

Firm productivity and government contracts

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Firm productivity and government contracts: The moderating role of corruption

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Abstract

Drawing on the literature examining asymmetric information issues emerging in public procurement, this research examines the interplay between current firm productivity and perceived corruption in determining the probability of firms to obtain government contracts. This study proposes that, in the absence of corruption, firm productivity is the main determinant of being awarded government contracts. In corrupt environments, however, most productive firms are excluded from bidding, and therefore, domestic-market oriented firms are better positioned to be awarded government contracts. To test this hypothesis, a longitudinal database is constructed from the World Bank Enterprise Survey, containing 1,898 observations across 33 developing economies. The findings corroborate our hypotheses and shows that corruption negatively moderates the relationship between firm productivity and being awarded a government contract for pro-market firms. This moderation, however, is positive for rent-seeking firms. These findings point to an important policy implication. Since excluding pro-market firms from bidding increases the cost and reduces the quality of public services, one mechanism to ensure smarter public procurement decisions is to open bidding processes to exporting firms, which our evidence suggests pay less bribes and commit less informal acts than domestic-market oriented firms.

Keywords: Government contracts; Total factor productivity; Corruption; Exporting firms; Developing countries.

‘Corruption is government intrusion into market efficiencies in the form of regulations. That is Milton Friedman. He got a goddamn Nobel Prize. We have laws against it precisely so we can get away with it. Corruption is our protection. Corruption keeps us safe and warm. Corruption is why you and I are prancing around in here instead of fighting over scraps of meat out in the streets. Corruption is why we win’

—Danny Dalton in the 2005 movie *Syriana* (IMDb, 2015).

1. Introduction

When externalized, the provision of public goods and services is contingent on the capacity of the private firms hired by the government to deliver high-standard outputs with a set of limited resources. Therefore, selecting the right contractor has consequences on the cost and quality of public services offered to taxpayers (Johnston and Girth, 2012; Cheaitou, Larbi and Al Housani, 2018). In an ideal world, the expectation is that, through a competitive process, firms that secure government contracts (the most productive) would be those offering the lowest possible price and producing high-quality standards of service (Hanauerová, 2019). However, in the real world many governments end up contracting less productive firms. One of the main arguments brought forward to explain this is the presence of corruption and the nature of the business environment (Cuervo-Cazurra, 2016; Bahoo, Alon & Paltrinieri, 2019).

Corruption is *‘the misuse of public office for private gain’* (Svensson, 2005, p. 20). Further evidence suggests that governments in developing countries often limit the access of productive suppliers to public procurement markets (Ssenoga, 2006, Witting, 2003). In the presence of corruption and less stable business environment, less productive firms may offer bribes to civil servants and politicians in order to improve their chance of succeeding in the bidding processes. This research evaluates how a firm’s prospect of securing future government contracts is influenced by its productivity and/or its capacity to use corruption to its advantage.

When analysed at country-level, corruption seems to be a threat to economic development through its negative correlation with income. Using data from Transparency International (2017), we group countries in quartiles and find that, the most corrupt countries have an average GDP per capita of \$2,800 (in current U.S. dollars). This figure rises to \$4,200 and \$9,500 for the second and third quartiles respectively. GDP per capita rises substantially to \$38,300 for countries with the least corruption. This simple exercise shows that corruption is more problematic and prevalent in lower-income countries. Despite the economic importance of corruption in developing economies, previous studies have not considered how corruption

influence the type of contractors selected in those countries (Bahoo et al., 2019). A contribution of this study is to examine how the business environment, defined by level of corruption and political stability in developing countries, impacts the probability that the most productive firms secure government contracts. By doing this, we respond to recent calls for studies to contextualize theory applicable to the full range of economic development settings (e.g. Teagarden, Von Glinow and Mellahi, 2018; Vendrell-Herrero, Darko and Ghauri, 2020)

When analysed at firm level, corruption represents a paradox for firms- either they follow *the rules of the market or the rules of the game* (Gomes et al, 2018). Firms that focus on the *rules of the market* (or pro-market firms) will invest in their operational efficiency and/or product differentiation in order to improve their market positioning. Firms that focus on the *rules of the game* (or rent-seeking firms) will engage in, as illustrated in the opening quotation, bribery activities and will invest managerial attention to liaison and building networks with government officials in exchange of getting around complex regulations and ultimately winning government contracts (Cuervo-Cazurra, 2016).

This could have dire consequences (Cuervo, Agaur and Singh, 2019). For instance, previous studies show that firms that pay bribes in their domestic market are less able to successfully internationalize (Lee and Weng, 2013). The data we use in this study provides further support to this claim and shows that exporting firms pay less bribes and engage less in informal acts. Moreover, among developing countries the returns from exporting are found to be greater in countries that implement pro-market reforms (Dau, 2013). Based on this evidence, the study presented in this paper operationalizes the pro-market vs rent-seeking duality using the exporting status of firms.

We argue that in highly corrupt environments, rent-seeking firms use corrupt practices as a barrier to entry, thus, making it difficult for pro-market firms to access government contracts. On the contrary, in the absence of corruption, rent-seeking firms will not be able to set barriers, thus enhancing the likelihood of pro-market firms to succeed. We therefore hypothesize that, corruption positively (negatively) moderates the relationship between firm productivity and the probability of securing future government contracts for rent-seeking (pro-market) firms.

A further contribution of this research is the added approach to ethics in government contracting. Previous studies examine the role of endogenous variables (i.e. corporate social responsibility) as positive signals for accessing government contracts (i.e. Berrios, 2006; Flammer, 2018). In contrast, the present study examines how an exogenous variable (i.e. level

of corruption) is likely to be strategically exploited by firms in order to gain an advantage in the attribution of government contracts.

To test these hypotheses, the study uses data from the World Bank Enterprise Survey (WBES) for the period 2002 to 2017 consisting of 33 countries. We exploit the longitudinal capacity of the survey and observe firms in two different moments in time. This further enables us to include variables that are observed at different moments of time, such as, current productivity and perceived corruption, and the future securement of government contracts. This novel approach applied to WBES data promises to inform future research endeavours, as it builds on previous studies that have used similar data for cross-sectional analysis (e.g Jensen, Li and Rahman, 2010; Desai and Olofsgård, 2011; Luo and Bu, 2016; Tajeddin, and Carney, 2018; Gomes et al., 2018; Vendrell-Herrero, Gomes, Melahi and Child, 2017).

The remainder of the study is organized as follows. The next section summarizes the background literature, followed by the development of the conceptual framework and the set of testable hypotheses in section three. The sample, variables and method are described in section four, while Section five presents the empirical results. The sixth section offers concluding remarks that include a theoretical discussion of the results and their implications for policy-making and future research.

2. Background literature

This section provides a review of different economic conceptualizations of government contracting and opposing justifications for the market (in-)efficiencies underlying public procurement. Government contracting is subject to imperfect information and rent-seeking issues that might deviate from first best outcomes. Whilst there is a consensus that on theoretical terms imperfect information issues do not necessarily have to distort optimal outcome, in practice, there are market inefficiencies coming from rent-seeking behaviour of managers and government officials. These inefficiencies can impact optimal public resource allocation negatively (Dastidar and Mukherjee, 2014; Williams-Elegbe, 2018), and therefore can generate tensions within private organizations, and between private and public sectors (Cunha et al., 2019; Gomes et al., 2015).

Government contracts potentially face two types of imperfect information issues. Firstly, in the bidding process, governments are confronted with adverse selection problems (hidden information), in which all applicants declare themselves as being highly productive, regardless

of their actual productivity. From a theoretical standpoint, literature has developed models in which contract allocation is determined by economic efficiency (Jovanovic, 1982; Melitz, 2003). Originally developed in free-market economies, these models predict a one-to-one correspondence between firm productivity and bidding success (Baldwin, 1995). Under these frameworks, most bidding processes will result in selecting productive firms offering high quality services at the lowest possible cost (see Hanauerová, 2019).

