Demand or Supply side of corruption: what drives firms' tax evasion in developing countries ?

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Abstract

Corruption and tax evasion are widespread and pervasive in developing countries with a negative impact on both domestic ressources mobilisation and the government ability to invest in development programs. While a large part of the literature tried to understand both corruption and tax evasion separately and together, there is no consensus as to what drives firms' tax evasion in developing countries. As a novelty, this paper identifies the demand and the supply side of corruption and examines their effects on firms' tax evasion. Using firm-level data from the World Bank Entreprise Surveys on 86 developing countries over the period 2002-2006, we provide evidence that firms' tax evasion is driven by the demand side of corruption. Public officials' culture of demanding a bribe increases sales not reported for tax purposes between 4.42 and 17.57 percentage points. From the vantage point of firms, public officials' culture of demanding a bribe may reduce risks involved with tax evasion activities. We address potential endogeneity issues between tax evasion and corruption using three different identification strategies: propensity score matching methods, instrumental variables method, and a structural model estimated with the three-stage least-squares (3SLS) estimator.

Keywords: Tax evasion, Corruption.

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1 Introduction

Corruption and tax evasion are widespread and pervasive in developing countries (Fisman and Svensson, 2007). Goyette and Kouamï£¡ (2016) show that firms in developing countries conceal 22% of their revenues to tax authorities compared to 7% in OECD countries. Even if this may seem profitable from the vantage point of the evading firms, tax evasion reduces a government's ability to provide public goods and services, and invest in development programs (Johnson et al., 1999). Similarly, corruption increases the cost of public goods and services and creates additional efficiency costs on private and public sector activities through distortions (Olken and Pande, 2012; Shleifer and Vishny, 1993).

The existing literature provides evidence on the effects of corruption and tax evasion at the macro and micro levels on economic growth and investment. However, evidence on the relationship between tax evasion and corruption, as well as the determinants of tax evasion, remains scant. To our knowledge, Alm et al. (2016), Gauthier and Goyette (2014), Uslaner (2010), and Goerke (2008) are the only papers examining the relationship between firms' tax evasion and corruption. The first three papers focus on the negotiation over bribes and taxes evaded between entrepreneurs and tax officials. Using the number of permits bought illegally as an indicator of corruption, Goerke (2008) argues that the opportunity to evade taxes does not affect the optimal amount of corruption, for a given tax rate. Hence, there is no clear consensus on the issue of what drives firms' tax evasion in developing countries.

This paper thus examines the internal and external determinants of tax evasion in developing countries by focusing on the effect of the demand and the supply side of the corruption on firms' tax evasion. We define the demand side of corruption as situations where firms are asked by public officials to pay a bribe in exchange of a license, a tax rebate, etc. (Shleifer and Vishny, 1993), while the supply side of corruption represents situations where firms initiate the act of corruption by offering a bribe to a public official. We argue that a firm's decision to evade its taxes is affected by who initiates the act of corruption: the firm or the public official. Indeed, on the supply side, an establishment can offer a bribe to reduce its taxes and compensate losses from failures

and inefficiencies from its business environment (Goyette and Kouamï£¡, 2016; López de Silanes et al., 2002), and/or to counterbalance a competitive disadvantage (Gauthier and Reinikka, 2006; Svensson, 2003). On the demand side of corruption, public officials may abuse their discretionary powers to extract rents from firms.

In order to analyze the effects of the demand and supply of corruption on firms' tax evasion, we use data from the World Bank Enterprises Survey (WBES) on 86 developing countries over the period 2002-2006. We deal with potential endogeneity issues between firms' tax evasion and corruption using three different identification strategies: an instrumental variables method (IV) and a structural equation model estimated using the three-stage least-squares (3SLS) estimator as well as a robustness check using propensity score matching methods (PSM).

The identification strategy using IVs relies on three exogenous instruments to identify a causal effect of the demand or supply of corruption on tax evasion. For the first two instruments, we first calculate for each firm a proportion of firms facing a demand for a bribe by a public official or a proportion of firms offering a bribe to a public official. These proportions are calculated based on current country-location-sector-size level but, in order to disentangle the reverse effect from tax evasion to bribe demands or bribe offers at the country-location-sector-size level, we match each firms with the proportion of firms associated with its initial size in the data. This is akin to (Aterido et al., 2011). This strategy should satisfy the exclusion restriction as long as the proportion of firms facing a demand for a bribe or offering bribe at the initial country-location-sector-size level affects a firm's level of tax evasion only through the current demands or offers (which are determined at the current country-location-sector-size level). In other words, as a firm grows or changes size it carries a certain "norm of corruption for tax evasion". This culture was picked up at an initial size but impacts current tax evasion behaviors. Concerns about reverse causality are thus greatly reduced as the firm does not belong anymore to the group of firms used to calculate the proportion, i.e., a firm's tax evasion decision does not impact the cultural traits of its previous reference group of firms.

The third instrument uses information on bribery activities associated with government contracts. Again this should satisfy the exclusion restriction as long as bribery activities associated

with government contracts affect tax evasion only through bribery demand/supply related to tax evasion. This is likely to be the case as a firm involved in bribery activities in one dimension is more likely to be involved in corruption for tax evasion than a firm which is not involved in bribery activities in other dimensions of its business environment. Finally, we use location-sector fixed effects to control for omitted variable bias from other institutional variables which may be related to a "norm of corruption for tax evasion" and we use year fixed effects to control for repeated interactions between firms and public officials, thus reducing concerns about a bias from serial correlation.

The PSM uses observable similarities between treated and untreated firms to generate comparison groups which can be used to identify the effect of the demand and the supply side of corruption on firms' tax evasion. An important assumption is that the expected probability of being face with a demand for a bribe by (or to offer a bribe to) a public official is exogenous from the vantage point of a firm once we condition on a set of observable and exogenous characteristics shared by the treated and untreated individuals. We thus consider this expected probability to be an exogenous treatment which allows identifying the effect of the demand and the supply side of corruption on firms' tax evasion.

Our findings can be summarized as follow. The demand side of corruption increases firms' tax evasion between 4.42 and 17.57 percentage points while there is no strong evidence that the supply side of corruption has an effect on firms' tax evasion. Public officials culture of demanding bribes reduces risks involved with tax evasion activities, and then generates a vicious circle between corruption and tax evasion in developing countries.

