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Abstract

We analyze the relationship between product market competition and corruption. The existing theoretical literature produces ambiguous implications for the sign of this relationship, making it an empirical issue. Unlike the existing empirical studies that use cross-country data, we test the relationship between competition and corruption using firm-level information. This approach overcomes serious estimation difficulties that result from relying on cross-country data. Contrary to the existing work, we show that greater product market competition is typically associated with greater corruption.

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1. Introduction

Control of corruption has been an important public policy issue both in developed and developing countries for many years. Encouraging competition in product markets represents one potential approach to dealing with corruption among officials regulating these markets that has attracted considerable attention in theoretical literature.[1] This literature has demonstrated that the relationship between corruption and the degree of product markets competition is complicated and depends on various factors such as technologies employed by the firms, preferences of corrupt officials, probability of punishment, and information that the officials possess about firms. One exception to the generally ambiguous implications of these models is the prediction by Bliss and Di Tella (1997) that an increase in the firms' fixed costs (that can be viewed as a sign of weaker product market competition in a given sector) decreases corruption, but this result was obtained under rather specific assumptions about the nature of the firms' profits and costs, the relationship between firms and corrupt officials, and information possessed by these officials. The theoretical ambiguity of the link between product market competition and corruption highlights the importance of empirical testing of this relationship, and this testing represents the main goal of the present paper.

Surprisingly, there has been little empirical analysis of the effect of product market competition on corruption. To the best of our knowledge, Ades and Di Tella (1999) and Emerson (2006) are the only two more or less substantial empirical studies that attempt to test this effect. Both papers use cross-country data to show that countries

[1] See Bliss and Di Tella (1997), Ades and Di Tella (1999), Straub (2005) and Emerson (2006).

characterized by greater degree of product market competition tend to have less corruption as measured by subjective indices that relate to the entire country. The reliance on cross-country data, however, has obvious drawbacks, including small number of observations and the possibility of omitted variable bias. In addition, the degree of market competition in these papers is usually measured in rather indirect ways. For example, Ades and Di Tella use such measures as the share of imports in GDP, the importance of fuels and minerals in exports, and the distance to world's major exporters while Emerson uses indicators of economy's competitiveness as reflected in World Economic Forum's Global Competitiveness rankings and the Heritage Foundation's Index of Economic Freedom.

Another significant drawback of the empirical approaches used by both Ades and Di Tella and by Emerson is the potential for reverse causality between corruption and competition that is difficult to adjust for.[2] As Bliss and Di Tella (1997) emphasized, both the conventional measures of competition and the degree of corruption are typically jointly determined by "deep competition" parameters related to characteristics of the products produced by the firms and the technologies they use.

The main goal of this paper is to provide an empirical investigation of the relationship between product market competition and corruption that alleviates, if not eliminates, the most important flaws of the existing work. In order to do this, we rely on a

[2] Both papers attempt to deal with potential reverse causality by using 2SLS estimation. Ades and Di Tella instrument the intensity of competition (proxied by share of imports in GDP) with the logarithm of population and logarithm of land area. Emerson instruments corruption, which is a right-hand side variable in his empirical model, with a civil liberties index and variables reflecting educational level in a country. Neither author presents formal tests of the validity of these instruments. While there is little doubt that the instruments used in each paper are correlated with the respective variables being instrumented, it is unclear why these instruments would be uncorrelated with the residuals. Moreover, Emerson's instruments are likely to be endogenous with the instrumented variable. That is, the degree of corruption in a country can easily affect its civil liberties and educational level via corruption's effect on politics and on economic development, for example.

firm-level survey that in our view allows for better controls and instruments than cross-country data.

The relationship between product market competition and corruption generally depends on the particular nature of corruption and on the reasons for stronger or weaker competition, among other factors. Corruption based on the extraction of existing rents that are due to some artificial (non-technological) limits on competition is likely to flourish in less competitive environments. Also, if competition is weak due to excessive regulation, then it might be associated with greater corruption that is promoted by this regulation. In this case, appropriate deregulation would result in both greater competition and lower corruption. Our measure of corruption appears to reflect mostly its cost-reducing variety. As we argue below, unlike rent extraction, corruption that reduces firms' costs is likely to be promoted by product market competition. Our data support this argument.