Secondly, there might be moral hazard problems once the contractual relationship has been established -hidden action- (Kimura and Morimitsu, 2018). These would be especially relevant when public contracts are subject to renegotiation (Tirole, 1986; Hart and Moore, 1988). Under institutional stability, a welfare-maximizing government can use soft budget constraints in cases where the cost of public service delivery is difficult to predict ex-ante and therefore contract is contingent on future renegotiation (Bös and Lülfsmann, 1996). These contracts can still reach first-best outcomes since government interacts with a limited number of contractors, who often have incentives to disclose their true costs of production, or otherwise, they might face a high risk of being replaced in future bidding processes. The US federal government's R&D contracts illustrate well the use of a flexible approach to public contracting. Within the US federal government R&D office, there are two types of R&D contracts: research grants that offer little in-process oversight, and cooperative agreements, which provide decision rights during the project. As described in Bruce et al. (2019), contracts under the form of cooperative agreements generate more innovation output (e.g. patents) and impact (e.g. citations) than contracts under the form of research grants. In sum, the literature on government contracts seem to suggest that a 'clean' government with a focus on welfare-maximization, in general, will find the way of allocating projects to the most productive contractors and will provide the appropriate incentives that will minimize the risk of delays.

However, when government officials engage in corrupt activities, important market distortions can arise and persist over time (Pandey, 2010). At first, there is a change in the incentive structure available to participating actors. These firms use bribes to form political ties, achieve government contracts and circumvent complex regulations (Cuervo-Cazurra, 2016). Rent-seeking behaviour is more common in developing countries as they tend to have weaker institutions (Acemoglu et al., 2005). Nevertheless, it is also prevalent in developed countries. To illustrate this fact, Agca, Igan, Li and Mishra (2019) use the context of lobbying activities in the US. They analyse the response firms gave to the unexpected reduction of the federal budget in March 2013. They find that current contractors with more exposure to

government cuts increased their lobbying spending in order to improve their chances of securing a larger share of the smaller federal budget, whilst firms with less experience in getting government contracts decided to reduce their expenditure on lobbying. This result indicates that reasons for gaining government contracts go beyond firm productivity. Consistent with previous empirical evidence, firms that obtain government contracts have lower corporate valuation (Esqueda et al., 2019) and international performance (Lee and Weng, 2013) than firms that do not sell goods and services to governments. In the next section, we provide a conceptual framework that examines more specifically how the level of corruption can moderate the effect of firm productivity on the likelihood of securing a government contract.

3. Conceptual model and empirical hypothesis

To construct our conceptual model, we divide firms in two types: Pro-market and rent-seeking firms. These firms make different investment decisions because they have a different set of incentives and strategic priorities (Gomes et al., 2018). On the one hand, pro-market firms follow the rules of the market, and therefore invest in improving their technology and operations in order to enhance productivity. On the other hand, rent-seeking firms have difficulties finding alternative sources of revenue, and focus their investment on getting government contracts. As shown in Figure 1, our conceptual model provides a two-stage analysis. In the first stage, the baseline scenario is set in a context of minimum corruption where we consider the direct effect between current productivity and gaining future government contracts; or in other words, how firms compete for government contracts in low corruption environment. In the second stage, we investigate the moderating role of corruption; or, how the baseline predictions change in highly corrupt environments.

- Insert Figure 1 here -

When corruption is minimum or non-existent, market efficiencies rule the way firms compete and the most productive firms will tend to survive (Baldwin, 1995; Jovanovic, 1982; Melitz, 2003). Firms making investments in improving their operational and technical capabilities (pro-market firms) will ultimately have higher productivity levels than firms that do not make productive investments (rent-seekers). Therefore, pro-market firms will tend to dominate the bidding process. Based on this reasoning, we propose the following hypothesis.

Hypothesis 1a: *Among pro-market firms, the probability of securing a government contract in future periods will be higher with increased productivity*

Consistent with our first hypothesis, we expect firms that pay bribes to government officials and/or engage in corrupt activities will be disadvantaged in competitive public biddings. However, these firms could still have opportunities to secure government contracts when firm heterogeneity is unobservable in part or in full (Kimura and Morimitsu, 2018). Hence, adverse selection forms due to information that is not immediately apparent to the government, including applicant's productive investment. In these circumstances, rent-seeking firms would be able to secure government contracts even in the absence of corruption and unstable business environments. We argue that if the level of productive investment of firms is not observable, the government might use softer elements of judgement, such as, being part of the political network when allocating a government contract. Since the level of productivity is often difficult to observe, especially within low income regions (Foster, Haltiwanger and Syverson, 2008), we argue that, for the case of rent-seeking firms, there is a negative relationship between current productivity and the likelihood of getting government contracts.

Hypothesis 1b: *Among rent-seeking firms, the probability of securing a government contract in future periods will be lower with increased productivity.*

We now consider the case of highly corrupt business environments. Arguably, in these circumstances, government officials will allocate contracts based on their networks rather than on the level of firm productivity, even if welfare is not maximized (Bahoo et al., 2019; Cuervo-Cazurra, 2016; Svensson, 2005). Pro-market firms will therefore not be able to use their productive capabilities to secure government contracts. On the contrary, rent-seeking firms can use their investment in political ties to secure government contracts. Based on this reasoning, we propose the following hypotheses concerning the moderating role of corruption over the productivity-contracting relationship.

Hypothesis 2a: *For pro-market firms, corruption negatively moderates the relationship between firm productivity and the probability of securing future government contracts.*

Hypothesis 2b: *For rent-seeking firms, corruption positively moderates the relationship between firm productivity and the probability of securing future government contracts.*

4. Methodology

4.1. Data

Data from the World Bank Enterprise Survey (WBES) is used. The survey has been conducted since 2002 and is based on a representative sample of private sector firms from over 130 countries across both developed and developing countries. The survey covers a broad range of topics including corruption, infrastructure, competition, performance, and access to finance. Due to the sensitivity of some of the survey questions, such as, those on business-government relations and bribery-related topics, private contractors, rather than any government agency or organisation/institution associated with the government, are hired by the World Bank to collect the data. Structured face-to-face interviews are conducted with top managers and business owners in major cities. Between 1200-1800 interviews are conducted in larger economies, and 360 interviews and 10 interviews are conducted in medium-sized and smaller economies respectively. Data are collected usually between 3 to 5 years, although all countries are not surveyed at the same time or in the same year. The primary business sectors surveyed are manufacturing and services sectors.