This paper makes three contributions to the literature. First, we examine the internal and external determinants of tax evasion. Second, we identify the "demand-side" and the "supply-side" of corruption, analyze their effect on firms' tax evasion and show that the demand-side of corruption is a statistically and economically significant determinant of tax evasion. Third, we examine these issues using a large sample of 86 developing countries, something which has not been done yet. Indeed, Alm et al. (2016) focus mainly on developed countries, Gauthier and Goyette (2014) focus on Uganda, and Uslaner (2010) focuses on a 26 transition countries.

The remainder of the paper is structured as follows. Section II describes the data, provides baseline evidence on the correlation between tax evasion and the demand and supply side of corruption. This section presents also identification strategies and the results. Section III examines the sensitivity of the findings. Section presents concluding remarks.

2 Data, specification, and identification strategy

In this section, we first present the data and baseline correlations between tax evasion and the demand and supply side of corruption as well as other internal and external determinants of tax evasion. We then describe the identification strategies to deal with potential endogenous issues between tax evasion and the demand and supply side of corruption.

2.1 Data and descriptives statistics

The empirical analysis is based on the World Bank Entreprise Surveys (WBES) data. The WBES is a collection of firm-level survey of a representative sample (random stratified sampling) of business environment mainly in developing countries. Questionnaires cover a wide range of business environment topics like infrastructure, performance measures, crime, corruption, competition, access to finance. The surveys are conducted within a framework of common guidelines in the design and implementation. A module of identical questions included in all questionnaires is used for assembling the data set, which allows cross-country comparisons. We use a sample of 67 326 firms in 86 developing countries during the period 2002-2006.

2.2 Empirical specifications

The empirical analysis focuses on the following specification:

$$Tax\_evasion_{ict} = \alpha_0 + \alpha_1 Intern\_factors_{ict} + \alpha_2 Extern\_factors_{ict} + \delta_c + \mu_s + \eta_t + \epsilon_{ict} \quad (1)$$

where, $Tax\_evasion_{ict}$ is the percent of total sales not reported for tax purposes by firm i in country c in a specific year t. $Intern\_factors_{ict}$ is a set of internal determinants of tax evasion. As internal determinants, we include the percentage of the firm owned by foreign or governmental interests (*Foreign share* and *Government share*), the percentage of the establishment's sales exported directly or indirectly (*trade*). We include three variables that capture firms' age categories: *Young*, 1-5; *Mature*, 6-15 and *Older*, more than 15 years (Older is the reference category), and four size classes: *Microenterprise*, 1-10 permanent employees; *Small*, 11-50; *Medium*, 51-200; and *Large*, more than 200 permanent employees (Large is the reference category). Finally, we control for firm's performance by including *Log(real sales per worker)*, the natural logarithm of the real total sales per worker. The supply side of corruption is captured by a dummy variable *Supply-side* which takes 1 if an establishment offers bribes to a public official, and 0 otherwise.

With respect to the external determinants, we include *Management time* which represents the percentage of time the senior management spends dealing with requirements imposed by government regulation, *Competition* which is a measure of the degree to which anti-competitive or informal practices are an obstacle for the operation and growth of the business (0 = No obstacle; 1 = Minor obstacle; 2 = Moderate obstacle; 3 = Major obstacle; 4 = Very Severe Obstacle). We include also the share of working capital financed by commercial banks (*Access to finance*), the degree of distortions in business environment measured as the percentage of sales lost due to inefficiencies in infrastructures and services (losses due to power outage, surges from public grid, insufficient water supply, unavailable mainline telephone service, transport failures, and delivery delays, etc.), crime (losses due to theft, robbery, vandalism or arson against the establishment), *Distortions*. We describe below how we identify the demand and the supply side of corruption.

Demand and supply side of corruption

Two questions in the WBES allow identifying the demand and the supply side of corruption. The first question is related to the percent of annual sales spent to make gifts or informal payments to public officials to "get things done". The second question is related to gifts or informal payments expected/requested in inspections and mandatory meetings with public officials of the

following agencies: tax inspectorate, labor and social security, fire and building safety, sanitation/epidemiology, municipal police, and environmental. We consider that an establishment faces a demand for a bribe if it spends a positive share of its annual sales to make gifts or informal payments to public officials *and* declares that gifts or informal payments were expected/requested during an inspection or any other mandatory meetings with public officials. The demand side of corruption is captured therefore by a dummy variable *Demand-side* that takes 1 if an establishment faces a demand for a bribe and 0 otherwise. A firm may therefore have a value of zero under two sets of circumstances: 1) if it pays a bribe *and* the bribe was not requested, or 2) if it does not pay a bribe. Similarly, we consider that an establishment offers a bribe (supply side of corruption) if the latter spends a positive share of its annual sales to make gifts or informal payments to public officials to "get things done" *and* gifts or informal payments were *not* expected/requested in inspections and mandatory meetings with public officials. In this case, a firm may have a value of zero for this variable under two sets of circumstances: 1) if it pays a bribe *and* the bribe was requested, or 2) if it does not pay a bribe.

Table 1 presents summary statistics for both external and internal determinants of tax evasion. On average 21.78 percent of establishments' annual sales are not reported for tax purpose, and 1.84 percent of firms' annual sales are spent to make gifts or informal payments to public officials. Approximately 21 percent of firms face a demand for a bribe, and 11 percent of them offering bribe to public officials. On average 14.43 percent of an establishment's working capital are financed by banks, 3.95 percent of annual sales are lost due inefficiencies in business environment. Microentreprise, small, medium and large firms represent respectively 30.8; 36.7; 19.2 and 13.3 percent of establishments in the sample. Similarly, firms between 0 to 5 years old, 5 to 15 years old, and more than 15 years old represent respectively 18.7, 43.2 and 38.1 percent of the establishments in the sample. Measure of firms performance measured by labor productivity growth, sales growth and employment growth are respectively 6.3, 8.6 and 5.6 a year. On average each top manager spend around 10 percent of his weekly time in dealing with constraints and regulations imposed by the government.