We use the dataset from the World Bank's Productivity and the Investment Climate Private Enterprise Survey (henceforth, PICS) that contains responses from several thousand firms across a number of countries. Most of the firms were surveyed during 2002-2005 period and some of the countries contain two rounds of the survey, although this is not a panel dataset. By using firm-level data and country, industry, and year fixed effects we are able to greatly alleviate the problems plaguing previous empirical work on this issue. Unlike this earlier work, we demonstrate that firms in more competitive environments as measured by the number of firm's competitors tend to pay a greater percentage of their sales in bribes, controlling for various firm-level characteristics and country, industry, and year fixed effects. While this relationship does not always hold as strongly when we use some other measures of the degree of product market competition available in PICS, we do not find any evidence that competition and corruption are inversely related. We also demonstrate that capital-labor ratio as a proxy for the firm's fixed costs -- a measure of deep market competition with respect to which Bliss and Di Tella obtained their unambiguous prediction – is indeed negatively related to the strength of competition as measured by the variables available from the survey (the number of competing firms, customer reaction to price increases, market share, and profit margin). We argue that the firm's capital-labor ratio is usually representative of capital-labor ratio in the firm's narrow industry and is a valid instrument for dealing with the problem of endogeneity of corruption and competition. Also, as an alternative instrument, we use capital-labor ratio in the US sectors that correspond to the broad sectors available from the survey. In addition to capital-labor ratio, we use capacity utilization as an instrument for competition.

While our Tobit regressions present mixed evidence, our instrumental regressions suggest a positive relations between the strength of competition and the extent of corruption. All coefficients in the instrumental regressions have signs consistent with this relationship and when we use the firm's capital-labor ratio as one of the instruments, most of the coefficients of the competition measures are highly statistically significant. Moreover, the firm's capital-labor ratio performs well in the standard tests for instrument validity. The difference in the results of Tobit regressions and instrumental regressions is instructive. It fits well with the conjecture of a substantial degree of reverse causality between competition and corruption. Moreover, because we control for country and broad industry sector fixed effects, the extent and nature of regulations as well as some other hard to measure factors are at least in part controlled for in our regressions.[3]

The paper is organized as follows. The next section briefly reviews the existing literature, focusing on the empirical implications of the models and on the existing empirical work. In addition, we suggest another simple model that implies a positive relationship between product market competition and cost-reducing corruption under some reasonable circumstances. We describe the data in Section 3. Our results are presented in Section 4. Section 5 concludes.

2. The existing theory and evidence

Most of the existing models of the relationship between product market competition and corruption produce ambiguous implications with respect to its sign. In the first paper analyzing this relationship, Bliss and Di Tella (1997) assume that each official deals with only one firm and the officials do not know the precise amount of rent enjoyed by the firm they oversee, but they know the distribution of these rents. The official's problem then is to demand the bribe that maximizes the expected value of bribe revenue while the firm agrees to pay the bribe as long as it is smaller than the firm's rent. If the bribe demanded is greater than the firm's rent, the firm exits the market. The degree of competition in this model is based on three "deep competition" parameters: (1) the degree of substitutability of the firms' products; (2) the degree of similarity of the firms' production functions; and (3) the amount of fixed costs in the industry. In other words, in

[3] Note that the "industries" whose fixed effects we control for are 15 rather broad sectors such as "Textiles" or "Metals and Machinery." Therefore, the extent of competition faced by firms within these industries may vary greatly, depending on what part of the industry the firm operates in and in what part of the country it is located.

this paper, the degree of competition is determined by the technological factors that are assumed to be exogenous with respect to the degree of corruption. When the degree of competition in Bliss and Di Tella's model depends on either the first or the second parameter, the relationship between competition and corruption measured by the size of the bribe demanded is ambiguous. If, however, the degree of competition is determined by the third parameter (i.e., fixed costs), greater competition always increases corruption.[4]