Although the WBES intention is to re-interview firms in subsequent surveys, this has not always been possible due to attrition and the frequent discontinuation of firms in the survey (See Aga and Francis, 2015, for more on firm exit using the WBES). As such, most studies that have used this survey have instead focussed on the cross-sectional capacity of the data (e.g. Jensen, Li and Rahman, 2010; Desai and Olofsgård, 2011; Luo and Bu, 2016; Tajeddin, and Carney, 2018; Gomes et al., 2018; Vendrell-Herrero et al., 2017). More recently, other studies have however been able to exploit the longitudinal capacity of the survey (Darko et al., 2018). We follow the latter and construct a panel dataset by restricting the sample to firms that have been surveyed more than once since 2002 (44,180). Doing so results in a total of 20,731 firms in both manufacturing and service sectors. Because our focus is on the relationship between receipt of government contract and productivity, measured as total factor productivity, we clean the data by dropping variables (monetary) with missing information, and are relevant for constructing the measure of total factor productivity (TFP). This resulted in 12,088 observations (5,780 firms). There was missing information for other key variables, such as those related to whether firms have received government contracts over the past 12 months. This led to a further reduction in the sample of firms used in the analysis. Our missing data at this point is similar (~70%) to previous studies using TFP with WBES data (Desai and Olofsgård, 2011). Finally, the data was further reduced as we imposed that firms retain their

domestic or international character across both periods. After the cleaning process, the final sample is made up of 949 firms (1,898 observations). The final sample used consists of 33 countries. Most firms are located in developing economies, with firms in Africa and South East Asia accounting for the largest share in our sample. Specifically, 24.5% of firms in the sample are located in low income countries and 4.1% in high income countries. 55.2% and 16.2% are located in lower-middle and upper-middle income countries respectively.¹

4.2. Relevant subsamples

We group firms into two categories, namely, pro-market (international) firms and rent-seeking (domestic) firms. Due to data limitations, it is not possible to directly observe rent-seeking behaviour of firms. As an alternative measure, we use exporting status of firms as a proxy. Domestic-market oriented firms are defined as firms that do not engage in exporting and other international activities. International firms are classified as firms that engaged in exporting activities and remain exporters throughout the period observed. Previous studies suggest that, in emerging markets, pro-market business environments are associated with greater economic incentives for export activity (Cuervo, Agaur and Singh, 2019). For example, Dau (2013) reported that pro-market reforms in a home market increased the impact on profit levels of exporting by 35%. Additionally, inappropriate business practices such as payment of bribes can be an obstacle for firms to internationalize (Lee and Weng, 2013). Altogether, there seems to be a very high association between firm exporting behaviour and the rent-seeking vs pro-market duality we aim to measure.

If the arguments above hold, then, engaging in unacceptable and informal acts such as the payment of bribes is more likely to be prevalent among domestic-market oriented firms. Table 1 shows descriptive statistics. We examine this possibility by looking at how much firms have paid out in informal activities, as well as whether each firm has ever been involved in an informal act. Since exporting firms are considerably larger, we divided informal payments by the number of employees, to obtain a measure of informal payments per employee. We find that exporting firms pay very little bribes (US\$1.43 per employee) compared with domestic-market oriented firms who pay almost ten times more in bribes (US\$14 per employee). A t-test

¹ The list of countries in our sample include: Bangladesh, Belarus, Brazil, Cameroon, Croatia, Czech Republic, Estonia, Ethiopia, Georgia, Honduras, Indonesia, Kazakhstan, Kyrgyz Republic, Lao PDR, Latvia, Lithuania, Macedonia FYR, Mali, Moldova, Mongolia, Myanmar, Nepal, Paraguay, Philippines, Romania, Russian Federation, Senegal, Serbia, Turkey, Ukraine, Vietnam, Yemen, Rep., Zambia.

shows that the difference (US\$12.53 per employee) is statistically significant at 5%. We also find that 19.5% of firms commit informal acts (measured as a dichotomous variable where ‘1’ indicates the firm has committed an informal act and ‘0’ if it did not commit an informal act). Again, the difference between domestic and international firms (24.3% vs 11.6%) is significant at 5%. Overall, the descriptive comparative analysis shows that domestic-market oriented firms are more engaged in rent seeking activities than exporting firms. In line with previous studies, we conduct analyses separately for domestic and international firms. See Cassiman and Golovko (2011) and Salomon and Jin (2008) for similar empirical approaches with subsamples.

- Insert Table 1 here -

4.3. Variables

The dependent variable, whether a firm received a *government contract* in the next survey round ($t+1$), is derived from the question “*Over the last year, has this establishment secured a government contract?*” 136 firms in the sample obtained government contract. Table 2 shows that domestic-market oriented firms receive (marginally) more contracts than internationalized firms (14% vs 12%).

- Insert Table 2 here -

The independent variable, *TFP*, is estimated using the Levinsohn and Petrin (2003) approach, with sales as proxy for input; cost of labour input as a measure of labour input; total cost of electricity, transport, and raw materials, as measure of intermediate inputs. The net book-value of machinery, vehicles and buildings was used as measure of capital. Monetary values were converted to US dollars using GDP deflators obtained from the World Bank. Stochastic analysis in Figure 2 compares TFP distribution between domestic and internationalized firms. These results are consistent with the extensive international trade literature, where internationalized firms are found to be more productive (Bernard and Jensen, 1999). This difference is statistically significant at 1% according to the Kolmogorov Smirnov test (Wilcox, 2005). Further test of difference in mean productivity levels of domestic and international firms showed significant differences at a 1% level.

- Insert Figure 2 here -

Corruption, the moderating variable in the analysis, is constructed as an index and is derived by taking the average of two-firm level perception variables – political instability and corruption. Both variables range from 0 to 4 with 0 being no obstacle and 4 very severe obstacle. The average is divided by 4, so it results in an index that ranges from 0 to 1. On

average, the variable is larger for internationalized firms (0.34 vs. 0.28), a test of difference in means between domestic and international firms showed statistically significant difference at 5% level, a result that is confirmed in the comparison of distributions (Figure 2). It is important to emphasize that this descriptive result does not necessarily mean that internationalized firms are in more corrupt business environments, it simply means that managers across these two types of firms have differing perceptions. Figure 3 shows country-level average corruption perceptions using the constructed measure of corruption. Countries are grouped into quartiles: very high corruption (Q1), moderately high corruption (Q2), moderately low corruption (Q3) and very low corruption (Q4). Consistent with other country-level measures of corruption (i.e. World Bank Corruption Perception Index, www.transparency.org) we find that, among developing countries, corruption is not geographically bounded. For instance, in Europe, Asia and Africa we have examples of countries with high (Romania, Nepal and Cameroon) and low (Estonia, Vietnam and Ethiopia) corruption.

- Insert Figure 3 here -

Control variables used in the analysis include, *number of workers*, *managers experience*, *age of the firm*, and *firm ownership type* (domestic or foreign owner). Additionally, we include controls for industry², survey collection year and the average years between the different survey collection rounds (*elapsed time*). As shown in Table 1, the combined average years between survey rounds for domestic (5.11 years) and international firms (4.4 years) is around 4.8 years. International firms are also shown to be larger in terms of the number of workers, with an average of around 270 workers, compared to 50 for domestic-market oriented firms. International firms also have more experienced managers and are largely foreign-owned. Domestic-market oriented firms are relatively younger although marginally compared to international firms.

Table 3 shows correlation analysis of some of the variables used in the regression analysis. The generally low value of the parameters signals that there is absence of multicollinearity (Farrar and Glauber, 1967).

- Insert Table 3 here -

²Textiles represent the highest share among domestic-market oriented firms and account for around 38.9% of firms followed by chemicals (13.6%) Wholesale and trade, and publishing account for the lowest share of firms in the domestic sample (1% and 1.5% respectively). Among international firms, food and beverages are disproportionately represented and accounts for 26% of firms, followed by chemicals (13%). Hotels and restaurants, construction, wholesale and retail account for the lowest share of firms, each accounting for around 1%.