In Figure 1 we present a cross-country comparison of tax evasion and bribes. First, we observe

Table 1: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Percentage of sales not reported for tax purposes	21.784	31.017	0	100	50774
Bribe as percentage of sales	1.844	5.609	0	100	42167
Internal determinants					
Proportion of firms initiating corruption	0.11	0.392	0	1	28853
Trade (%)	19.191	26.537	0	100	66803
Foreign share (%)	9.601	27.208	0	100	65784
Government/State share (%)	5.33	21.41	0	100	65520
Number of employees	142	731.742	0	67598	65730
Labor productivity growth	0.063	0.267	-1	1	13155
Sales Growth	0.086	0.268	-1	1	19024
Employment Growth	0.056	0.213	-1	1	52249
Proportion of Microenterprise	0.308	0.462	0	1	65730
Proportion of Small firms	0.367	0.482	0	1	65730
Proportion of Medium firms	0.192	0.394	0	1	65730
Proportion of Large firms	0.133	0.34	0	1	65730
Proportion of Young firms (0-5)	0.187	0.39	0	1	67326
Proportion of Mature firms (5-15)	0.432	0.495	0	1	67326
Proportion of Older firms (16 and more)	0.381	0.486	0	1	67326
External determinants					
Proportion of firms facing a demand for corruption	0.205	0.43	0	1	28853
Management time (%)	9.899	15.586	0	100	60470
Degree of anti-competitive or informal practice	1.123	1.336	0	4	62276
Percentage of working capital financed by banks	14.425	26.931	0	100	61255
Distortions (%)	3.948	9.207	0	100	67326

a positive correlation between tax evasion and bribes. Moreover, firms in more developed countries (red circles) tend to pay less bribes and evade less than those in less developed countries (blue circles). Also, Figure 2 and 3 below show that sales not reported for tax purposes and sales paid in bribes are higher for both firms for firms facing a demand for a bribe or offering a bribe. These graphs provide descriptive evidences of the potential relationship between tax evasion and the demand and the supply side of corruption.

