, Gang, and Goswami 2000; Ghura 2002; Attila 2008), the growth effects of corruption (Barreto and Alm 2003; Cerqueti and Coppier 2010), and the ways in which fiscal decentralization affects corruption (Fisman and Gatti 2002), among other things.

information on taxpayer compliance. Even here, the limited amount of empirical work has likewise largely examined individual evasion of the individual income tax.[2]

Despite all of this work on corruption and on tax evasion, there is very little work on their interrelationship, especially as this relates to firms. Existing theoretical analysis that combines corruption and evasion focuses not on firms but on households (Chander and Wilde 1992; Besley and McLaren 1993; Hindriks, Keen, and Muthoo 1999; Acconcia, D'Amato, and Martina 2003; Akdede 2006). A notable exception here is Goerke (2008), who examines the firm's corruption decision in the presence of tax evasion; however, his focus is on firm corruption activities that are not related to evasion, and indeed he finds that evasion has no bearing on the firm's bribery decision. The limited amount of empirical work on firm tax evasion (Rice 1992; Murray 1995; Alm, Blackwell, and McKee 2005) focuses exclusively on firm tax evasion, with no recognition of the ways in which firm evasion may affect, or be affected by, corruption. To our knowledge, only Uslaner (2007) examines empirically the relationship between corruption and evasion, focusing exclusively on a limited number of transition countries in 2002 and 2005, and he finds corruption to be an important factor that negatively affects the decision to pay taxes.

In this paper we contribute to both theoretical and empirical research on corruption and evasion, first by developing a theoretical model of firm reporting when bribery is an option for the firm, and then by empirically investigating whether corruption leads to greater levels of firm tax evasion. In our theoretical model, a firm chooses how much to report, when bribing a corrupt official is also an option. In our empirical work we use detailed firm-level data gathered by the World Bank over multiple countries and years, the World Enterprise Survey (WES) and Business Environment and Enterprise Performance Survey (BEEPS), which include measures of firm reporting. We employ both instrumental variables methods and propensity score matching

[2] See Cowell (1990), Andreoni, Erard, and Feinstein (1998), Slemrod and Yitzhaki (2002), Sandmo (2005, 2012), Slemrod (2007), Torgler (2007), and Alm (2012) for comprehensive surveys and assessments of the evasion literature. See especially Slemrod and Weber (2012) for a discussion of the challenges of empirical work.

techniques in order to estimate the relationship between corruption and tax evasion, including as explanatory variables those that capture the main drivers of evasion and corruption.

Our estimation results indicate that corruption of tax officials is a statistically and economically significant determinant of tax evasion. Tax inspectors who request bribes result in reduction of sales reported for taxes of between 4 and 10 percentage points. Additionally, larger bribes result in higher levels of evasion. These results give support to the argument that tax compliance is dependent on the quality of the tax enforcers. However, while corruption increases tax evasion, very high levels of corruption can create an atmosphere conducive to compliance. If the costs of evading taxes grow greater than the costs of paying taxes, then a rational firm can simply comply with the law and avoid paying bribes. As a result, in situations in which the firm must pay a bribe rate to corrupt officials in excess of the tax rate, firm evasion begins to fall. These results indicate that governments seeking to increase their tax revenues must work first to ensure an honest tax administration.

2. Theoretical Framework

In this section we develop a theoretical model of the firm's decisions to pay or to evade taxes when bribery of government officials is also a possibility. A firm is assumed to earn a total income of *Y*, which it can either declare to the authorities *D* or attempt to hide *E*, so

$$Y = D + E \tag{1}$$

The firm faces a risky gamble based on the probability *p* of being audited by the authorities. If it is not audited ("NA") with probability *(1-p)*, then the firm receives an income of:

$$I_{NA} = Y - \tau D - h_0(Y - D)^2 \tag{2}$$

where τ is the tax rate on income declared and h_0 is the costs of evasion such as keeping two sets of book or hiring lawyers or accountants to help hide income. Costs are assumed to be increasing

with the square of the amount of money being hidden because larger hidden sums require more resources (e.g., holding cash in Swiss bank accounts is more expensive than hiding cash under a mattress).

Now consider the possibility of bribing a corrupt official. If the firm is audited with probability *(1-q)* by a non-corrupt or "straight" official ("AS"), then it is fined and its resulting income is:

$$I_{AS} = Y - \tau D - \pi\tau(Y - D) - h_0(Y - D)^2 \quad (3)$$

where the firm must pay taxes at the tax rate of τ and fines at the fine rate of π on the evaded/detected taxes. Note that resources used in hiding the income are lost even in the event that the bribery is not successful. Suppose instead that the firm faces the possibility of bribing a corrupt official, where the probability of being audited by a corrupt official is *q*. In a system with corruption, the firm faces a corrupt official who is willing to take a bribe to enable the firm's tax evasion, in which case the firm's income with audit ("AC") is defined as:

$$I_{AC} = Y - \tau D - B - f(B)h_0(Y - D)^2 \quad (4)$$

with

$$\frac{\partial f(B)}{\partial B} < 0\ , f(B) \in [0,1]$$

where *B* is the bribe paid to the official and **f(B)** is the factor by which bribing the official reduces the costs of hiding income. This factor is decreasing in *B*, as larger bribes should buy bigger reductions in the costs of evasion. Defining *B* and *f(B)* and substituting into equation (4) redefines I_{AC} as:

$$B = \theta\pi\tau(Y - D) \quad (5)$$

$$\theta \in [0,1]$$

$$f(B) = (1 - \theta)^{\alpha} \quad (6)$$

$$I_{AC} = Y - \tau D - \theta\pi\tau(Y - D) - (1 - \theta)^{\alpha} h_0 (Y - D)^2 \qquad (4)'$$

Following Besley and McLaren (1993), θ is the fraction of the tax and fine liability paid as a bribe and represents the tax inspector's bargaining power, and the benefit of bribery *f(B)* is assumed to be dependent on this bargaining power, as adjusted by α, which represents the effectiveness of the corrupt official in reducing costs. This parameter can encompass a wide range of factors including the level of enforcement of anti-corruption laws, the general level of corruption in a country, or even firm specific circumstances.[3] In a very corrupt country, the bribe may be sufficient to fully eliminate evasion costs; the corrupt official takes the bribe and ignores the taxpayer. In a more honest or vigilant society, the corrupt official may be able to mitigate the evasion costs, but the taxpayer must still incur some costs in order to completely hide evasion.

There are as a result three potential income levels, which can be placed in an expected utility framework with associated probabilities:

$$E(U) = qpU(I_{AC}) + (1 - q)pU(I_{AS}) + (1 - p)U(I_{NA}) \qquad (7)$$

where *p* is the probability of being audited, *q* is the probability of being audited by a corrupt tax inspector, and *(1-q)* is the probability of being audited by a non-corrupt inspector. The firm's problem is to maximize expected utility by deciding what amount of income to declare.

Substituting the appropriate equations and maximizing (7) with respect to *D* results in a first-order condition of:

$$\frac{\partial E(U)}{\partial D} \equiv \varphi = qp\frac{\partial U}{\partial I_{AC}}\frac{\partial I\_AC}{\partial D} + (1 - q)p\,\frac{\partial U}{\partial I_{AS}}\frac{\partial I_{AS}}{\partial D} + (1 - p)\frac{\partial U}{\partial I_{NA}}\frac{\partial I_{NA}}{\partial D} \qquad (8)$$

[3] For example, a U.S. multinational company operating in a corrupt environment may engage in bribery to avoid local taxes, but it would still need to use additional resources to circumvent U.S. laws against corruption, such as the Foreign Corrupt Practices Act. In this case, the corrupt tax official's effectiveness in abetting evasion is limited to only what he or she can do in the home country.