4.4. Empirical design

We use a binary dependent variable model, logit, to estimate the probability of a firm to secure a public contract. More precisely, for a given firm, the probability to secure public contract y_j^* , is linearly related to a vector of observable variables, x_j , and non-observable factors all of which are absorbed in the error term, ε_j :

$$y_j^* = \beta x_j + \varepsilon_j \quad (1)$$

The firm's probability to secure a contract cannot be directly observed but we only know the actual outcome, which is defined as y_i and has a value of 1 when the firm is awarded a future government contract and 0 if otherwise. The probability that $y_i=1$ is given by Equation 2, where β is the vector of coefficients to be estimated.

$$P(y_j = 1|x_j) = \frac{\exp(x_j'\beta)}{1+\exp(x_j'\beta)} \quad (2)$$

Following this, the equation that is estimated is of the form:

$$G_{j,t+1} = \beta_0 + \beta_1 * TFP_{j,t} + \beta_2 * COR_{j,t} + \beta_3 * TFP \times COR_{j,t} + \Omega_{j,t} + \vartheta_s + \vartheta_c + \vartheta_t + \vartheta_b + \varepsilon_{j,t} \quad (3)$$

where subindex j refers to the firm; $G_{j,t+1}$ measures whether firm j at time $t+1$ is awarded a government contract, $TFP_{j,t}$ and $COR_{j,t}$ are the total factor productivity and perceived corruption of firm j at time t respectively. $\Omega_{j,t}$ is a vector of firm characteristics (i.e. firm size, firm age, manager experience, number of years between survey collection [elapsed time], foreign ownership), ϑ_s indicates sector dummies, ϑ_c refers to country dummies, ϑ_t are year dummies, ϑ_b indicates that firm is part of a business group and $\varepsilon_{j,t}$ is the error term.

The adopted modeling strategy helps overcome collinearity and endogeneity problems (Wooldridge, 2010). Following the constructions developed in similar models (Lafuente et al., 2017), the one implemented in this study controls for the potential endogeneity problems emerging from the correlation between the set of independent variables and the time-invariant unobserved heterogeneity. The fact that in period t none of the firms had government contract and the dependent variable is measured in a future period ($t+1$) implies that we are able to adequately address concerns of reverse causality between independent, moderation and dependent variables (Abdallah, Goergen & O'Sullivan, 2015). We however acknowledge that the results might still be affected by endogeneity due to omitted variables (Lafuente et al. 2017).

β_1 and β_3 are the parameters of interest. We estimate separate regressions for international and domestic-market oriented firms. For the sample of international firms, we expect β_1 to be

positive (H1a) and β_3 to be negative (H1b). For the sample of domestic-market oriented firms, we expect the opposite effect, that is, β_1 is expected to be negative (H2a) and β_3 to be positive (H2b). For both samples, models include a nonlinear term for TFP, as investments in productivity might show diminishing returns in the objective variable.

5. Results

5.1. Main specification

Table 4 reports the marginal effects from a number of logit estimations. The fit of those models is good, showing a pseudo- R^2 ranging between 0.177 and 0.195, and a percentage of correctly predicted cases ranging between 71% and 74%³.

- Insert Table 4 here -

Models 1 and 5 report results without the interaction term between corruption and TFP for domestic and international firms, respectively. In relation to Equation 3 those models assume β_3 to be zero. Samples of domestic and international firms exhibit different results. On the one hand, according to Model 5 productivity is an antecedent of securing future government contracts for international firms. According to the estimates, and assuming all other variables remain constant, a 1% increase in productivity increased the probability of firms to secure a government contract in the future by approximately 0.031 percentage points ($p < 0.05$). This result goes in line with our predictions and supports Hypothesis 1a. On the other hand, according to Model 1, productivity is not an antecedent of securing government contracts for domestic-market oriented firms since β_1 is not statistically distinguishable from zero, and consequently, our results do not support Hypothesis 1b, which proposes a negative relationship between productivity and likelihood of securing future government contracts for domestic-market oriented firms. Nevertheless, to have a clearer picture of these relationships we need to include the interaction term with our corruption measure. This allows the level of corruption to be taken into consideration in the relationship between firm productivity and government contract.

Models 2 and 6 introduce interaction terms between productivity and corruption for domestic and internationalized firms respectively. When considering the sample of international firms, the results fully confirm the negative moderation effect of perceived

³ The cut-off level for the ex-post predictive analysis has been performed with the assumption that the predicted probability of securing a government contract is the average in each sample.

corruption in the relationship between current productivity and securing future contracts, supporting Hypothesis 2a. However, results in the sample of domestic-market oriented firms remain insignificant. Models 3 and 7 include the quadratic term for TFP. Results remain fairly unchanged and are similar to the ones reported in Models 2 and 6. However, for the sample of international firms, the effect of TFP is inverse U-shaped (see Model 6). For low levels of TFP, increasing TFP has a positive effect on the probability of being awarded a government contract until a turning point is reached and then the effect becomes negative.

Models 4 and 8 extend the proposed model in Equation 3 by introducing the quadratic effect of TFP in the main parameter and the interaction term. When introducing this model, the results do not fit for the sample of international firms, but finally show significant estimates for the sample of domestic-market oriented firms. We will focus the remainder of the analysis on the models that report significant coefficients, Model 6 (interaction effects) for international firms, and Model 4 (interaction and quadratic effects) for domestic-market oriented firms.

For international firms, the interaction term is negative ($\beta_3 = -0.130$) and statistically significant (p-value < 0.01). This result suggests that corruption negatively moderates the relationship between productivity and securing government contracts, supporting hypothesis 2a. The moderation effect is important since the effect of productivity on the probability of securing contracts becomes negative when corruption is highest, i.e. when corruption equals one the effect of TFP on the probability of securing government contract is $\beta_1 - \beta_3 = 0.079 - 0.130 = -0.051$.

For domestic-market oriented firms, the joint interpretation of the interaction and quadratic effects involves analysing the relationship between TFP and government contracts at different values of corruption. For simplicity, we use minimum (0) and maximum (1) values for corruption. For the case when corruption equals zero, there is a U-shaped relationship that follows the function $Pr(contract) = a + 0.016*TFP^2 - 0.13*TFP$ where “a” is a vector of all the other covariates. When corruption equals one, however, there is an inverse U-shaped relationship ($Pr(contract) = a + 0.016*TFP^2 - 0.073*TFP^2 - 0.13*TFP + 0.595*TFP = a - 0.057*TFP^2 + 0.465*TFP$). Along the corruption continuum, the relationship changes from a U-shape to an inverted-U gradually.

This result has two implications, both of which support hypothesis 2b. First, domestic-market oriented firms operating in low-corruption environments with low TFP have diminishing returns to scale, i.e. a productivity gain reduces the probability of securing a

contract. However, domestic-market oriented firms in high-corruption environments, have increasing returns to scale. That is, the probability of securing a contract increases as TFP increases. This finding is in line with the literature of institutional quality (Acemoglu et al., 2005). Second, the relationship between TFP and the probability of securing a contract is steeper with more curvature when corruption is higher. This is because the size of the absolute value of the quadratic term is higher when corruption is high (0.016 vs 0.057). In other words, the same variation in TFP results in larger difference in the probability of securing a contract as corruption increases. This possibly suggests that corruption could intensify the relationship between TFP and securing government contracts.⁴

5.2 Graphical analysis

In this section, we provide graphical analyses of the interaction effects using contour plots (see Hoetker, 2007 and Zelner, 2009, for a discussion on interpreting interaction terms in binary choice models). This graphical illustration assumes that the productivity range can take values observed in the sample (e.g. TFP ranges between 1 and 10) and other covariates are at their mean.

Figure 4 shows the interaction plot. In this figure, perceived corruption is restricted to four values: very low (0); medium-low (0.25); medium-high (0.75); and, very high (1). Figure 4 Panel A plots the graph for domestic-market oriented firms. The results are consistent with the hypothesized relations. In very low corruption environments, there is a negative relationship between productivity and the predicted probability of securing a future government contract (supporting Hypothesis 1b). However, this relationship becomes positive when corruption is medium-high or very high, supporting Hypothesis 2b.

- Insert Figure 4 here -

Figure 4 Panel B plots the graphical illustration for international firms. Consistent with our predictions, the plot shows that in the very low and medium-low corruption environments there is a positive relationship between current productivity and the predicted probability of getting future government contracts. This supports Hypothesis 1a. Moreover, this relationship becomes negative in highly corrupt environments, supporting the negative moderation effect of corruption for international firms (Hypotheses 2a).