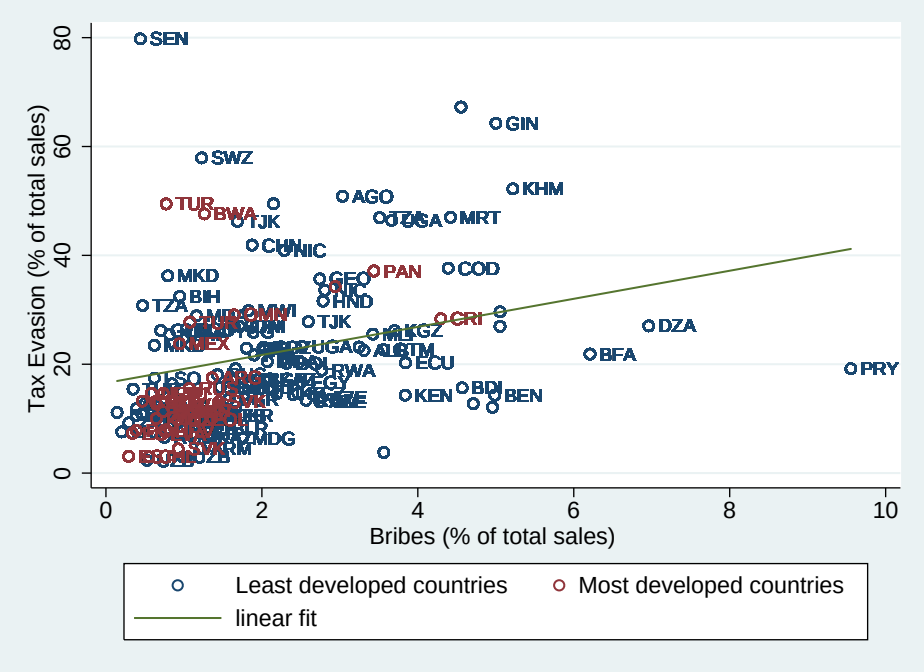

Figure 1: Bribes and Tax evasion

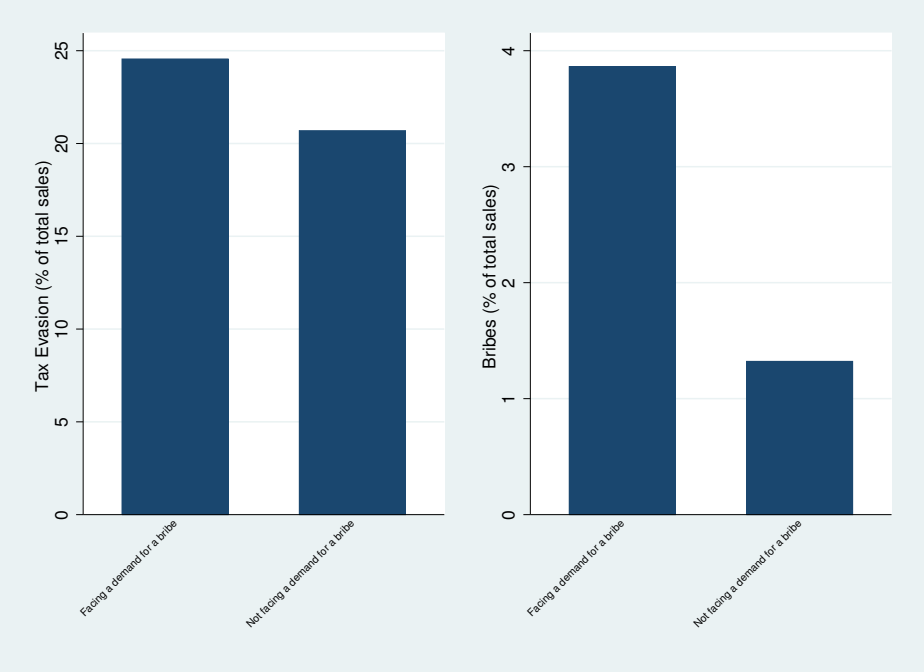

Figure 2: Tax evasion and bribes: demand-side of corruption

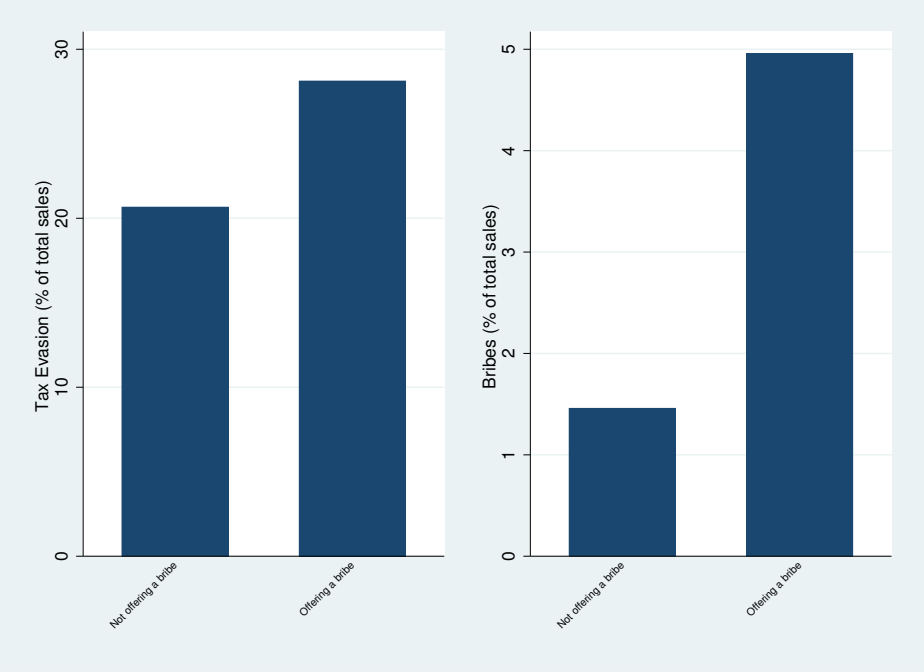

Figure 3: Tax evasion and bribes: supply-side of corruption

2.3 Baseline results

Table 2 reports baseline estimations of the determinants of tax evasion. Columns (1) to (3) show estimates from equation (1) using a combination of country, sector and year fixed effects. Column (1) considers only the demand side of corruption, column (2) the supply side of corruption, while column (3) to (5) includes both the demand and the supply side of corruption. As can be observed in the Table 2, the demand side of corruption is strongly correlated with firms' tax evasion. These results show that facing a demand of corruption increases the share of annual revenues not reported for tax purposes between 4.94 and 6.78 percentage points. The results highlight also a positive correlation between offering bribe and tax evasion in column (3) to (5). However, the magnitude of the effect is small and barely significant. With respect to the external determinants, anti-competition or informal practices and distortions in the business environment increase firms' tax evasion, while access to finance is negatively correlated with the proportion of sales reported for tax purposes. Regarding the internal determinants, the share of public and foreign ownership reduce firms' tax evasion. Moreover, being a microenterprise or small firm increases the proportion of sales not reported for tax purposes. Column (4) and (5) show estimates using respectively country*sector and year fixed effects and country*sector*year fixed effects. The findings remain qualitatively similar.

In Table 3, we control for other determinants of firms' tax evasion. We include the share of annual sales spent to make gifts or informal payments to publics officials *Bribes*. We control also for other measures of firm's performance by including the growth of employees between t and $t-3$ and the log of the value added per worker. Column (1) to (3) show estimates from equation (1) including each of these controls separately. The results confirm the positive correlation of the demand and supply side of corruption with firms' tax evasion. Among these other determinants of tax evasion, the proportion of sales paid as a bribe and employment growth are correlated with firms' tax evasion.

Table 2: OLS: Internal and external determinants of tax evasion

	(1)	(2)	(3)	(4)	(5)
External determinants					
Demand-side of corruption	4.940***		5.294***	5.871***	6.078***
	(1.153)		(1.263)	(1.076)	(1.066)
Management time	0.00417	0.00820	0.00294	0.00477	0.0138
	(0.0181)	(0.0182)	(0.0181)	(0.0185)	(0.0167)
Competition	0.905***	1.033***	0.885***	0.870***	0.848***
	(0.291)	(0.282)	(0.288)	(0.274)	(0.271)
Access to finance	-0.0173*	-0.0162*	-0.0177*	-0.0181*	-0.0154
	(0.00976)	(0.00974)	(0.00975)	(0.00936)	(0.00958)
Distortions	0.0846*	0.0895**	0.0815*	0.103**	0.0828**
	(0.0431)	(0.0425)	(0.0422)	(0.0431)	(0.0402)
Trade	-0.00343	-0.00115	-0.00391	-0.00457	-0.000944
	(0.0123)	(0.0124)	(0.0122)	(0.0130)	(0.0125)
Internal determinants					
Supply-side of corruption		0.421	1.638	2.095*	1.795
		(1.057)	(1.157)	(1.151)	(1.190)
Foreign share	-0.0285**	-0.0281**	-0.0286**	-0.0159	-0.0205*
	(0.0117)	(0.0116)	(0.0117)	(0.0113)	(0.0114)
Government share	-0.0216**	-0.0262**	-0.0211**	-0.0197*	-0.0139
	(0.0102)	(0.00995)	(0.0104)	(0.0101)	(0.0111)
Log(real sales per worker)	-0.950	-1.030*	-0.949	-1.711***	-1.816***
	(0.596)	(0.572)	(0.598)	(0.368)	(0.396)
Microenterprise	6.938***	6.940***	6.968***	6.552***	6.255***
	(1.091)	(1.089)	(1.101)	(1.082)	(1.060)
Small	2.675***	2.834***	2.673***	2.589***	2.505***
	(0.796)	(0.819)	(0.800)	(0.837)	(0.824)
Medium	1.591*	1.703*	1.581*	1.679*	1.590*
	(0.847)	(0.866)	(0.843)	(0.876)	(0.901)
Young	1.866	1.906	1.845	2.158	1.885
	(1.365)	(1.370)	(1.365)	(1.371)	(1.412)
Mature	0.545	0.581	0.525	0.442	0.497
	(0.528)	(0.530)	(0.529)	(0.528)	(0.514)
Observations	22,745	22,745	22,745	22,745	22,745
R-squared	0.227	0.225	0.228	0.227	0.243
Country FE	YES	YES	YES	NO	NO
Sector FE	YES	YES	YES	NO	NO
Year FE	YES	YES	YES	YES	NO
Country*Sector FE	NO	NO	NO	YES	NO
Country*sector*Year FE	NO	NO	NO	NO	YES

Robust standard errors clustered at the country level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3: Other determinants of tax evasion

	(1)	(2)	(3)
Demand-side of corruption	4.733***	5.087***	6.625***
	(1.258)	(1.405)	(1.173)
Supply-side of corruption	0.918	1.920	2.898**
	(1.182)	(1.329)	(1.127)
Bribes	0.166**		
	(0.0709)		
Log(VA per worker)		0.229	
		(0.541)	
Employment growth			1.648*
			(0.910)
Observations	22,745	19,231	19,034
R-squared	0.228	0.234	0.224
Firms controls	YES	YES	YES
Country FE	YES	YES	YES
Sector FE	YES	YES	YES
Year FE	YES	YES	YES

Robust standard errors clustered at the country level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

2.4 Identification strategy

In the baseline analysis, potential endogeneity issues between tax evasion and demand and supply side of corruption may bias our estimates of the true relationship between corruption and tax evasion. We address these potential endogeneity issues between tax evasion and demand and supply side of corruption by using three different identification strategies which are: an instrumental variables method (IV) and a structural equation model estimated using the three-stage least-squares (3SLS) estimator as well as a robustness check using the propensity score matching methods (PSM).