$$= qp\,\frac{\partial U}{\partial I_{AC}}[\pi\tau\theta - \tau + 2h_0(Y-D)(1-\theta)^{\alpha}] + (1-q)p\frac{\partial U}{\partial I_{AS}}[\pi\tau - \tau + 2h_0(Y-D)]$$

$$+ (1-p)\frac{\partial D}{\partial I_{NA}}[2h_0(Y-D) - \tau]$$

$$= 0$$

Note that the second derivative of φ with respect to D is less than zero, indicating a maximum:

$$\frac{\partial \varphi}{\partial D} = qp\frac{\partial^2 U}{\partial I_{AC}^2}[\pi\tau\theta - \tau + 2h_0(Y-D)(1-\theta)^{\alpha}]^2 + qp\frac{\partial U}{\partial I_{AC}}(-2h_0(1-\theta)^{\alpha})$$

$$+ (1-q)p\frac{\partial^2 U}{\partial I_{AS}^2}[\pi\tau\theta - \tau + 2h_0(Y-D)]^2 + (1-q)p\frac{\partial U}{\partial I_{AS}}(-2h_0)$$

$$+ (1-p)\frac{\partial^2 U}{\partial I_{NA}^2}[2h_0(Y-D) - \tau]^2 + (1-p)\frac{\partial U}{\partial I_{NA}}(-2h_0)$$

$$< 0 \tag{9}$$

The optimal amount of declared income can therefore be defined as:

$$D^* = D(\tau, \pi, p, q, \theta, \alpha, h_0, Y) \tag{10}$$

Equation (8) also implicitly defines the optimal amount of declared income D^* as a function of the corruption variables q, α, and θ. It is straightforward to demonstrate that the comparative statics of these variables are given by:

$$\underset{(-)}{\frac{\partial \varphi}{\partial q}} = p\frac{\partial U}{\partial I_{AC}}[\pi\tau\theta - \tau + 2h_0\underset{(-)}{(Y-D)}(1-\theta)^{\alpha}] - p\frac{\partial U}{\partial I_{AS}}\underset{(+)}{[\pi\tau - \tau + 2h_0(Y-D)]} \tag{11}$$

$$\underset{(?)}{\frac{\partial \varphi}{\partial \theta}} = pq[\pi\tau\theta - \tau + 2h_0(Y-D)(1-\theta)^{\alpha}]\underset{(?)}{\frac{\partial^2 U}{\partial I_{AC}^2}}(-\pi\tau(Y-D) + \alpha(1-\theta)^{\alpha-1}h_0(Y-D)^2)$$

$$+ pq\,\underset{(-)}{\frac{\partial U}{\partial I_{AC}}}\,(-\alpha 2h_0(Y-D)(1-\theta)^{\alpha-1}) \tag{12}$$

$$\underset{(?)}{\frac{\partial \varphi}{\partial \alpha}} = pq(\pi\tau\theta - \tau + 2h_0(Y-D)(1-\theta)^{\alpha}\underset{(+)}{\frac{\partial^2 U}{\partial I_{AC}^2}}(-h_0(Y-D)^2\ln(1-\theta)\,(1-\theta)^{\alpha}) + pq\underset{(-)}{\frac{\partial U}{\partial I_{AC}}}(2h_0(Y-D)\ln(1-\theta)\,(1-\theta)^{\alpha}) \tag{13}$$

Given that the sign of the derivative of φ with respect to q (or the probability of being audited by a corrupt official) is negative while the sign is ambiguous for α (or the effectiveness of the corrupt official in reducing costs) and for θ (or the fraction of the tax and fine liability paid as a bribe), then the signs of the comparative statics effects are given by:

$$\frac{\partial D}{\partial q} = -\frac{\varphi_q}{\varphi_D} = -\frac{(-)}{(-)} \tag{14}$$

$$\frac{\partial D}{\partial \theta} = -\frac{\varphi_\theta}{\varphi_D} = -\frac{(?)}{(-)} \tag{15}$$

$$\frac{\partial D}{\partial \alpha} = -\frac{\varphi_\alpha}{\varphi_D} = -\frac{(?)}{(-)} \tag{16}$$

Note that income from a crooked audit will always exceed that from a straight audit. Should a corrupt tax inspector attempt to extort an amount greater than the tax and fines on the evaded amount, the taxpayer could simply approach a straight tax inspector and pay the full tax and fine owed. As a result, the bribe rate plus the reduced evasion costs associated with the bribe will always be less than the fine/tax rate on evaded income plus the full costs of evasion. In this respect, businesses will always prefer to be audited by a crooked auditor, and a firm will always decrease its reported income as the probability of audit q by a corrupt auditor increases.

The auditor's bargaining power and bribery effectiveness have more ambiguous results on declared income. These two variables serve to change the "price" of tax evasion, with larger bribes and more effective bribes, as represented by higher values of θ and α, respectively, reducing the costs of tax evasion. As the size of the bribe grows, the change in price of tax

evasion has an income and substitution effect on the amount of income declared, and the conflicting income and substitution effects create ambiguity in the comparative statics.

For example, consider equation (12), which gives the effects of the bribe amount on declared income. The income effect is represented by the first term of equation (12). As disposable income grows due to the lower costs of evasion from the larger bribe, declared income will also increase. Declaring more income creates more certainty, thus declared income is a normal good. However, while the increase in income from falling costs of evasion is positive, the bribe must be paid to the corrupt authority. Paying the bribe offsets the income gains from the cost of evasion reduction and thereby reduces the amount of declared income. These two countervailing effects serve to create ambiguity with regard to the overall effect of the bribe rate on declared income. The substitution effect from the relative price change between declared and undeclared income due to the bribe size is represented by the second term of equation (12). As the costs of evasion fall, the relative price of declaring income increases. This results in the substitution of evaded income for declared income as indicated by the negative sign of the substitution effect. Given the ambiguity of the income effect and the impossibility of determining which effect dominates, the total effect of changing the bribe size on declared income is theoretically ambiguous.

A similar analysis applies to the effects of α (or the effectiveness of the corrupt official in reducing costs) on declared income. A change in α also results in a change in the costs of evasion, with higher values resulting in lower evasion costs. The more effective a corrupt official is at reducing the costs, the lower the costs will be. The resulting change in declared income is also subject to income and substitution effects. Unlike a change in the bribe size, increasing officials' effectiveness only creates a decrease in the costs of evasion, which results in higher income. Because the firm receives all the benefit from this income increase, the effect on

declared income is unambiguously positive. Since declared income is a normal good, then the resulting increase in income will reduce tax evasion. Counterbalancing this income effect is a substitution effect. Like larger bribes, more effective corruption will reduce the costs of evasion. Correspondingly, the relative price of declaring income will increase, and a firm will substitute away from declared income to undeclared income. Again, it is impossible to determine which effect will dominate, so the overall effect of an increase in α on declared income is theoretically ambiguous.

The next section presents our approach for estimating these effects.

3. Data and Estimation Strategy

3.1. Data

Our data come from a compilation of survey information from the World Bank. Through the first decade of the millennium, the World Bank conducted the World Enterprise Survey (WES) and the Business Environment and Enterprise Performance Survey (BEEPS), which are polls of individual firms regarding their business environment. The survey questions of interest cover over 16,000 firms from 33 different countries; due to missing data, sample sizes for richer specifications are closer to 8,000 observations. The descriptions of variables are in Table 1, and summary statistics are in Table 2.

We seek to estimate equation (10), or the determinants of the firm's optimal amount of declared income. The dependent variable follows from a question asking each firm about the amount that the "typical" firm in its area reports for tax purposes. Asking a firm directly about its own reporting decision is of course likely to result in unreliable responses, as respondents are often wary of incriminating themselves or they may wish to present themselves in a positive light (Elffers, Weigel, and Hessing 1987). Indirect survey questions seek to limit this misreporting by

asking about the behavior of others. The respondent's answer is assumed to be informed by its own experiences, and is thus assumed to be a reasonable proxy for its own behavior. Even so, these data are not without potential problems. While the indirect nature of the questions mitigates misreporting due to self-presentation reasons, the questions may still be subject to misreporting due to a firm's misperceptions of its own behavior. If the firm does not realize that it is engaging in tax evasion, then it cannot report its experience with tax evasion. However, the lack of formal high-quality audit data often makes these types of survey data the only way to proceed in investigating tax evasion, especially at the firm level.