⁴ We acknowledge the support and guidance provided by one of the referees in interpreting the quadratic terms.

Figure 5 displays a Contour plot, which shows the conditions under which current productivity and perceived corruption work simultaneously to increase the probability of being awarded a contract. The contour plot enables both explanatory variables—current productivity and perceived corruption—to be continuous (Press *et al.*, 2007). Therefore, colours with a darker grey show those combinations of current productivity and perceived corruption that report higher predicted probability of getting government contracts in the future.

- Insert Figure 5 here -

Figure 5 Panel A displays these relationships for domestic-market oriented firms. The results exhibit that domestic-market oriented firms maximize their probability of securing government contracts (which goes beyond 80%) when TFP and corruption are both high. For domestic-market oriented firms, corruption is a necessary but not sufficient condition for securing government contracts. Our interpretation of this result is that whilst corruption restricts the number of firms that can bid for the government contract, productivity is also a factor that influences contract allocation, reflecting a degree of competition among rent-seeking firms.

For the case of international firms (Panel B), the results show that firms maximize their likelihood of securing government contracts (with a predicted probability above 66%) when productivity is high and corruption is low. For international firms, productivity is a necessary and sufficient condition in clean business environments. This result is in line with theoretical models predicting that most productive firms self-select (Jovanovic, 1982; Baldwin, 1995; Melitz, 2003) and hence can secure government contracts.

5.3. *Additional analysis*

One possible source of bias in the analysis is that contracts awarded to exporting and domestic-market oriented firms could be different in a number of ways, such as nature of activity to be completed and deliverables, amount of funding awarded, duration of project, etc. Unfortunately, the WBES data does not provide information related to these characteristics. However, assuming that firms in the same sector and with similar size can bid for analogous projects, then it is possible to eliminate part of this bias. To address this, we implemented propensity score matching (PSM) to construct statistically comparable samples of awarded domestic and exporting firms and re-estimated Table 4. Results of the PSM and re-estimation are provided in Appendix. The results from this exercise are qualitatively the same to the ones

reported earlier in Table 4. Therefore, our results are not contingent on the type/quality of government contract awarded.

6. Conclusion and Discussion

This study has examined the interplay between productivity and corruption, and how the two enhance the probability of firms to secure future government contracts. The study proposed that, in the absence of corruption, firm productivity is the main determinant of a firm's ability to secure a government contract. In contrast, productive firms may be less likely to secure government contracts when operating in corrupt business environments. By proving the existence of a synergetic effect between firm productivity and corruption in securing government contracts, this study has responded to recent calls aimed at analysing the economic implications of corruption in developing countries (Bahoo et al., 2019; Cuervo-Cazurra, 2016).

To test these hypotheses, the WBES data from 33 different countries for the period 2002 to 2017 was used in a novel manner that exploited the longitudinal capacity of the survey. By doing so, the study found that in highly corrupt business environments, rent-seeking firms use corrupt practices as a barrier to entry, thus, making it difficult for pro-market firms to access government contracts. We identify two valuable insights from this evidence: First, our evidence suggests that productivity and corruption could be substitutes for pro-market firms and complements for rent-seeking firms. Operating in business environments with high levels of corruption can weaken the productive capacity of pro-market firms. On the other hand, operating in business environments with high levels of corruption could favour firms that understand the rules of the game and are willing to engage in informal activities, i.e. rent seekers, in order to remain competitive. Due to data limitations, our analysis does not directly test for the complementarity or substitutability effects (as done by Poppo and Zenger (2002)), further research is therefore needed to better understand how the two effects co-exist (or not) in developing countries.

Second, our results show that most productive firms are able to secure government contracts. However, the presence of corruption restricts the number of firms that can bid for government contracts. This study has shown that, firms are likely to strategically exploit the presence of corruption in order to secure government contracts.

These findings point to important policy implications. Dissuading or directly excluding pro-market firms from bidding increases the cost and reduces the quality of public services. To

attenuate this problem, the model developed in the study indicates that one mechanism to ensure smarter public procurement is the elimination of barriers limiting potential bidders, notably firms that have international market exposure. Favouring the participation of internationalized firms in the bidding processes for the attribution of government contracts can contribute to eradicate corruption in public procurement due to their relatively greater pro-market, less rent-seeking, character. Deliberately promoting the participation of pro-market firms can serve to breach the barriers that corruption sets in its attempt to limit access to public tenders.

Limitations of this study can be addressed, and further specifications of its model can be made in future research. One such limitation that can be surmounted through further research comes from the inability of the current study to deterministically distinguish rent-seeking and productive firms in every public bidding event. Firms may not necessarily adopt a consistent behavior from one tender to another. Nevertheless, prior empirical evidence (Darko et al., 2018; Gomes et al., 2018) and robustness checks implemented in the methodology of this study would tend to indicate that any distortion coming from such inconsistent behavior is not sufficiently prominent as to affect the obtained results. Similarly, future research may build upon the findings of this study in order to delve further into the links between internationalized and pro-market firms that limit their rent-seeking behavior. Likewise, future research should explore other approaches to operationalize the rent-seeking vs pro-market duality.

Further research opportunities that open-up because of this study, which could contribute to detailing some of the findings made, come from solving some of the limitations of the WBES data. The WBES is recognised as a rigorous source of data and has been used in many high-impact academic studies in the past (Jensen, Li and Rahman, 2010; Desai and Olofsgård, 2011; Luo and Bu, 2016; Tajeddin, and Carney, 2018; Darko et al., 2018; Gomes et al., 2018; Vendrell-Herrero et al., 2017). However, the WBES data sometimes suffers from a high proportion of missing values, which could limit the extent to which the data can be used to perform certain analyses. A possible alternative is for future studies to implement advanced imputation techniques, such as expectation maximization bootstrap and multiple imputation, to recover missing values (Honaker and King, 2010). Similarly, for the specific needs of the current line of research, the WBES does not provide the monetary value of the government contracts observed. Complementary data collection providing such details could give us a fuller picture of the phenomenon under study.

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Fig 1. Conceptual model and hypotheses