2.4.1 Instrumental variables method

In this section, we employ instrumental variables method as an alternative identification strategy. Especially, we check the robustness of our results by examining whether our results hold using instrumental variables methods to deal with potential endogeneity issues between tax evasion and the demand and the supply side of corruption. The instrumental variables method requires finding instrumental variables which are correlated with firms' tax evasion only through the demand an/or the supply side of corruption (pertinence and validity conditions).

As instruments, we use the proportions of establishments facing a demand of corruption or offering bribe to public officials in each country-location-sector-size group, and firms' bribery activities associated to government contracts. Several reasons justify why we support these variables as suitable instruments i.e. satisfy the validity and pertinence conditions. The underlying intuition of the two first instruments is based on the literature on the social conformity effect[1]. Especially, if demand for a bribe and/or offering bribe are social norms for a group of firms, an establishment belonging to this group will be more likely to be involved in corruption activities (demand and/or supply side of corruption). Indeed, as argued by Alm et al. (2016) the culture of bribery reduces the stigma and social costs involved with all forms of bribery.

[1]See Fortin et al. (2007); Myles and Naylor (1996); Gordon (1989) for more detailed discussion on social conformity effect.

The way the proportions are calculated and matched to firms is particularly important to address properly endogeneity problem (Aterido et al., 2011). Indeed, these proportions must be calculated so that they take into account the fact that firms may change size over the period[2]. In order to do so, we follow a two steps approach similar to Aterido et al. (2011). First, we account for potential effects of firms' size change on bribery activities and tax evasion using the average size of firms in calculating the country-location-sector-size proportions of firms facing a demand for a bribe and/or offering bribe. Indeed, bribery environment for firms that have changed size over the period may be different relative to what is typical for firms that have been in a given size category for a while. In the next step, we minimize endogeneity issues by matching proportions obtained to firms based on their size three years ago (initial size). Indeed, matching based on the current size may leave endogeneity untackled as a norms related to corruption and tax evasion are endogenous at the country-location-sector-size level. We therefore match proportions based on the initial size of s firm. The rationale is that the owner/manager of a firm carries some corrupt practices and norms from earlier stages of existence of his firm into its current situation. We assume in our identification strategy that the objective culture of corruption remains constant over time in a country-location-sector-size group. As pointed out by Aterido et al. (2011), using this assumption we can use for example the information on conditions facing microenterprise now to measure what microenterprise firms faced 3 years ago.

Regarding bribery activities associated with government contracts, we argue as Alm et al. (2016) that a firm is involved in bribery activities in some dimension of its business environment will more likely be involved in bribery activities in other dimensions of its business environment. Thus, bribes for government contracts do not affect tax evasion (Alm et al., 2016; Goerke, 2008) but are certainly correlated with other corruption activities which might be related with tax evasion.[3] The variable capturing bribery activities associated with government contracts is a dummy variable that takes 1 if a firm reports that a positive share of the contract value is paid in gifts or informal

[2]We use here firms' size informations in period $t-3$ and t.

[3]Indeed, this kind of bribe can be viewed as a cost of doing business similar to wage rate and capital costs. The question associated with bribery activities is specified as follow: "When establishments in your industry do business with the government, how much of the contract value is typically expected in gifts or informal payments to secure the contract?

payments to secure a contract, and 0 otherwise.

Fixed effects are used to control for omitted variable bias, namely other effects this norm of "bribe for taxes" might have on institutional variables at the location-sector level and on a firm specific level of tax evasion. Moreover, long-term relationships between firms and public officials may generate a serial correlation across time through repeated interactions which is in part captured by year fixed effects. Given that we have three instruments for two endogenous variables, we can test over-identifying restrictions (Sargan-Hansen test).

Table 4 presents estimates from first step regressions. Column (1) and (2) show estimates of the first stage regressions with a combinaison of country, sector and year fixed effects. Bribery activities related to government contracts have a positive and statistically significant effects on both the likelihood to face a demand for a bribe and offering bribe to public officials. Similarly, the proportion of firms facing a demand for a bribe increases the likelihood that a firm belonging to the same country-location-sector size group face a demand for a bribe. However, this proportion decreases the likelihood that a firm belonging to the same size group initiate the act of corruption. Further, the proportion of firms offering a bribe in a size class increases the likelihood that a firm belonging to the same size class offer a bribe to public officials. All the estimations in Table 4 include firm controls and robust standard error are clustered at the country level. The null hypothesis of weak identification test reported in Table 4 is rejected in all specifications, thereby confirming that our instruments are not weak.