Table 1: Variable Names and Descriptions

Variable	Description
rprt_sales	Percentage of sales reported for tax purposes
brib_taxes	Bribed to deal with taxes dummy
brsal_per	Total briberyas percentage of sales
tax_inspec	Inspected by tax authorities in past year dummy
obst_taxreg	Tax regulations are an obstacle to business (0-No Obstacle, 3-Major Obstacle)
obst_hightax	Tax rates are an obstacle to business (0-No Obstacle, 3-Major Obstacle)
obst_corrup	Corruption is an obstacle to business (0-No Obstacle, 3-Major Obstacle)
lnsales	Natural log of sales
Yoper	Number of years the firm has been in operation
Empfull	Full time permanent employment
Listed	Legal organization – Listed
Closed	Legal organization – Closed
Sole Proprietorship	Legal organization – Sole Proprietorship
Partnership	Legal organization – Partnership
Public Sector	Legal organization – Public Sector
Other	Legal organization – Other
Domestic Private	Ownership – Domestic Private
Foreign Private	Ownership – Foreign Private
State	Ownership – State
brib_infra	Bribed to deal with infrastructure dummy
brib_license	Bribed to deal with licenses dummy
brib_contr	Bribed to deal with contracts dummy
VAT Rate	Value Added Tax rate
PIT Rate	Personal Income Tax rate
CIT Rate	Corporate Income Tax rate
gfdddi01	Bank private credit to GDP

gfdddm01	Stock market capitalization to GDP
gfddai01	Bank accounts per 100,000 adults

Table 2: Descriptive Statistics

Variable	Observations	Mean	Standard Deviation	Min	Max
rprt_sales	16231	88.164	19.918	1	100
brib_taxes	16231	0.405	0.491	0	1
brsal_per	16231	1.087	2.603	0	50
tax_inspec	11009	0.529	0.499	0	1
obst_taxreg	15925	1.468	1.134	0	3
obst_hightax	16047	1.685	1.122	0	3
obst_corrup	15444	1.060	1.138	0	3
lnsales	12789	6.151	2.110	0	14.509
Yoper	15058	15.939	17.639	3	202
Empfull	16213	114.422	440.698	2	9960
Listed	16231	0.021	0.142	0	1
Closed	16231	0.256	0.436	0	1
Sole Proprietorship	16231	0.348	0.476	0	1
Partnership	16231	0.249	0.433	0	1
Public Sector	16231	0.087	0.282	0	1
Other	16231	0.039	0.193	0	1
Domestic Private	16231	0.793	0.405	0	1
Foreign Private	16231	0.121	0.326	0	1
State	16231	0.086	0.280	0	1
brib_infra	16044	0.250	0.433	0	1
brib_license	15981	0.441	0.496	0	1
brib_contr	15333	0.343	0.475	0	1
VAT Rate	10774	0.188	0.028	0.100	0.250
PIT Rate	15755	0.022	0.020	0.000	0.084
CIT Rate	15755	0.024	0.017	0.000	0.084
gfdddi01	18307	39.671	38.760	3.440	140.970
gfdddm01	16037	26.102	19.332	0.260	84.020
gfddai01	5228	1531.961	1182.842	356.520	4279.260

3.2 Empirical Specification

Following from equation (10), our main econometric specification is:

$$rprt\_sales_i = \beta_0 + \beta_1 brib\_taxes_i + \beta_2 brsal\_per_i + \beta_3 tax\_inspec_i + \beta_4 obst\_taxreg_i + \beta_5 obst\_hightax_i + \beta_6 \ln(sales)_i + \beta_n X_i + u \quad (17)$$

where *rprt_sales* is the percentage of sales a firm declares for tax purposes, *brib_taxes* is a dummy variable equal to one if the firm has made a bribe to deal with taxes, *brsal_per* is the firm's total bribery payments for tax and other purposes as a percentage of sales, *tax_inspec* is a dummy variable indicating that the firm has been audited within the past year, *obst_taxreg* and *obst_hightax* are categorical variables measuring how much the firm views tax regulations and rates as an obstacle to doing business, and *ln(sales)* is the natural log of the firm's sales. The vector *X* contains control variables, including country fixed effects that also control for the tax and penalty rate faced by the firm. Due to data limitations, not all parameters affecting the optimal level of income reporting in equation (10) can be explicitly included in the econometric specification. Measures of the tax rate τ and penalty rate π are not available, and in any event these variables are likely to be defined solely by legal statute. However, as these statutes are constant at the country level, a vector of country fixed effects will control for them. Most all other factors affecting the firms reporting decision are represented in the data set.

In particular, the theoretical model identified several main factors that affect the reporting decision of the firm in a corrupt environment. The dummy variable *taxinspect* controls for the audit probabilities faced by the firm, and potentially controls for other omitted variables that are correlated with both corruption and audit activities. Firm income is measured by the natural log of firm sales. The costs of evasion are proxied by the survey questions that ask the firm's view of tax regulations being an obstacle to doing business (*obst_taxreg*) and of tax rates as an obstacle (*obst_hightax*). While these variables do not measure evasion costs directly, the firm's view of tax regulations and tax rates as obstacles to business contains useful information about these costs. The firm's evasion costs consist of pecuniary and non-pecuniary costs. Some pecuniary costs typically associated with evasion are the salaries to the accountants and lawyers enabling evasion or the bank fees accompanying an account in which gains can be hidden; non-pecuniary

or psychological costs arise from the social stigma of tax evasion or the possible embarrassment of being caught. Both of these costs can contribute to firms viewing tax regulations/rates as an obstacle to business. When a firm faces low costs, it is easier to evade taxes. When taxes are easy and cheap to evade, they do not pose a large obstacle to doing business, and a firm will simply evade the taxes it needs to evade and move on with business.[4] However, when costs of evasion are high and evasion does not come as easily, taxes are not so lightly dismissed. In this respect, taxes increasingly become an obstacle to business as evasion costs increase.

The two coefficient estimates of most interest are β_1 and β_2. The variable *brib_taxes* measures the firm's probability of facing a corrupt tax inspector, and thus represents the q variable from equation (10). The variable *brsal_per* captures information on the amount of the bribe for tax evasion (or a firm's entire bribery load), and thus is a measure of θ. While the effectiveness of tax officials in reducing costs α is not specifically controlled for in this specification, the country level fixed effects included in the X vector offer some control.

The effectiveness of officials in reducing evasion costs depends in part on how acceptable corruption is in the country. As corruption becomes more common and (presumably) more acceptable, corruption becomes more effective at reducing costs associated with evasion. For example, a firm engaged in evasion may keep two sets of books; upon being audited by a corrupt auditor, the firm can then bribe the auditor to report the cooked books to his superiors, thus enabling the evasion. In a society in which corruption is more common, the corrupt auditor's superiors could simply accept the auditor's word that the firm's books are straight, particularly if the superiors gain something from the transaction as well.[5] This obviates the need

[4] A similar effect has been shown to occur in the relationship between foreign direct investment (FDI) and taxation. High levels of corruption attenuate the relationship between tax levels and FDI (Goodspeed, Martinez-Vazquez, and Zhang 2013).

[5] A recent case in India illustrates the potential collusion between corrupt tax officials and their superiors. In his defense, a corrupt tax official claimed that the bribe "…accepted by him was to be passed on to his senior Nahar and was not for his use only" (PTI 2013).

for two sets of books; the auditor's (corrupted) word stands in for the cooked books. Each country has its own level of corruption acceptance, and the country fixed effects capture this acceptance level.

3.3. Econometric Issues

As emphasized in our theoretical discussion, the level of tax corruption in the country in which a firm operates affects the amount of tax evasion in which a firm engages, so that corruption and evasion are jointly determined. Çule and Fulton (2000) argue that tax evasion by firms and corruption by inspectors are complementary activities; that is, while corruption may induce more firms to cheat on taxes, more cheating on taxes creates more opportunities for bribery of tax officials. This potential endogeneity must be addressed.

We deal with this potential endogeneity in several ways. In a first strategy, we employ an instrumental variable approach. An appropriate instrument for the corruption variables is one that is correlated with tax corruption but uncorrelated with tax evasion. One set of variables that meets these requirements is the information regarding the firm's other bribery activity. Such variables include whether a firm bribed authorities to get connected to infrastructure, to obtain a business license, and to obtain a government contract.

We argue that these variables are suitable instruments, for several reasons. As corruption takes root in a society, these types of bribes will grow in conjunction with bribery of tax officials to evade taxes. A culture of bribery reduces the stigma and social costs involved with all forms of bribery. Further, if a firm is comfortable with bribing for other reasons, then it is unlikely to view tax bribery as unacceptable and refuse to engage in it. As a result, the other bribe variables meet the first condition for instrumental variables; that is, they are correlated with bribery to deal with taxes.

Since the bribery activity captured by the instrumental variables does not affect the firm's relationship with the tax authorities, they are also independent of the tax evasion decision (Goerke 2008). In a sense, these bribes can be viewed as a cost of doing business similar to the wage rate or cost of capital. While such costs affect total income and profits, they do not affect the amount of sales to report for tax purposes. As a result, these instruments also meet the second condition of instrumental variables. Further, given three instruments (e.g., bribery to deal with infrastructure, business licenses and government contracts) and only one endogenous variable, the equation is over-identified, which allows for testing of both instrumental variable conditions.

In a second strategy, we also address potential endogeneity of the corruption variable through propensity score matching (DiPrete and Gangl 2004). The event of facing and bribing a corrupt tax collector can be viewed as a random treatment that the firm experiences, with the subsequent outcome being the amount of sales that are reported for tax purposes. The effect of corruption on tax evasion can then be determined by finding the average treatment effect on the treated firms (ATT). The effect of the treatment on the outcome is observable on the treated firms, and the effect of non-treatment on the outcome is also visible for non-treated firms. Denoting declared income Y_1 for treated firms and Y_0 for non-treated firms, the average treatment effect (ATE) can be written:

$$ATE = E(Y_1|C = 1 - Y_0|C = 0) \quad (18)$$

where *E* is the expectations operator and *C* is a dummy variable indicating if the firm faced corruption or not. However, due to potential endogeneities, the ATE will not be the same as the ATT. The ATT is determined by:

$$ATT = E(Y_1|C = 1 - Y_0|C = 1) = E(Y_1 - Y_0|C = 1) \quad (19)$$

Thus finding the ATT requires observation of the outcomes of the untreated firms when they are treated ($Y_0|C=1$), which is of course unobserved. Because the treatment is not necessarily

completely random, it is necessary to employ propensity score matching to establish a control group for comparison with the treated group.