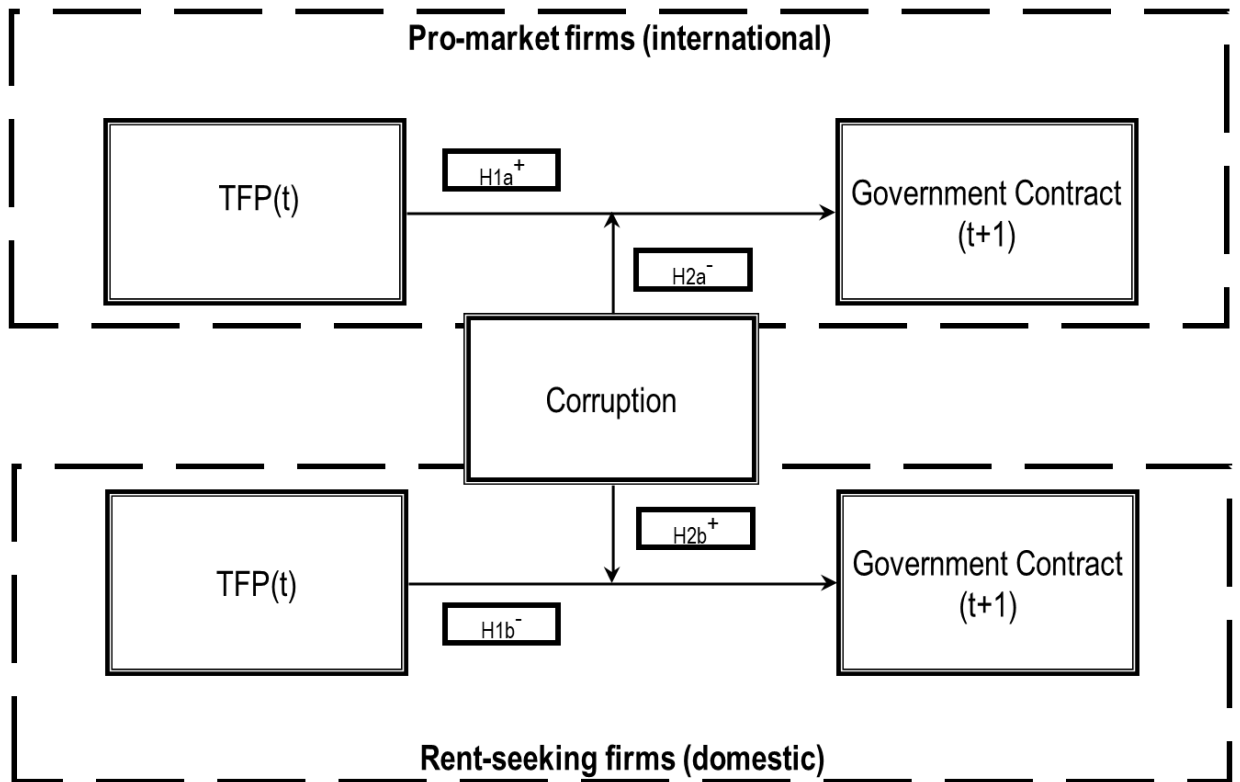


Fig 2. Differences in productivity and corruption between domestic and international firms

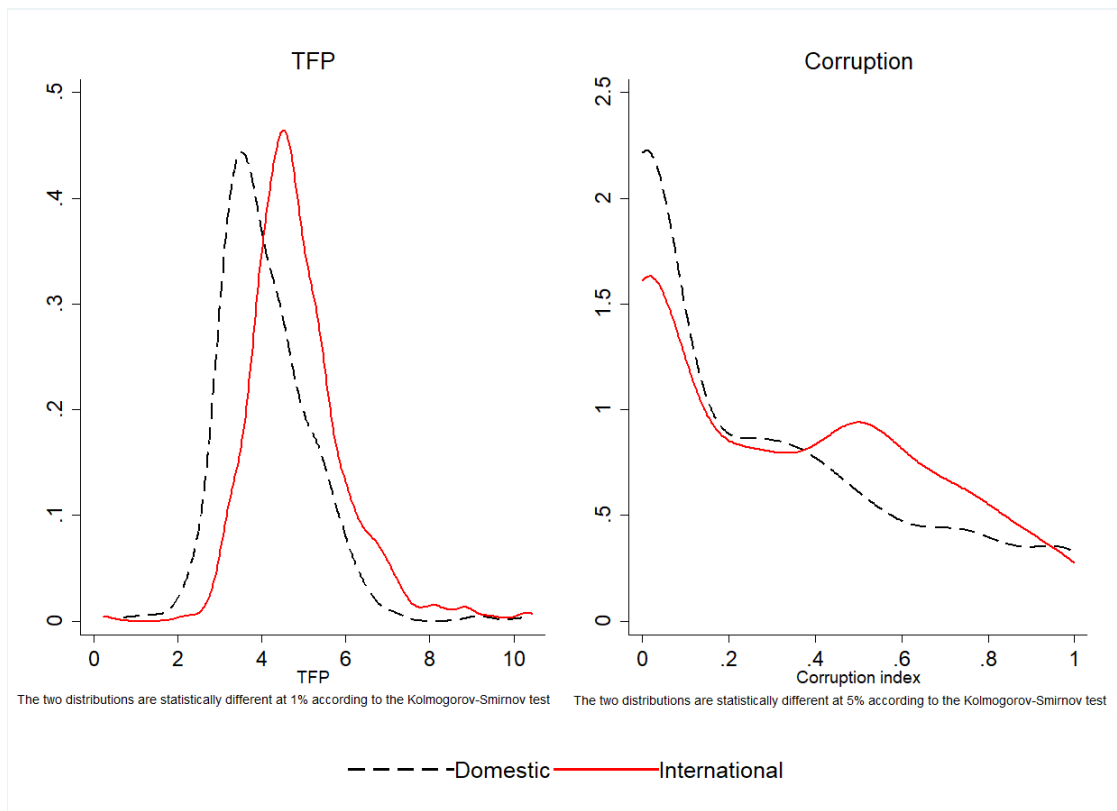


Fig 3. Average perceived corruption in sampled countries.