Table 4: First stage and IV regressions

	First stage		IV
	(1)	(2)	(3)
VARIABLES	Demand-side	Supply-side	Tax evasion
Demand-side			17.57***
			(3.998)
Supply-side			-2.089
			(8.079)
Pr. of firm facing a	0.304***	-0.0537**	
demand for a bribe	(0.0693)	(0.0228)	
Pr. of firms offering a bribe	-0.0212	0.129**	
	(0.0425)	(0.0622)	
Bribe for government's contracts	0.245***	0.158***	
	(0.0328)	(0.0292)	
Management time	0.000784***	0.000687**	-0.00597
	(0.000247)	(0.000290)	(0.0253)
Competition	0.0211***	0.00275	0.607*
	(0.00520)	(0.00299)	(0.355)
Access to finance	0.000251*	0.000174	-0.0123
	(0.000136)	(0.000119)	(0.0122)
Distortions	0.00102***	0.00139**	0.0522
	(0.000363)	(0.000600)	(0.0488)
Trade	0.000288***	0.000239*	-0.00676
	(9.20e-05)	(0.000123)	(0.0125)
Foreign share	0.000109	-4.15e-05	-0.0337***
	(9.39e-05)	(9.24e-05)	(0.0103)
Government share	-0.000731***	-1.00e-05	-0.0138
	(0.000224)	(0.000129)	(0.0127)
Log(real sales per worker)	-0.00247	0.00183	-1.605***
	(0.00450)	(0.00293)	(0.401)
Microenterprise	-0.00588	-0.0228**	6.275***
	(0.00789)	(0.0102)	(1.086)
Small	0.00750	-0.0127	2.433***
	(0.00730)	(0.00841)	(0.815)
Medium	0.00908	-0.00585	1.837*
	(0.00648)	(0.00799)	(0.990)
Young	0.00728	0.00196	0.472
	(0.00953)	(0.00788)	(0.753)
Mature	0.00583	0.00164	0.111
	(0.00530)	(0.00583)	(0.608)
Observations	18,378	18,378	16,875
R-squared	0.351	0.126	0.221
Weak identification test (F statistics)			29.987
Hansen J statistic			0.889
Hansen's p-value			0.346
Country FE	YES	YES	YES
Sector FE	YES	YES	YES
Year FE	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4 reports results of two stage least squares in column (3). The findings broadly corroborate our previous results according to which firms' tax evasion in developing countries is driven by the demand side of corruption. The demand-side of corruption is statistically significant at the 1 percent level, increases firms' tax evasion by 17.57 percentage points. As previously, the supply-side of corruption has no statistically significant effect on firms' tax evasion. Over-identifying restrictions and weak identifications test reported in Table 4 confirm the validity and the pertinence of our alternative identification strategy. Indeed, the null hypothesis of weak identification is rejected, with a F-statistic at 29.987. Further, over-identifying restrictions test (Hansen J) fails to reject the null hypothesis that all the instruments are uncorrelated with the error term i.e. the instruments are valid. The Hansen's p-value associated is 0.346.

Findings reported in Table 4 show that having access to finance, having foreign and/or government contribution, and real sales per worker decrease the share of sales reported for tax purposes. While, being a microenterprise or a small firms increase the share of sales reported for tax purposes.

2.4.2 Structural Model

Finally, we use a simultaneous equation model using the three-stage least-square as another alternative identification strategy. This methodology has the advantage to specify a structural equations for all endogenous variables, thereby exploits the cross equation correlation of errors. Especially, we estimate the following model:

$$\begin{cases} Tax\_evasion_{ict} = \alpha_0 + \alpha_1 Demandside_{ict} + \alpha_2 Supplyside_{ict} + \alpha_3 X_{ict} + \epsilon_{ict} \\ Demandside_{ict} = \beta_0 + \beta_1 Tax\_evasion_{ict} + \beta_2 Z_{ict} + \beta_3 X_{ict} + \upsilon_{ict} \\ Supplyside_{ict} = \gamma_0 + \gamma_1 Tax\_evasion_{ict} + \gamma_2 W_{ict} + \gamma_3 X_{ict} + \vartheta_{ict} \end{cases}$$

where, X_{ict} is the set of control variables described previously including the firm's bribery activities related to government contracts. Z_{ict} and W_{ict} are respectively the proportion of firms facing a demand for a bribe and offering a bribe to public officials in each country-location-sector-size group.

Table 5 presents results of three-stage least-square estimations based on the simultaneous equation model described above. Column (1) shows estimates of tax evasion equation, where the demand-side of corruption has a positive and statistically significant effect on sales reported for tax purposes. Firms facing a demand for a bribe underreport their sales for tax purposes by 15.54 percentage points. As in the previous identification strategies, the supply-side of corruption does not affect firms' tax evasion in developing countries.

Column (2) and (3) show respectively estimates of the demand and the supply side of corruption respectively including in both equations the share of sales not reported for tax purposes and government activities related to government's contracts. Moreover, column (2) and (3) include respectively the proportion of firms facing a demand for a bribe and the proportion of firms offering bribe in each country-location-sector-size group. Here, firms' tax evasion has a negative and statistically significant effect on the demand-side of corruption, whereas this variable has no effect on the supply-side of corruption. A increase in the share of sales not reported for tax

purposes decreases the likelihood to face a demand for a bribe. Further, the proportion of firms facing a demand for a bribe in the size class increases the likelihood to face a demand for a bribe, and bribery activities related to government's contracts has a positive effect on both the demand and the supply-side of corruption. These results are similar to those obtained in the first stage regressions.

In sum these results show that the demand-side of corruption drives firms's tax evasion in developing countries. These results corroborate those obtained using IV regressions and propensity score matching methods. Public officials' culture of demanding bribe increases the proportion of sales not reported for tax purposes of between 4.76 and 17.57 percentage points. Our results highlight that in developing countries, firms' tax evasion is not generated by an opportunistic behaviour from firms but are the results of public officials' culture of demanding bribe.

Table 5: Impact of the demand and the supply side of corruption on tax evasion - 3SLS regression

	(1)	(2)	(3)
VARIABLES	Tax evasion	Demand-side	Supply-side
Tax evasion		0.0159	-0.00839
		(0.010)	(0.00585)
Demand-side	17.57***		
	(4.313)		
Supply-side	-2.089		
	(7.437)		
Pr. of firms facing a demand for a bribe		0.212***	
		(0.0423)	
Pr. of firms offering bribe			0.131***
			(0.0323)
Bribe for government's contracts		0.195***	0.198***
		(0.0409)	(0.0272)
Observations	16,875	16,875	16,875
Country FE	YES	YES	YES
Sector FE	YES	YES	YES
Year FE	YES	YES	YES

Robust standard errors clustered at the country level in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

2.4.3 Robustness: Propensity Score Matching

The propensity score matching uses observable similarities between treated and untreated establishments to create a control group that can be used to identify the effects of bribery on firms' tax evasion. For our analysis, we therefore have two treated groups (i) firms with a positive expected probabilty of facing a demand for a bribe from a public officials, and (ii) firms with a positive probability to initiate the act of corruption by offering a bribe. The other establishments with an expected probability of zero constitute the members of the untreated groups. For each establishment, the potential outcome is defined by Y_{iD}, where D is the binary treatment variable which takes 1 for treated establishments, and 0 for the untreated establishments. Hence, the Average Treatment effect on the Treated (ATT) i.e. the average effect of engaging in corruption activities (demand or supply) on tax evasion, can be expressed as

$$ATT = E[(Y_{i1} - Y_{i0})|D = 1] = E[Y_{i1}|D = 1] - E[Y_{i0}|D = 1]$$

However, the outcomes for the treated establishments when they are untreated $(Y_{i0}|D = 1)$ is unobserved. An alternative might be to use the outcomes on untreated firms. However, this alternative is inappropriate because of potential self-selection issue i.e. the treatment is not completely random. So, to address this potential problem of selection, we use a variety propensity score matching to establish a control group for comparison with the each treated group.