The propensity score model first identifies the characteristics that are highly associated with treatment. Based on those characteristics, firms that have a high probability of being treated but in actuality are not are established as a control group with which the treated group can be compared. From this group, the ATT can be measured, giving the effect of corruption on tax evasion.

Since the treatment is partially based on the firm's actions of engaging in bribery, it is important to control for a wide range of firm characteristics to account for this potential selection bias. We use a number of observable firm characteristics, including firm size in sales and employees, ownership and industry type, its attitude toward regulations/rates, and other bribery activities in order to identify the untreated firms that would have been likely to fall into the treated group in order to establish a control group. Since the firm's other bribery activity is an observable and captures the firm's attitudes toward corruption, the potential selection bias is mitigated. Once this is accounted for, the treatment contains a random element because bribing to deal with taxes can only occur if the firm has the chance to be audited by a corrupt official. The treatment captures whether a bribe is paid to deal with taxes. A probit regression then gives the propensity that a firm engages in bribery based on the observable characteristics. After obtaining the fitted values from the probit regression, firms within the control group are matched with firms in the treated group based on their propensity scores. The resulting average difference in outcomes is the effect of bribing to deal with taxes on tax evasion.

As emphasized by Caliendo and Kopeinig (2008), in matching propensity scores there is a tradeoff between efficiency and bias depending on what matching method is used for finite samples. To address this tradeoff, we use three matching techniques: Nearest Neighbor, Gaussian

Kernel, and Epanechikov Kernel matching. Nearest Neighbor matching pairs observations based on which propensity scores are closest to one another. The similarity of the propensity scores between treated and non-treated observations reduces bias in the comparison; however, the one-to-one comparison reduces the number of matches between groups, which increases the variance. Gaussian and Epanechikov Kernel matching methods address this issue by using a weighted average of all control group observations to create a counterfactual for the treatment observation. Since all control group observations are used, the variance of the estimate is reduced. However, this method can introduce bias as bad matches may be used in the weighting scheme.

In addition to the potential endogeneity of the tax bribery variable, it is clear from equation (4)' that the size of the bribe, as measured by *brsal_per*, is determined by both the bargaining power of the corrupt official (measured by the parameter θ) and by the level of evasion (our dependent variable). As with the tax corruption variable, we use an instrumental variable approach to isolate the portion of variation in *brsal_per* that arises from θ. To this end, we use the percentage of time that the firm spends on regulations as an instrument for the corrupt official's bargaining power.

When viewed as a bargaining game, the official's bargaining power is positively related to the level of regulations in two ways. First, many government regulations represent a large burden on firms and translate into a high demand for circumvention. In such a situation, corrupt officials have more bargaining power, as they can charge a higher price to ease the regulatory burden. Additionally, corrupt officials can often impose new regulations of their own, in order to increase their bargaining power (Shleifer and Vishny 1993). When corrupt officials have rule-making power, they can increase a firm's regulatory compliance costs and extract additional payments that "allow" the firm to comply. Indeed, many rules and regulations may be in place only to provide the opportunity for officials to demand bribes (De Soto 1989). Under the

assumption that more time spent on regulations is the result of more numerous regulations, our chosen instrument would then be positively associated with larger bribes due to more bargaining power on part of the corrupt official. As with the decision to bribe for reasons other than tax purposes, the amount of time spent on regulations should not be related to the level of sales reported for taxes, and thus meets the orthogonality condition.

Finally, a third strategy recognizes the jointly endogenous relationship between evasion and tax corruption; that is, the firm's decision to evade and its decision to bribe are jointly determined and can be estimated simultaneously. We have jointly estimated both decisions as part of our estimation strategy; because the results are practically unchanged, for space reasons the simultaneous estimations are not reported here.[6]

Note that the dependent variable also presents estimation issues in the OLS case. The percentage of sales reported for tax purposes is bounded between 0 and 100, with a large proportion (55 percent) of the sample reporting 100 percent of sales. The transformation from a continuous distribution (or the actual amount of sales reported for tax purposes) to a limited distribution (or the percentage of sales reported) creates obvious issues for conventional regression methods (Green 2003). This fractional response can be estimated by a generalized linear model with a logistic transformation (Papke and Wooldridge 1993).

4. Estimation Results

4.1. Basic Results: IV Analyses

Table 3 reports first stage regressions for the IV analyses. Column one shows estimates from the least squares first stage regression on bribery to deal with taxes. The instruments chosen are positively correlated with tax corruption and significant at the 1 percent level. A firm that bribes to deal with contracts, licenses, or infrastructure increases the likelihood a firm bribing to

[6] All estimation results are available upon request.

deal with taxes by between 18.8 and 28.5 percent. Column two gives the least squares first stage estimates for bribe size. As with the first estimation, the chosen instrument of time spent on regulations is positively correlated with bribe size, with an additional percentage point of time spent on regulations increasing bribe size by 0.03 percentage points of sales.

Table 3: First Stage Regressions

Variables	brib_taxes	brsal_per
brib_infrastr	0.205***	0.161*
	(0.014)	(0.083)
brib_license	0.294***	0.482***
	(0.014)	(0.067)
brib_contract	0.204***	0.561***
	(0.013)	(0.071)
law_govreg	0.000	0.027***
	(0.000)	(0.005)
tax_inspec	0.034***	0.038
	(0.010)	(0.052)
obst_taxreg	0.025***	0.070**
	(0.005)	(0.029)
obst_hightax	0.007	0.027
	(0.005)	(0.028)
lnsales	-0.005*	-0.041***
	(0.003)	(0.015)
Yoper	-0.000*	-0.002*
	(0.000)	(0.001)
Closed	-0.011	-0.086
	(0.037)	(0.227)
Sole Proprietorship	-0.004	-0.021
	(0.024)	(0.187)
Partnership	0.005	0.042
	(0.024)	(0.175)
Public Sector	-0.023	-0.168
	(0.025)	(0.175)
Other	-0.102*	-0.170
	(0.058)	(0.219)
Foreign Private	0.004	-0.000
	(0.014)	(0.071)
State	0.057	-0.126
	(0.056)	(0.165)
Constant	0.051	0.640

	(0.056)	(0.447)
Observations	7,833	7,834
R-Squared	0.478	0.153

*** p<0.01, ** p<0.05, * p<0.10

Table 4: OLS Regressions

	Model Controls	Extended Controls	Tax Controls	Financial Controls
	rprt_sales	rprt_sales	rprt_sales	rprt_sales
brib_taxes	-5.182***	-4.696***	-3.879*	-5.660***
	(0.979)	(0.851)	(1.757)	(0.777)
brsal_per	-1.017***	-0.922***	-0.831**	-0.740**
	(0.211)	(0.198)	(0.330)	(0.280)
tax_inspec	-0.213	-0.417	-0.661	-0.025
	(0.859)	(0.606)	(0.981)	(1.185)
obst_taxreg	-0.369	-0.830**	-0.618	-0.153
	(0.360)	(0.352)	(0.467)	(0.745)
obst_hightax	-0.691*	0.092	0.149	0.066
	(0.340)	(0.342)	(0.539)	(0.778)
lnsales	0.933***	0.669***	0.740***	0.511**
	(0.177)	(0.104)	(0.188)	(0.194)
Yoper		0.002	-0.018	0.007
		(0.011)	(0.018)	(0.020)
Listed		-0.019	-3.335	1.518
		(1.341)	(2.736)	(1.683)
Closed		-1.485	-5.953***	-0.239
		(1.058)	(1.751)	(1.576)
Sole Proprietorship		-4.808***	-10.549***	-3.459**
		(0.985)	(1.852)	(1.166)
Partnership		-3.098**	-8.227***	-2.912
		(1.307)	(1.998)	(1.948)
Public Sector		-8.854	-1.097	-0.137
		(8.019)	(4.920)	(1.766)
Foreign Private		1.253	0.461	1.845*
		(0.856)	(1.588)	(0.937)
State		8.456	-2.610	
		(8.870)	(4.375)	
VAT Rate			-62.081	
			(81.436)	
PIT Rate			136.149	
			(164.604)	
CIT Rate			-46.590	
			(82.631)	
gfdddi01				-0.067
				(0.119)
gfdddm01				0.197
				(0.203)
gfddai01				0.007
				(0.006)
Constant	88.973***	87.497***	115.208***	53.939*
	(1.779)	(2.368)	(14.575)	(26.209)
Observations	7,875	7,866	3,495	3,145
R-squared	0.083	0.159	0.137	0.129
Industry Fixed Effects		x	x	x
Country Fixed Effects		x		
Region Fixed Effects			x	x
Year Fixed Effects		x	x	
Clustered SE	X	x	x	x