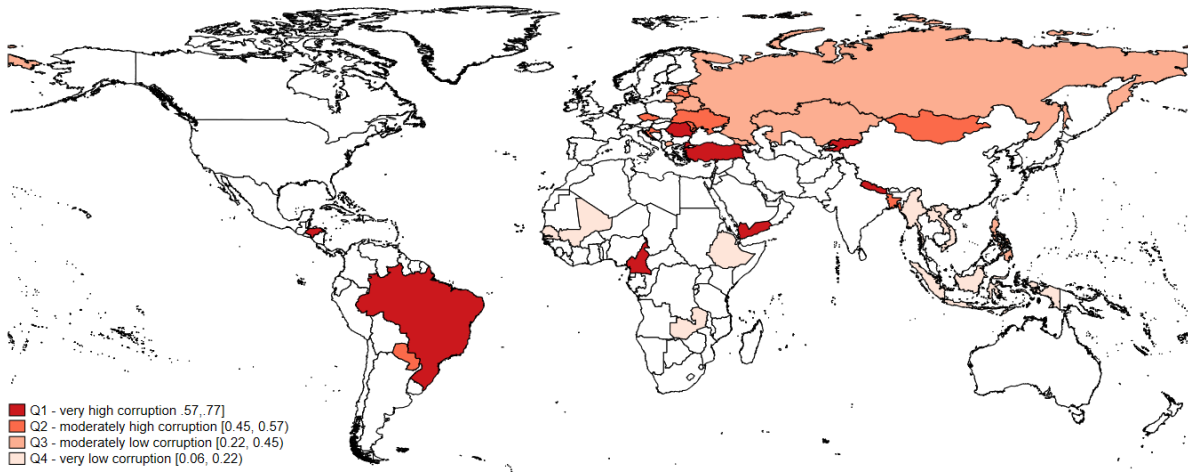


Fig 4. Plotting the interaction terms

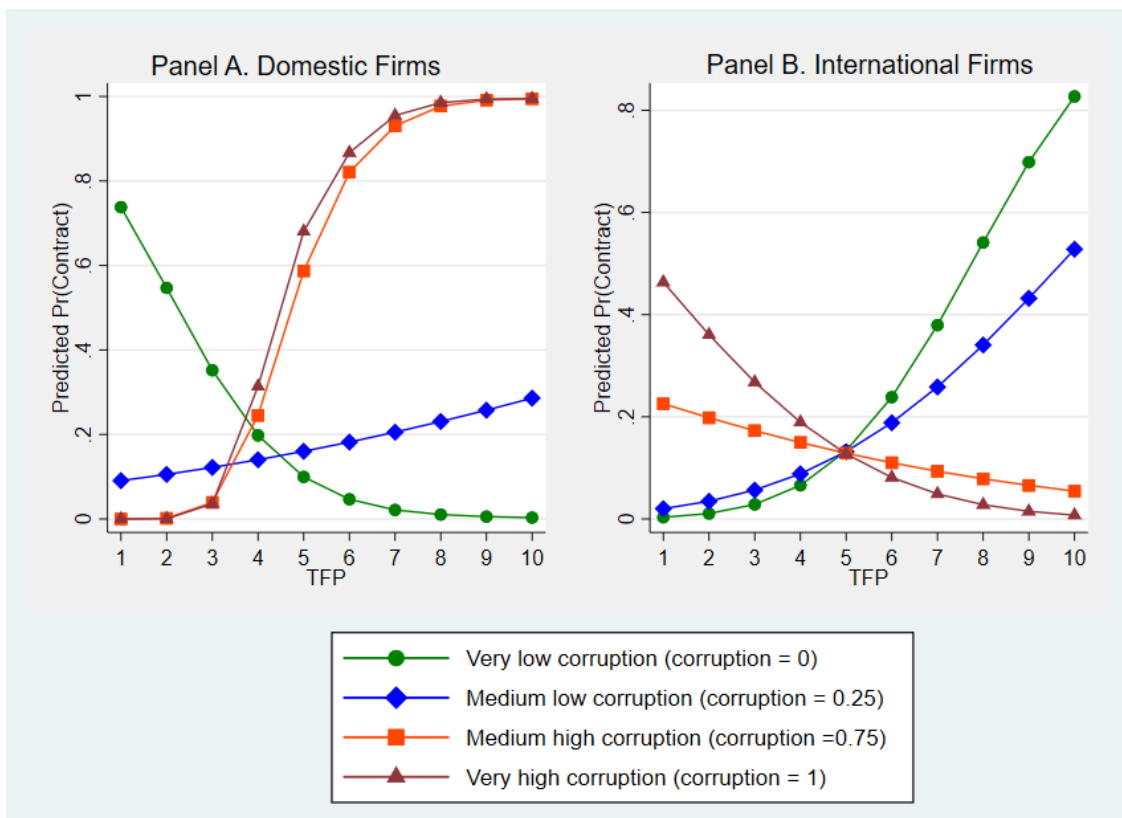
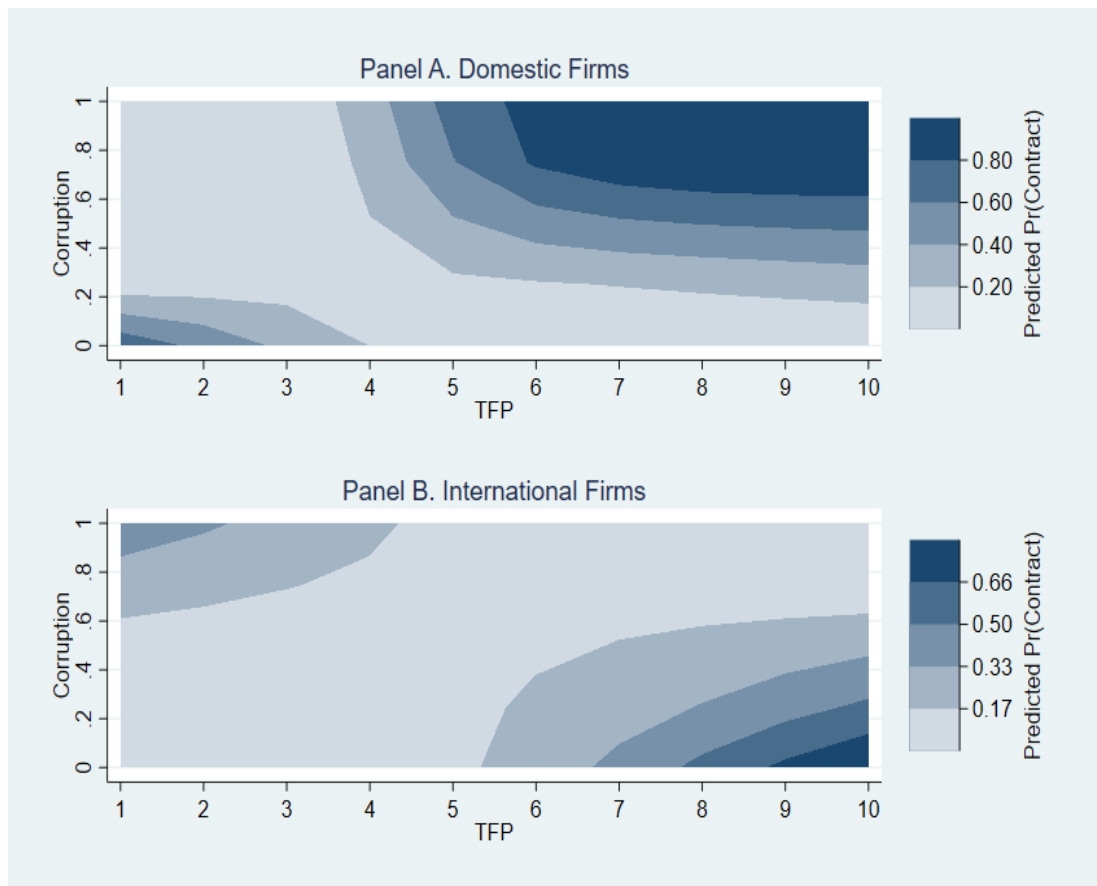


Fig 5. Contour plot



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Table 1. Informal payment and informal acts by domestic and international firms that secure government contracts.

	Domestic firms	International firms	Difference in means	T-test P-value
Informal payments per employee (Observations)	US\$ 13.97 (22)	US\$ 1.43 (20)	US\$ 12.53	0.049
Committed informal act (Observations)	24.28% (70)	11.63% (43)	12.65%	0.047

Table 2. Descriptive statistics

	Domestic firms (n = 571)				International Firms (n = 378)			
	Mean	Std.	Min	Max	Mean	Std.	Min	Max
Contract (t+1)	0.14	0.35	0	1	0.12	0.32	0	1
Corruption	0.28	0.32	0	1	0.34	0.31	0	1
TFP	4.08	1.06	0.71	10.20	4.87	1.17	0.21	10.45
Elapsed time	5.11	1.49	2	7	4.40	1.55	2	7
Workers	0.05	0.11	0.01	1.66	0.27	0.40	0.01	2.40
Manager experience	14.39	9.17	0	50	15.63	9.20	0	57
Firm age	12.28	7.35	1	30	12.94	6.51	1	30
Foreign ownership	4.57	19.68	0	100	21.47	39.16	0	100

Table 3. Correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)
PANEL A. DOMESTIC-MARKET ORIENTED FIRMS (N=571)						
(1) Government contract (t+1)	1					
(2) Corruption	-0.0061	1				
(3) TFP	0.0671	-0.1060	1			
(4) Workers	-0.0627	0.0171	0.2900	1		
(5) Manager experience	-0.0038	0.1720	-0.0864	0.0079	1	
(6) Firm age	-0.0012	0.2370	-0.0044	0.1570	0.3850	1
PANEL B. INTERNATIONAL FIRMS (N=378)						
(1) Government contract (t+1)	1					
(2) Corruption	-0.0541	1				
(3) TFP	0.0157	0.1880	1			
(4) Workers	-0.0275	0.0853	0.2880	1		
(5) Manager experience	-0.0750	0.0701	-0.0226	-0.0950	1	
(6) Firm age	0.0121	0.1680	0.0832	0.0562	0.3310	1