Employing PSM requires two main assumptions for validity. First, we need to make the assumption that conditional on the observables, the outcome is independent of the treatment variable i.e. $Y_{i1}, Y_{i0} \perp X$, the so-called "conditional independence". However, the large number of covariates in X makes it difficult to implement matching on each component of X. We address this issue by following Rosenbaum and Rubin (1983) using the matching on the probabilities of facing a demand of corruption or offering bribes conditional on the observables covariates X (propensity scores). The second assumption needed for the validity of the PSM is the "common support assumption" or "overlap condition". This assumption ensures that establishments with same observable char-

acteristics X have a positive probability of being in both treated and untreated group[4]. Figure 4 and 5 below show the common support between treated and untreated establishments. Both distributions overlap, hence providing close matches across the entire range of propensity score. Based on the overlap condition, firms that have a positive probability of being treated but in reality are not can be used to form the control group, and thereby identify the treatment effect.

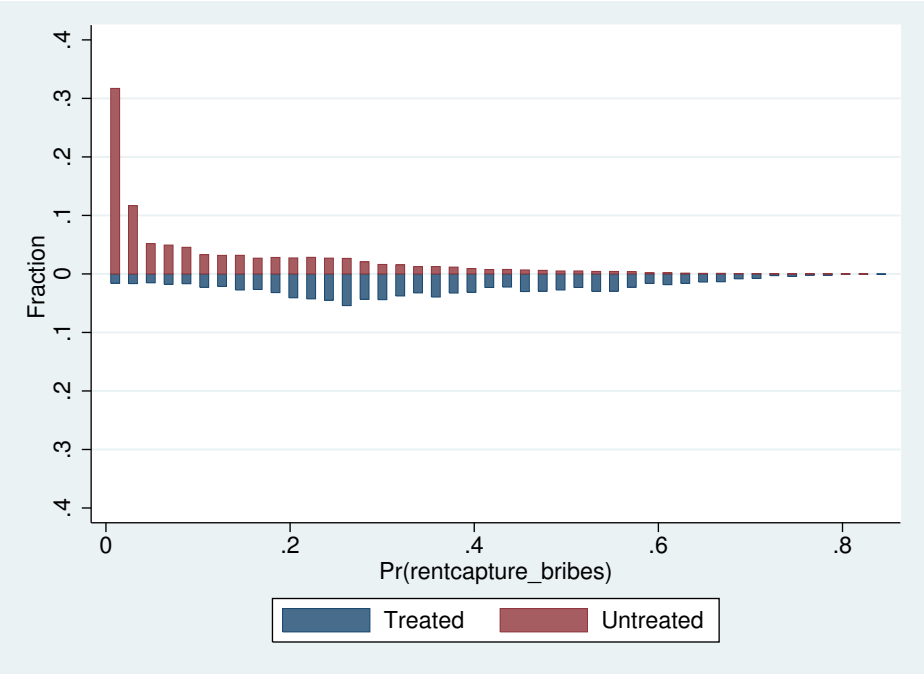

Figure 4: Common support - Demand side of corruption

We estimate the propensity score using a probit model with the treatment variables (i.e. expected probability of a demand or supply of corruption) as the dependent variable. Here, we include the internal and external determinants of firms' tax evasion. Based on propensity scores, we employ four different matching methods to match each treated firms with untreated ones : Nearest Neighbor (NN), Radius, Gaussian Kernel, and Local Linear regression. The NN method matches each treated firms with the N firms in the control group (we use N=1 and N=3) that have the closest propensity score. However, as highlighted by Caliendo and Kopeinig (2008) NN matching faces the risk of bad matches if the closest neighbour is far away. In addition, the NN matching technique generates a tradeoff between bias and variance (Smith and Todd, 2005). In-

[4]Heckman et al. (1998)

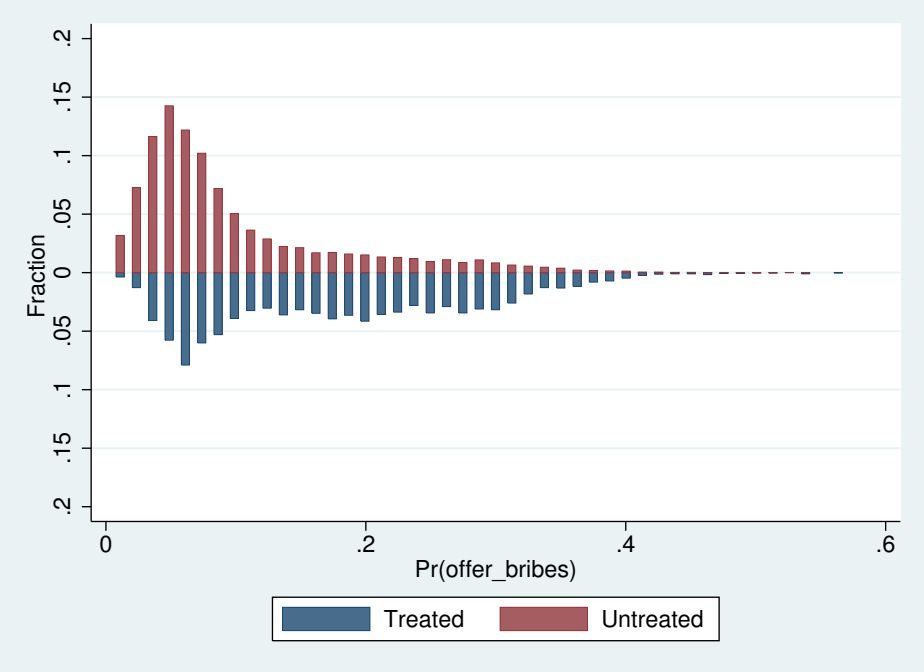

Figure 5: Common support - Supply side of corruption

deed, the similarity of the propensity score between treated and untreated firms reduce the bias in the comparaison but increases the variance. The Radius matching technique addresses these issues by imposing a tolerance level on the maximum propensitiy score distance (caliper). This technique prevents bad matching and hence increases the quality of matching. However, as discussed in Smith and Todd (2005), a potential drawback of radius matching is the choice of the tolerance level. We use the standard deviation of the propensity score as the tolerance level. Finally, we address the previous issues by using two non-parametric matching estimators: Kernel, and Local Linear regression techniques. These techniques use weighted averages of all control group observations to create a counterfactual for the treatment observations. One major advantage of these non-parametric approaches is to use more information, hence provide lower variance. These methods allow dealing with the tradeoff between efficiency and bias depending on what matching technique is used for finite samples[5].