*** p<0.01, ** p<0.05, * p<0.10

Throughout specifications and estimation methods, corruption on the part of tax officials enables tax evasion. Table 4 presents estimates from the main variables of the regression analysis. Column one of Table 4 gives results of a base model with only factors from the theoretical model included. Corruption and tax evasion are strongly linked, and all measures of corruption are statistically significant at the 1 percent level. Column two presents results with a richer set of firm controls, and the addition of these additional firm controls does not affect the statistical significance of these results. Column three estimates add the VAT, personal income tax, and corporate income tax rates, and column four controls for financial development. Due to collinearity issues, these models are estimated with regional fixed effects instead of country fixed effects. Importantly, the negative relationship between reported sales and corruption holds.[7]

In these specifications, tax bribery results in lower sales reporting for tax purposes, with a bribe estimated to reduce reported sales by 3.9-5.7 percentage points. Additionally, as the amount of bribery increases so does tax evasion. An increase of one percentage point in bribes as a percent of sales decreases reported sales by between 0.75 and 1 percentage points.

The results of the least squares IV analysis are in Table 5. As with the non-IV regressions, corruption is shown to be a significant factor in tax evasion. Results in column two show that bribing to deal with taxes reduces amount of sales reported for tax purposes by about 5 percentage points. Larger bribe sizes also result in more evasion, with a decrease of 2.4 percentage points in reported sales for every additional percentage point of sales paid in bribes. However, this effect becomes imprecisely estimated in the final two columns when controls for tax rates and financial development are included.

[7] While the inclusion of country fixed effects in these models results in the omission of various control variables, the results on the variables of interest remain consistent with the results presented. The omission of country fixed effects allows us to examine not only the VAT tax rate, but also the personal income tax and corporate income tax rates in the tax rate specifications and all three measures of financial development in those specifications. The results with country fixed effects included are available from the authors upon request.

Table 5: IV Regressions

	Model Controls	Extended Controls	Tax Controls	Financial Controls
Variable	rprt_sales	rprt_sales	rprt_sales	rprt_sales
brib_taxes	-4.412***	-4.973**	-9.868*	-3.755
	(1.650)	(2.132)	(5.439)	(2.700)
brsal_per	-3.024***	-2.386**	1.599	-2.526
	(0.781)	(1.135)	(3.458)	(1.577)
tax_inspec	0.353	-0.575	-0.618	-0.654
	(0.838)	(0.404)	(0.644)	(0.771)
obst_taxreg	-0.112	-0.438*	-0.699	-0.007
	(0.357)	(0.237)	(0.463)	(0.430)
obst_hightax	-0.591*	0.020	0.388	-0.152
	(0.312)	(0.230)	(0.457)	(0.404)
lnsales	0.739***	0.632***	0.907***	0.449**
	(0.189)	(0.120)	(0.218)	(0.199)
Yoper		0.000	-0.016	0.012
		(0.008)	(0.016)	(0.015)
Listed		0.324	-3.330	1.171
		(1.370)	(2.182)	(2.207)
Closed		-1.308	-6.451***	-1.205
		(0.998)	(1.533)	(1.721)
Sole Proprietorship		-4.401***	-11.482***	-3.664**
		(1.003)	(1.585)	(1.742)
Partnership		-3.075***	-8.783***	-3.955**
		(1.023)	(1.600)	(1.754)
Public Sector		0.367	-3.397	-1.911
		(1.761)	(4.357)	(2.203)
Foreign Private		1.683***	-0.219	2.267**
		(0.537)	(1.282)	(0.882)
State		-0.713	-0.159	
		(1.685)	(4.567)	
VAT Rate			-135.986	
			(184.426)	
PIT Rate			365.777	
			(445.206)	
CIT Rate			34.370	
			(104.427)	
gfdddi01				-0.031
				(0.054)
gfdddm01				0.101
				(0.067)
gfddai01				0.004*
				(0.002)
Constant	90.946***	97.842***	125.012***	100.468***
	(1.890)	(2.312)	(28.401)	(4.390)
Observations	7,074	7,749	3,120	2,804
R-squared	0.025	0.130	0.052	0.073
Underidentification LM Statistic	13.40	47.72	9.341	17.90
LM Statistic P-Value	0.0039	0.0000	0.0251	0.0005
Weak Identification F Statistic	10.00	11.90	2.230	5.029
Hansen's J	4.938	2.091	2.362	2.964
Hansen's P-value	0.0847	0.351	0.307	0.227
Industry Fixed Effects		x	x	x
Country Fixed Effects		x		
Region Fixed Effects			x	x
Year Fixed Effects		x	x	
Robust SE		x	x	x

Clustered SE		x		

Table 6: GLM Logit Transformation Regressions

Variable	Model Controls	Extended Controls	Tax Controls	Financial Controls
brib_taxes	-0.597***	-0.538***	-0.448**	-0.692***
	(0.100)	(0.094)	(0.186)	(0.101)
brsal_per	-0.074***	-0.072***	-0.059**	-0.057**
	(0.015)	(0.016)	(0.029)	(0.024)
tax_inspec	-0.021	-0.032	-0.083	0.024
	(0.104)	(0.081)	(0.135)	(0.148)
obst_taxreg	-0.042	-0.098***	-0.083*	-0.014
	(0.041)	(0.038)	(0.047)	(0.080)
obst_hightax	-0.099**	-0.006	0.016	-0.016
	(0.047)	(0.043)	(0.063)	(0.088)
lnsales	0.126***	0.098***	0.115***	0.069***
	(0.024)	(0.016)	(0.026)	(0.026)
Yoper		0.002	-0.002	0.002
		(0.002)	(0.003)	(0.003)
Listed		0.118	-0.660	0.387
		(0.239)	(0.489)	(0.306)
Closed		-0.225	-1.172***	0.050
		(0.182)	(0.429)	(0.213)
Sole Proprietorship		-0.617***	-1.677***	-0.389***
		(0.165)	(0.384)	(0.149)
Partnership		-0.456**	-1.450***	-0.337
		(0.201)	(0.416)	(0.234)
Public Sector		-1.284	8.619***	-0.018
		(0.853)	(0.931)	(0.254)
Foreign Private		0.222*	0.142	0.298**
		(0.128)	(0.266)	(0.140)
State		1.213	-9.230***	
		(1.002)	(0.862)	
VAT Rate			-8.317	
			(6.583)	
PIT Rate			18.680	
			(19.443)	
CIT Rate			-8.881	
			(8.373)	
gfdddi01				-0.003
				(0.009)
gfdddm01				0.018
				(0.017)
gfddai01				0.001
				(0.000)
Constant	2.066***	3.062***	5.863***	2.888***
	(0.230)	(0.275)	(1.405)	(0.746)
Observations	7,875	7,866	3,495	3,145
MFX brib_tax	-4.927	-4.313	-3.587	-5.506
MFX brsal_per	-0.613	-0.575	-0.469	-0.457
Industry Fixed Effects		x	x	x
Country Fixed Effects		x		
Region Fixed Effects			x	x
Year Fixed Effects		x	x	