Table 4. Logistic regression: Government contract securement logistic regression

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Domestic-market oriented firms				International firms			
Corruption	-0.047 (0.059)	0.115 (0.176)	-0.045 (0.059)	-1.188** (0.570)	0.014 (0.065)	0.645** (0.252)	0.0128 (0.065)	0.920 (0.789)
TFP	0.017 (0.017)	0.027 (0.021)	-0.043 (0.054)	-0.130* (0.076)	0.031** (0.015)	0.079*** (0.023)	0.193** (0.087)	0.230 (0.151)
TFP ²			0.006 (0.005)	0.016** (0.007)			-0.015* (0.007)	-0.015 (0.014)
Corruption*TFP		-0.039 (0.039)		0.595** (0.271)		-0.130*** (0.050)		-0.247 (0.288)
Corruption*TFP ²				-0.073** (0.031)				0.012 (0.026)
Elapsed time	0.017 (0.025)	0.040 (0.034)	0.042 (0.034)	0.042 (0.034)	0.057 (0.045)	0.035 (0.041)	0.046 (0.046)	0.029 (0.043)
Workers	-0.404* (0.228)	-0.373 (0.227)	-0.408* (0.226)	-0.318 (0.237)	0.036 (0.039)	0.041 (0.039)	0.028 (0.039)	0.033 (0.040)
Manager experience	-0.001 (0.002)	-0.001 (0.002)	-0.001 (0.002)	-0.001 (0.002)	-0.003* (0.002)	-0.003* (0.002)	-0.003* (0.002)	-0.003* (0.002)
Firm Age	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)	0.003 (0.003)	0.002 (0.003)	0.002 (0.003)	0.002 (0.003)
Foreign Ownership	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Observations	571	571	571	571	378	378	378	378
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES
Business group FE	YES	YES	YES	YES	YES	YES	YES	YES
Pseudo R-squared	0.177	0.176	0.179	0.188	0.171	0.192	0.180	0.195
Log likelihood	-193.363	-193.011	-192.789	-190.688	-112.745	-109.893	-111.52	-109.458
Correctly predicted								
Cut-off	0.1436	0.1436	0.1436	0.1436	0.1164	0.1164	0.1164	0.1164
Contract	71.95%	69.51%	71.95%	73.17%	77.27%	77.27%	75.00%	75.00%
No contract	72.60%	72.39%	72.80%	72.80%	71.56%	73.05%	70.66%	73.95%
Overall	72.50%	71.98%	72.68%	72.85%	72.22%	73.54%	71.16%	74.07%

Dependent variable: government contract securement (t+1). Parameters are Marginal effects. Robust standard errors in parentheses.

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

APPENDIX 1. CORRECTING FOR THE QUALITY OF GOVERNMENT CONTRACTS

To further reduce the effect of firm level heterogeneities, we implemented a statistical technique that ensures that the sample of exporting and domestic firms awarded a government contracts are statistically comparable. Propensity score matching (PSM) technique is used for this exercise (Deheija and Wahba, 2002). Using PSM, we construct a sample of domestic and pro-market firms that have been awarded a government contract that have similar characteristics. By restricting the group of firms that receive government funding, the sample size is reduced; however, by doing this we diminish a potential source of bias produced by quality heterogeneities in government contracts.

As a first stage, we consider only firms that have secured a government contract and run a logit model using exporting status as the dependent variable (82 domestic firms and 54 exporting firms). The logit estimation includes controls such as the initial number of workers, industry dummies, whether the firm is part of a larger establishment, manager's experience, and firm age. In order to maximise proximity between pairs, nearest neighbour matching with calliper criterion (0.05) without replacement was used to identify 1:1 comparable pairs. We retained the maximum number of firms in the matched sub-sample that allow differences in propensity scores between groups to be insignificant. For that purpose, we used the Kolmogorov Smirnov (KS) test to compare differences in propensity scores before (KS = 0.404, p-value = 0.000) and after (PSM; KS = 0.100, p-value = 1.000) matching. This procedure resulted in a matched sub-sample of 80 firms that were awarded a contract, 40 for each category. Figure A1 shows results of the matching process. As shown, the distributions are almost perfectly balanced, an indication of good match.

As a second stage, we re-run the model reported in Table 4 for which we drop observations not included in the matching. Sample size of non-awarded firms also decreased (to 402 domestic firms and 263 exporting firms) because in some instances year, country or industry dummies perfectly identify the absence of government contracts. Results from this exercise are reported in Table A2. As shown, the results are qualitatively similar to the ones reported in Table 4. Overall, these outcomes support the idea that results are not driven by the quality of government contract.

Figure A1. Density distributions of propensity scores before and after matching

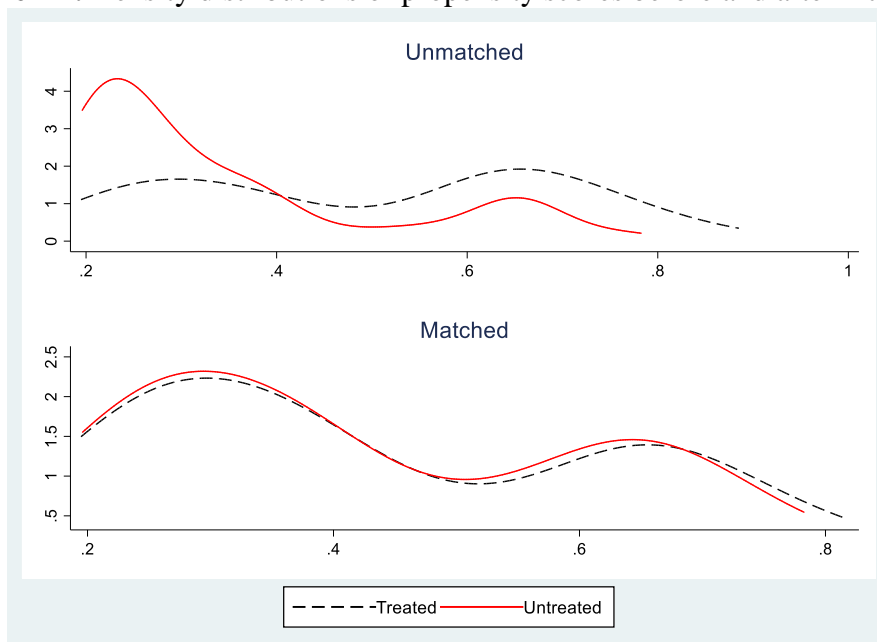


Table A2 . Logistic regression: Government contract securement logistic regression

	(1)	(2)	(3)	(4)	(5)	(6)
	Domestic-market oriented firms			International firms		
Corruption	-0.027 (0.052)	0.095 (0.153)	-0.980** (0.482)	-0.014 (0.061)	0.673** (0.286)	0.887 (0.706)
TFP	0.023 (0.014)	0.030* (0.018)	-0.097 (0.067)	0.044** (0.019)	0.093*** (0.025)	0.134 (0.136)
TFP ²			0.013** (0.006)			-0.004 (0.013)
Corruption*TFP		-0.030 (0.033)	0.502** (0.228)		-0.141** (0.060)	-0.227 (0.250)
Corruption*TFP ²			-0.062** (0.026)			0.008 (0.022)
Elapsed time	-0.104*** (0.022)	-0.164*** (0.029)	-0.157*** (0.028)	0.048 (0.044)	0.023 (0.039)	0.021 (0.039)
Workers	-0.514** (0.247)	-0.478** (0.243)	-0.437 (0.269)	0.058 (0.046)	0.059 (0.046)	0.058 (0.048)
Manager experience	-0.001 (0.002)	-0.001 (0.002)	-0.001 (0.002)	0.000 (0.002)	0.000 (0.002)	0.000 (0.002)
Firm Age	0.002 (0.002)	0.002 (0.002)	0.002 (0.002)	-0.001 (0.003)	-0.001 (0.003)	-0.001 (0.003)
Foreign Ownership	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)	-0.000 (0.000)	-0.000 (0.001)	-0.000 (0.001)
Observations	442	442	442	303	303	303
Year FE	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
Business group FE	YES	YES	YES	YES	YES	YES
Pseudo R-squared	0.1485	0.1505	0.1653	0.1990	0.2310	0.2312

Dependent variable: government contract propensity (t+1). Parameters are Marginal effects. Robust Standard errors in parentheses.

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