Table 6 below reports estimations of the propensity score using a probit model. The results show that the time a top manager spends in dealing with requirements imposed by the government, the

[5]See Caliendo and Kopeinig (2008) for more extensive discussion.

percentage of annual sales lost due to inefficiencies in infrastructures and crimes, the magnitude of the connection with international markets, the perception of anti-competitive or informal practices as an obstacle to business, all the variables increase the likelihood to face a demand for a bribe from public officials. Similarly, being, a small or a medium firm, as well as being a mature firm increase the likelihood to face a demand for a bribe from the public officials. Regarding the supply-side, time the top manager time spends in dealing with requirements imposed by the government, the percentage of annual sales lost due to inefficiencies in infrastructures and crimes, informal and anti-competitive practices, being a young firm increases the likelihood for a firms to initiate the act of corruption. Finally, propensity score estimations show that being a micro-enterprise reduces the likelihood to initiate the act of corruption. All estimations include country, sector, and year fixed effects, and robust standard errors are clustered at the country level.

Table 7 reports the results of the propensity score matching. These results show that the difference in tax evasion between firms facing a demand for a bribe and those that do not face a demand for a bribe is between 4.42 and 5.62 percentage points. This difference remains statistically significant at the 1 percent level across matching techniques. Unlike the demand-side of corruption, offering a bribe to public officials does not have a robust effect on firms's tax evasion. Indeed, the difference in tax evasion between firms' offering a bribe and those that do not is statistically significant in only two matching techniques (out of five techniques).

The results highlight that the demand-side of corruption drives firms' tax evasion in developing countries. In other words, firms facing a demand for a bribe from public officials underreport their sales for tax purposes.

Table 6: Propensity score estimations

VARIABLES	(1) Demand-side	(2) Supply-side
Management time	0.00583***	0.00335***
	(0.00136)	(0.00118)
Competition	0.119***	0.0383**
	(0.0187)	(0.0154)
Access to finance	0.00206***	0.000671
	(0.000636)	(0.000611)
Distortions	0.00616***	0.00590***
	(0.00159)	(0.00174)
Trade	0.00191***	0.00106*
	(0.000424)	(0.000573)
Foreign share	0.000214	-2.45e-05
	(0.000432)	(0.000399)
Government share	-0.00340***	-0.00135
	(0.00119)	(0.00115)
Log(real sales per worker)	-0.0678**	0.0166
	(0.0330)	(0.0113)
Microenterprise	-0.0189	-0.128**
	(0.0612)	(0.0572)
Small	0.123***	-0.0345
	(0.0454)	(0.0479)
Medium	0.0864**	-0.0196
	(0.0376)	(0.0529)
Young	0.0550	0.0641*
	(0.0396)	(0.0343)
Mature	0.0620**	0.0434
	(0.0271)	(0.0276)
Observations	23,921	24,418
Country FE	YES	YES
Sector FE	YES	YES
Year FE	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Impact of demand and supply side of corruption on tax evasion – ATT

	Matching Methods					Obs
	Nearest-neighbor matching	Three nearest-neighbor matching	Radius matching	Local linear regression matching	Kernel matching	
Demand side of corruption	4.768***	5.452***	4.415***	5.623***	5.289***	21870
	(0.875)	(0.735)	(0.566)	(0.680)	(0.644)	
Supply side of corruption	-0.338	-0.368	1.36*	0.655	1.843***	22316
	(0.999)	(0.816)	(0.694)	(0.706)	(0.689)	

3 Conclusion

Corruption and tax evasion are entangled and ubiquitous in developing countries. A firm can offer a bribe to public officials in order to cover its tax evasion activities, negotiate on taxes, counterbalance a competitive disadvantage. Similarly, public officials can abuse their discretionary powers to extract rent from firms and negotiate on taxes. By generating a resources misallocation and reducing the government ability to invest in development programs both tax evasion and corruption have a negative impact on poverty reduction and development process.

As a novelty, this paper identifies the demand and the supply side of corruption and examines their effects on firms' tax evasion. We consider that an establishment faces a demand for a bribe if it spends a positive share of its annual sales to make gifts or informal payments to public officials and declares that gifts or informal payments were expected/requested during an inspection or any other mandatory meetings with public officials. At the opposite, an establishment offers a bribe (supply side of corruption) if the latter spends a positive share of its annual sales to make gifts or informal payments to public officials to "get things done" when gifts or informal payments was not expected/requested in inspections and mandatory meetings with public officials. This paper uses firm-level data from the WBES to show that firms' tax evasion decisions in developing countries are driven by the demand side of corruption. Facing a demand for a bribe from public officials increases sales not reported for tax purposes of between 4.42 and 17.57 percentage points. The culture of demanding bribes by public officials reduces firms' risks associated with underreporting

annual sales for tax purposes, thereby generating a trap of underdevelopment where tax evasion and corruption are are entangled. We address endogeneity issues using three different identification strategies which are propensity score matching methods, instrumental variables method, and a structural equation model estimated with the three-stage least-squares (3SLS) estimator. These identification strategies corroborate each other in the sense that the demand side of corruption remains statistically and economically significant in each of them. While we find no evidence that the supply side of corruption has an effect on sales not reported for tax purposes.

In terms of policy implication, the findings highlight governments can break the vicious circle between tax evasion and corruption by tackling public officials culture of demanding bribes. Governments can pursue a variety of reforms in public agencies that increase the risk for a public officials to initiate the act of corruption, and honesty among them.

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