Clustered SE	x	x	x	x

Table 7: IV-GLM Logit Transformation Regressions

Variable	Model Controls	Extended Controls	Tax Controls	Financial Controls
brib_taxes	-0.574***	-0.699***	-1.202**	-0.577**
	(0.154)	(0.223)	(0.517)	(0.230)
brsal_per	-0.323***	-0.216**	0.186	-0.256**
	(0.080)	(0.094)	(0.245)	(0.115)
tax_inspec	0.041	-0.062	-0.093	-0.058
	(0.104)	(0.095)	(0.155)	(0.156)
obst_taxreg	-0.013	-0.067*	-0.096**	-0.002
	(0.043)	(0.039)	(0.038)	(0.088)
obst_hightax	-0.091**	-0.011	0.047	-0.042
	(0.045)	(0.044)	(0.066)	(0.090)
lnsales	0.113***	0.103***	0.135***	0.070**
	(0.026)	(0.020)	(0.031)	(0.030)
Yoper		0.002	-0.002	0.003
		(0.002)	(0.004)	(0.003)
Listed		-0.313*	-1.228***	-0.143
		(0.173)	(0.421)	(0.164)
Closed		-0.713***	-1.793***	-0.490***
		(0.173)	(0.341)	(0.143)
Sole Proprietorship		-0.570***	-1.520***	-0.526**
		(0.189)	(0.423)	(0.208)
Partnership		6.601***	7.246***	-0.251
		(0.589)	(0.842)	(0.309)
Public Sector		0.002	-0.747	0.249
		(0.232)	(0.540)	(0.239)
Foreign Private		0.251*	0.063	0.380**
		(0.138)	(0.238)	(0.151)
State		-6.759***	-7.826***	
		(0.594)	(0.744)	
VAT Rate			-13.601	
			(10.716)	
PIT Rate			38.573	
			(36.223)	
CIT Rate			0.563	
			(4.956)	
gfdddi01				-0.001
				(0.010)
gfdddm01				0.013
				(0.017)
gfddai01				0.000
				(0.000)
Constant	2.177***	2.728***	3.046***	0.224
	(0.263)	(0.351)	(0.442)	(2.117)
Observations	7,383	7,065	3,120	2,804
MFX brib_tax	-4.536	-5.602	-10.1	-4.457
MFX brsal_per	-2.556	-1.729	1.561	-1.981
Industry Fixed Effects		x	x	X
Country Fixed Effects		x		
Region Fixed Effects			x	X

Year Fixed Effects		x	x	
Clustered SE	x	x	x	X

Additional instrument validity statistics can be found at the bottom of Table 5. Underidentification is strongly rejected with the LM statistic ranging from 9.34 to 47.72 depending on the specification. Similarly, tax bribery and bribe size are strongly identified by the instruments, with the null hypothesis of weak identification test rejected for all specifications. These results indicate that the first instrumental variable condition of correlation between the instruments and the variable of interest is fulfilled.

Further, with three separate instruments for tax bribery, the equation is overidentified, which allows testing for orthogonality. These estimates produce a Hansen J statistic between 2.09 and 4.94, which fail to reject the null hypothesis of orthogonality at the 5 percent level for all specifications and at the 10 percent level for the preferred specification. These results show that the chosen instruments are appropriate as they meet both conditions for valid instrumental variables.

Tables 6 and 7 report results of the generalized linear model in which the dependent variable is transformed with a logistic function. As with the other results, tax bribery and bribe size are associated with less tax reporting, and the magnitudes of the estimates are in line with the OLS and IV analyses. The IV-GLM estimates give marginal effects of tax bribery as reducing reported income between 4.5 and 10.1 percentage points, with our preferred specification giving a marginal effect of a reduction of 5.6 percentage points. Similarly, bribe size is shown to be negative and significant over three of the four specifications (with the fourth being imprecisely estimated). A one percentage point increase in the bribes to firm sales ratio results in 1.7 percentage point decline in reported sales.

While the IV test statistics indicate that the instruments chosen are valid, these results could be sensitive to the instruments chosen. To examine this possibility, the IV models are estimated using three alternative sets of instruments for tax bribery and one alternative for bribe

Table 8: Alternative Instruments

	Extended Controls	Extended Controls	Extended Controls	Extended Controls	Extended Controls	Extended Controls
	IV	IV GLM	IV	IV GLM	IV	IV GLM
Variable	Bribery Is Common/Government Regulation		Bribe Safety, Fire, Environmental Inspection/Goverment Regulation		Bribe for Courts, Customs/Bribe Price Is Known/Percent Protestant.	
brib_taxes	-6.782**	-1.419***	-4.568**	-0.633***	-3.430***	-0.177
	(3.098)	(0.376)	(2.044)	(0.194)	(1.308)	(0.215)
brsal_per	-2.639***	-0.147**	-3.094**	-0.272***	-3.584***	-0.516***
	(0.759)	(0.067)	(1.276)	(0.090)	(0.681)	(0.119)
tax_inspec	-0.278	-0.003	-0.265	-0.017	-0.228	-0.010
	(0.432)	(0.092)	(0.416)	(0.093)	(0.419)	(0.096)
obst_taxreg	-0.257	-0.021	-0.408*	-0.068	-0.580**	-0.085*
	(0.259)	(0.044)	(0.246)	(0.041)	(0.245)	(0.047)
obst_hightax	0.102	0.007	0.055	-0.000	0.233	0.020
	(0.233)	(0.041)	(0.234)	(0.047)	(0.236)	(0.049)
lnsales	0.642***	0.106***	0.614***	0.101***	0.608***	0.097***
	(0.123)	(0.019)	(0.123)	(0.020)	(0.123)	(0.020)
Yoper	-0.002	0.001	-0.002	0.001	-0.008	0.000
	(0.009)	(0.002)	(0.009)	(0.002)	(0.009)	(0.002)
Closed	-0.018	-0.276	0.198	-0.280	0.602	-0.152
	(1.363)	(0.175)	(1.371)	(0.186)	(1.417)	(0.210)
Sole Proprietorship	-1.229	-0.652***	-1.194	-0.680***	-0.710	-0.564***
	(0.999)	(0.177)	(1.018)	(0.181)	(1.117)	(0.193)
Partnership	-4.075***	-0.547***	-4.191***	-0.554***	-3.732***	-0.425**
	(1.002)	(0.200)	(1.014)	(0.203)	(1.111)	(0.192)
Public Sector	-3.121***	-1.426*	-3.121***	-1.849**	-2.536**	-1.455
	(1.018)	(0.795)	(1.034)	(0.814)	(1.117)	(0.946)
Other	-7.447	-0.088	-9.649	-0.016	-7.499	0.124
	(7.548)	(0.236)	(9.056)	(0.250)	(8.022)	(0.262)
Foreign Private	1.228**	0.164	1.327**	0.205	1.429***	0.246*
	(0.568)	(0.130)	(0.558)	(0.130)	(0.547)	(0.127)
State	6.822	1.234	8.687	1.603*	7.019	1.269
	(7.512)	(0.912)	(9.012)	(0.907)	(7.967)	(1.086)

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Constant	91.655***	1.544***	97.612***	2.554***	97.975***	2.474***
	(2.311)	(0.358)	(2.486)	(0.364)	(2.375)	(0.458)
Observations	7,841		7,981		7,975	
R-squared	0.108		0.089		0.077	
Underidentification LM Statistic	74.79		37.06		138.8	
LM Statistic P-Value	0		4.48e-08		0	
Weak Identification F Statistic	19.42		9.376		35.93	
Hansen's J for Overidentification			0.857		0.847	
Hansen's P-value			0.651		0.655	
Industry Fixed Effects	x	x	x	x	x	x
Country Fixed Effects	x	x	x	x	x	x
Year Fixed Effects	x	x	x	x	x	x
Robust SE	x	x	x	x	x	x

*** p<0.01, ** p<0.05, * p<0.1

size. These alternative instrument sets are similar to the chosen instruments in that they measure the firm's bribery perceptions and activities. Table 8 gives the results of these alternative instrument specifications.

The first alternative instrument for tax bribery is the firm's perception that bribery is common. The second set of instruments for tax bribery includes indicators of the firm's bribery to deal with safety inspections, to deal with fire inspections, and to deal with environmental inspections. The final instruments are two indicators of the firm's bribery activity, one to deal with courts and one to deal with customs and imports that are paired with alternative instruments for tax bribery, whether the general bribe price is known or not and the percentage of the population that is Protestant. The first two sets of alternative instruments follow the rational of the instruments from the main analyses, or that tax corruption is associated with a culture of corruption that does not directly influence the reporting decision. However, the results of the Sargan-Hansen test of overidentifying restrictions can be suspect in this case; if one instrument is invalid, then all may be invalid (Murray 2006). To compensate, in addition to alternative measures of corruption culture, we include the percentage of population that is Protestant as an additional instrument. A Protestant tradition has been identified as a determinant of corruption levels (Treisman 2000), but has no apparent association with tax evasion. As such, the percentage Protestant provides an instrument rooted in historical and religious traditions instead of corruption culture and allows us to test the robustness of the Sargan-Hansen tests.

All sets of alternative instruments, for both IV and GLM-IV estimators, give results similar to our main results. In the two specifications with alternative instruments based only on the culture of corruption rational, bribery to deal with taxes and bribes as a percentage of sales are both statistically significant, and have magnitudes in line with those in the primary analyses.

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Including the percentage of the population that is Protestant does not significantly alter the results. Only bribery to deal with taxes, while still negatively associated with reported sales, becomes imprecisely estimated in the GLM-IV specification. This could be due to the nature of the Protestant variable, which only varies at the country level and thus does not fully capture firm level characteristics. With the inclusion of the Protestant variable as an instrument, the Hansen J statistic remains insignificant; the test fails to reject the null hypothesis that all instruments are valid. This indicates that the instruments based on the culture of corruption are valid despite being grounded in the same rational.

4.2. Basic Results: Propensity Score Matching Analyses

The results of the IV regression analyses are broadly confirmed by the propensity score matching analyses. Table 9 presents summary statistics of firm characteristics by whether they bribed for tax purposes or not. Differences in means are fairly small, indicating a close relationship between the groups and a good likelihood of finding appropriate matches between the groups for comparison. The unconditional difference in mean sales reporting is -7.1 percentage points, with firms that do not bribe reporting 93.3 percent of their sales and firms that do bribe reporting only 86.2 percent of their sales.

The results of the smaller sample propensity score regression (Table 10) show that being audited and believe that regulations/taxes are an obstacle to doing business (*tax_inpec* and *obst_taxreg/obst_hightax*, respectively) are associated with a greater probability of engaging in bribery. Tax inspections provide more opportunities for bribery, while ambivalence toward taxes reduces the moral costs of tax bribery. More established and foreign private firms (as compared to the omitted category of domestic private firms) are less likely to bribe to deal with taxes.

Propensity score matching is successful only if appropriate matches can be made between treated and untreated observations. To achieve good matches, the propensity scores for both

Table 9: Summary Statistics by Treatment

Bribed to deal with Taxes?	**No**			**Yes**			
Variable	Observations	Mean	Standard Deviation	Observations	Mean	Standard Deviation	Difference
Mining	5246	0.009	0.096	3046	0.010	0.097	0.000
Construction	5246	0.119	0.324	3046	0.125	0.330	0.006
Transport/communication	5246	0.069	0.253	3046	0.063	0.242	-0.006
Trade	5246	0.196	0.397	3046	0.223	0.416	0.027
Business services	5246	0.122	0.327	3046	0.078	0.268	-0.044
Hotels/restaurants	5246	0.065	0.246	3046	0.070	0.256	0.005
Other service	5246	0.089	0.285	3046	0.072	0.259	-0.017
MF-Food	5246	0.068	0.251	3046	0.118	0.322	0.050
MF-Textile	5246	0.017	0.129	3046	0.018	0.132	0.001
MF-Garments	5246	0.044	0.205	3046	0.045	0.207	0.001
MF-Chemicals	5246	0.011	0.106	3046	0.012	0.111	0.001
MF-Plastics and rubber	5246	0.006	0.074	3046	0.007	0.085	0.002
MF-Non-metallic min. product	5246	0.013	0.112	3046	0.014	0.118	0.001
MF-Metals and metal product	5246	0.052	0.223	3046	0.053	0.223	0.000
MF-Machinery and equipment	5246	0.056	0.231	3046	0.046	0.209	-0.011
MF-Electronics	5246	0.006	0.079	3046	0.003	0.057	-0.003
MF-n.e.c	5246	0.059	0.235	3046	0.045	0.207	-0.014
Listed	5246	0.021	0.142	3046	0.015	0.123	-0.005
Closed	5246	0.319	0.466	3046	0.244	0.430	-0.075
Sole Proprietorship	5246	0.327	0.469	3046	0.398	0.490	0.071
Partnership	5246	0.235	0.424	3046	0.265	0.441	0.030
Public Sector	5246	0.067	0.251	3046	0.045	0.207	-0.023
Other	5246	0.032	0.175	3046	0.033	0.179	0.002
Domestic Private	5246	0.009	0.096	3046	0.857	0.350	0.848
Foreign Private	5246	0.119	0.324	3046	0.098	0.298	-0.020
State	5246	0.069	0.253	3046	0.044	0.206	-0.025
tax_inspec	5246	0.434	0.496	3046	0.647	0.478	0.213
obst_taxreg	5246	1.213	1.137	3046	1.764	1.046	0.551
obst_hightax	5246	1.483	1.161	3046	1.908	1.025	0.425
Empfull	5246	100.440	357.527	3046	81.734	284.266	-18.706
lnsales	5246	6.700	2.100	3046	6.081	1.963	-0.619
Yoper	5246	18.355	18.801	3046	14.468	15.482	-3.886
rprt_sales	5246	93.265	14.114	3046	86.201	18.985	-7.064

types of observations must share a common support. Figure 1 shows the common support between firms engaging in bribery and those which do not for the small sample matching. The distribution of the treatment group is nearly uniform across propensity scores, while untreated

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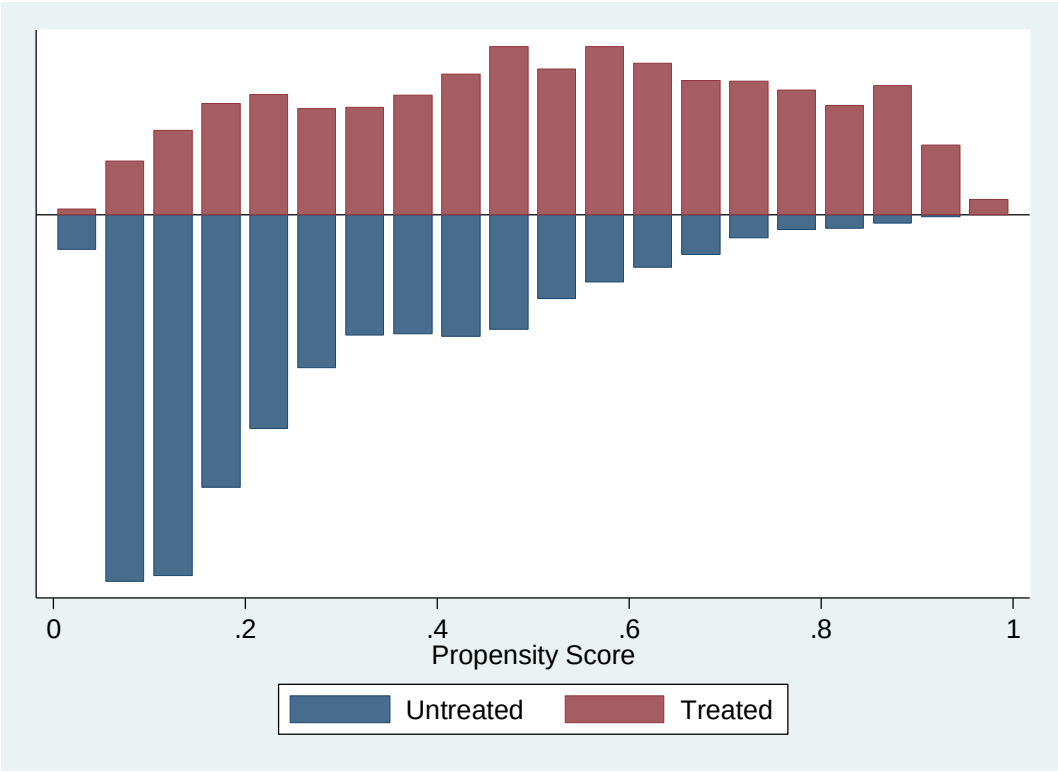
Figure 1: Common Support



firms are positively skewed with a majority having low propensity scores. However, both distributions completely overlap, providing close matches between groups across the entire range of propensity scores.

Table 11 provides the results of the propensity score matching. These results again show that the entire sample of treated and untreated firms is on-support for both the large and the small samples. The difference in average percentage of sales reported for taxes before matching, -6.5 for the small sample and -8.8 for the large sample, is statistically significant at the 1 percent level. After matching, while the average difference falls, the difference is still significant across matching techniques and sample sizes. In the small sample, the matched mean difference in reported sales between the two groups is between -4.4 and -4.6 percentage points. The large sample shows similar results, with matched mean differences between -7.4 and -8.0 percentage points.

Table 10: Propensity Score Estimations, Alternative Samples

	Small Sample	Large Sample
Variables	brib_taxes	brib_taxes
tax_inspec	0.193***	
	(0.034)	
obst_taxreg	0.220***	
	(0.018)	
obst_hightax	0.042**	
	(0.019)	
lnsales	0.005	
	(0.011)	
Empfull	-0.000	
	(0.000)	
Yoper	-0.005***	-0.004***
	(0.001)	(0.001)
Closed	0.103	0.130**
	(0.119)	(0.060)
Sole Proprietorship	0.138	0.185***
	(0.121)	(0.060)
Partnership	0.143	0.158***
	(0.121)	(0.060)
Public Sector	-0.404	-0.285
	(0.573)	(0.283)
Other	0.091	0.216***
	(0.142)	(0.072)
Foreign Private	-0.091*	-0.066**
	(0.051)	(0.031)
State	0.240	-0.024
	(0.566)	(0.280)
Constant	-0.038	0.467***
	(0.248)	(0.133)
Observations	9,169	18,939

*** p<0.01, ** p<0.05, * p<0.10

These results show that firms that engage in bribery will typically report fewer sales for tax purposes. Further, these results are similar in magnitude and significance to the earlier IV regression results, which show that bribery reduces the percentage of sales reported by around 5 percentage points.

Table 11: Propensity Score Estimates, Alternative Matching Estimators

	Unmatched	Nearest Neighbor	Kernel – Gaussian	Kernel - Epanechnikov
Small Sample – Extended Matching Controls				
Treated	86.225	86.225	86.225	86.304
Controls	92.691	90.628	90.807	90.706
Difference	-6.466	-4.402	-4.581	-4.402
Standard Error	0.369	0.735	0.493	0.545
t-statistic	-17.500	-5.990	-9.290	-8.070
On-Support	8,855	8,855	8,855	8,831
Large Sample – Limited Matching Controls				
Treated	81.288	81.288	81.288	81.288
Controls	90.084	89.252	88.674	88.682
Difference	-8.797	-7.965	-7.386	-7.395
Standard Error	0.311	0.553	0.358	0.374
t-statistic	-28.260	-14.400	-20.620	-19.770
On-Support	18,939	18,939	18,939	18,939

Both the regression and matching analyses support our theoretical predictions in which firms decrease reported sales as the probability of facing a corrupt tax administrator increases. Additionally, the regression analysis shows that the ambiguous theoretical result on bribe size is nonlinear as well. Evasion first increases with bribe costs as firms can evade more if they pay more. However, once the costs of bribery become too great, firms will rather report their income than incur those bribery cost and evasion falls.

4.3. Intensive and Extensive Margins

In our theoretical framework, a firm assesses the probability of facing a corrupt tax administrator and then choses the optimal amount of evasion in which to engage. Two similar firms, facing the same audit and corruption probabilities, will choose similar evasion levels. A corrupt audit will not affect the chosen level of evasion as the firms have optimally chosen their evasion levels. However, if corruption is not a driver of evasion or if evasion enables corruption, then evasion levels are chosen independently of bribery opportunities. In this case, the two similar firms will still chose the similar initial evasion levels, but when one encounters a corrupt official it will change its evasion level in response to the corruption. As such, examining a firm's evasion behavior at the "intensive margin" (by how much does evasion occur) and the "extensive margin" (does evasion occur or not occur) provides additional insight into the role of corruption on evasion.

To examine the intensive margin, the IV and GLM-IV analyses presented above are conducted only on firms reporting that they engaged in evasion.[8] By excluding all firms that did not evade their tax liability, only the response of the level of evasion to corruption is measured. If corruption creates changes at this intensive margin, it would indicate that the decision to evade is independent of corruption.

To examine the extensive margin, a binary variable is created to indicate if the firm has reported 100 percent of its sales or has engaged in evasion by reporting less than 100 percent of sales; that is, the variable equals 1 if the firm is honest and 0 if the firm is dishonest. This variable is then used as the dependent variable in logit and IV-logit estimations. By consolidating all evading firms into one category, this analysis focuses on only the extensive margin. If

[8] Only the GLM-IV results from the first set of instruments, "bribery to deal with infrastructure", "bribery to deal with licenses", and "briber to deal with contracts", are presented. The other instrumental variable sets give similar results, and are available from the authors upon request.

corruption creates changes at the extensive margin, then this would suggest that corruption drives evasion.

Table 12: Intensive and Extensive Margins

	Intensive Margin	Intensive Margin	Extensive Margin	Extensive Margin
	OLS	GLM-IV	Logit	IV-Logit
	rprt_sales	rprt_sales	honest	honest
brib_taxes	-0.002	0.423**	-0.857***	-1.611***
	(0.008)	(0.188)	(0.138)	(0.374)
brsal_per	-0.002	-0.200**	-0.152***	-0.127
	(0.002)	(0.082)	(0.028)	(0.161)
tax_inspec	-0.004	-0.050	-0.057	-0.033
	(0.011)	(0.079)	(0.090)	(0.108)
obst_taxreg	-0.001	-0.020	-0.149***	-0.078*
	(0.005)	(0.039)	(0.043)	(0.044)
obst_hightax	0.002	0.032	-0.019	-0.048
	(0.005)	(0.036)	(0.056)	(0.057)
lnsales	0.008***	0.043***	0.100***	0.103***
	(0.002)	(0.016)	(0.021)	(0.029)
Yoper	0.000	0.000	-0.000	-0.001
	(0.000)	(0.001)	(0.003)	(0.004)
Listed	-0.017	-0.291	-0.288	-0.345*
	(0.016)	(0.224)	(0.224)	(0.209)
Closed	-0.042**	-0.446*	-0.754***	-0.830***
	(0.018)	(0.236)	(0.184)	(0.187)
Sole Proprietorship	-0.032*	-0.436*	-0.507**	-0.572***
	(0.017)	(0.233)	(0.220)	(0.206)
Partnership	-0.254***	-0.517*	-0.793	7.932***
	(0.028)	(0.269)	(0.972)	(0.625)
Public Sector	-0.047*	-0.517	0.424	0.379
	(0.024)	(0.314)	(0.268)	(0.261)
Foreign Private	0.003	0.051	0.327**	0.344**
	(0.019)	(0.122)	(0.149)	(0.160)
State	0.183***		1.114	-7.743***
	(0.031)		(1.122)	(0.652)
Constant	0.614***	1.146***	1.499***	1.052*
	(0.036)	(0.397)	(0.500)	(0.543)
Observations	3,035	2,654	7,866	7,065
Industry Fixed Effects	x	x	x	x
Country Fixed Effects	x	x	x	x
Year Fixed Effects	x	x	x	x
Clustered SE	x	x	x	x

*** p<0.01, ** p<0.05, * p<0.10

The results from the intensive and extensive margin analysis are presented in Table 12. The first two columns detail the IV and GLM-IV results of the intensive margin analysis. Tax bribery is not significant in the IV analysis; however, bribery is positive and significant in the GLM-IV analysis, with bribery resulting in a 0.4 percentage point increase in sales reported. This is perhaps indicative of the increased marginal cost of evasion when a firm that has already set a course of evasion must also pay a corrupt official it has encountered on that course. However, there is still some evidence that firms engage in negotiations with the corrupt official as bribe size remains a significant factor in determining evasion levels, with larger bribers resulting in more evasion.

In contrast, the results of the extensive margin analyses indicate that corruption plays a significant role in the decision to engage in evasion in the first place. Bribery to deal with taxes plays a significant and negative role in the decision to remain honest and to report 100 percent of tax liability in both the logit and IV-logit estimations. These results indicate that corruption can induce a firm to engage in evasion, as suggested by our theoretical analysis.

In short, it appears that high levels of corruption create more tax evaders. However, corruption does not induce tax evaders to engage in more evasion than they would have otherwise. The negative marginal effects of corruption on sales reporting come primarily from firms making the rational choice to evade and setting their optimal evasion levels in light of existing corruption rates. Our results therefore suggest that corruption creates more cheaters instead of making existing cheaters worse. This may be particularly worrisome as widespread tax evasion could be more harmful than limited but severe tax evasion.

5. Conclusions

While corruption and tax evasion can exist separately, they can easily become entangled. Corruption enables tax evasion by making it easier for taxpayers to hide their income, while tax evasion can contribute to corruption by creating additional opportunities for corruption to thrive. Policymakers must understand the relationship between the problems. Our basic estimation results provide consistent evidence that corruption is a driver of evasion.

Our estimation results indicate that corruption of tax officials is a statistically and economically significant determinant of tax evasion. Tax inspectors who request bribes result in reduction of sales reported for taxes of between 4 and 10 percentage points. Additionally, larger bribes result in higher levels of evasion. These results give support to the argument that tax compliance is dependent on the quality of the tax enforcers. Corruption effectively negates any reduction in evasion from establishing higher audit rates and penalties, the traditional enforcement measures used to increase compliance rates. Rules do not matter if no one bothers to enforce them. As a result, policymakers cannot attack tax evasion and expect results without addressing potential corruption issues first.

These results indicate that governments seeking to increase their tax revenues should first ensure that their tax administration is honest. Corrupt tax administrations not only cause tax shortfalls through increased evasion on part of the taxpayers, but they can also appropriate some portion the collected taxes due to the government. An honest tax administration enforces the existing tax laws, effectively reducing evasion and remitting all tax collections to the government. Addressing corruption can ameliorate both corruption (directly) and tax evasion (indirectly). Additionally, an honest tax administration allows policymakers to pursue a variety of other tax reforms designed to reduce evasion with the confidence that those reforms will be properly implemented.

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