Ades and Di Tella (1999) also assume that each official deals with only one firm, but unlike Bliss and Di Tella, they assume that the official knows precisely the firm's amount of profit which is random and is not observed by the state. The official may collude with the firm to hide the true amount of profit in exchange for a bribe. If the bribe is detected by the state, however, the official loses his wage. The state's problem is to set the officials' wages in such a way as to reveal (and collect) the greatest amount of profit net of the officials' wages. The degree of competition in this model is measured as the exogenous number of firms in the market and the extent of corruption is defined as the frequency of bribes with the amount of each bribe held constant. The assumed exogeneity of the number of firms implies that the direction of causality on which the model focuses is from competition to corruption. In this framework, corruption decreases in the number of firms unless increased competition leads the state to decrease the officials' wages too much. In particular, if the wages do not depend on the number of firms in the economy, an increase in competition would always reduce the frequency of bribes.[5]

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[4] To prove this result, Bliss and Di Tella assume that the distribution of the firms' overhead costs is uniform.

[5] A recent paper by Straub (2005) contains a model that is somewhat similar to Ades and Di Tella's in that the number of firms is exogenous and the officials assigned to each firm have perfect information about the

The two models outlined above assume that the bribes represent pure extortion and are obtained from the firms' pre-existing rents. Moreover, Ades and Di Tella's (1999) results are contingent on the exogenous number of competitors. However, bribes are often paid *in return for* some service even if this service consists in letting the firm bypass some regulation that was established to facilitate bribe-taking. The important point here is that corrupt officials are not always free to extract firms' rents, but can charge bribes only up to the value of the service they are providing to the firm. As Shleifer and Vishny (1993) point out extortion is more difficult to hide and easier to fight than cost-reducing corruption such as when an importer pays a bribe instead of the official customs duty or a firm pays a bribe to avoid complying with costly regulations. Shleifer and Vishny note that "[c]ompetition between buyers of government services assures the spread of cost-reducing corruption" (p. 604) while such competition does not promote the spread of corruption of the extortion kind. The argument here is essentially that firms are likely to resist corruption when it represents pure extortion, but might welcome cost-reducing corruption.[6] This suggests that cost-reducing corruption is likely to be more widespread than extortion.

Cost-reducing bribes may be charged for reducing fixed costs or for reducing variable costs (this latter type of corruption would be more natural when bribes are

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firms' rents. The firm's rents in this model depend on whether the firm uses a "good" technology that does not produce externalities or "bad" technology that is cheaper for the firm but generates a non-pecuniary negative externality for the consumers. The main result of Straub's model relevant for our purposes is that a greater number of firms may either increase or decrease corruption measured as the aggregate amount of bribes.

[6] Sequeira and Djankov (2010) expand on Shleifer and Vishny's agruments by classifying corruption into collusive and coercive. " 'Collusive' corruption emerges when public officials and private agents collude to share rents generated by the illicit transaction… 'Coercive' corruption takes place when a public bureaucrat coerces a private agent to pay a fee just to gain access to the public service." (pp. 12-13). Collusive corruption is always cost-reducing in Shleifer and Vishny sense and leads to an increased demand for public service while coercive corruption in cost-increasing, leading to lower demand.

charged in the course of day-to-day business rather than in a lump-sum fashion, e.g., when the firm needs to import supplies from time to time or obtain other official permits that depend on the level of output). It is straightforward to show that in a very basic model of Cournot competition with linear demand curves, when firms are paying bribes to reduce their costs (either fixed or variable) by a given amount, a decrease in the firms' fixed costs (or equivalently, an increase in the number of competitors in the market) results in greater corruption measured either as the percentage of sales (the so-called, *bribe tax*) or as the total amount of bribes.

Specifically, consider a market with Cournot competitors producing identical good at a constant marginal cost and with common to all firms fixed cost, f,[7] and facing an inverse demand curve $p = a - Q$, where $Q = \sum_{i=1}^{N} q_i$ and q_i is output of firm i. The fixed and marginal costs determine the number of firms in this market via a zero profit condition.[8] Let's assume that all firms have the same opportunities for cost reduction via a bribe and that the corrupt official obtains 100% of the cost saving. Denote each firm's fixed cost reduction by Δf and marginal cost reduction by Δc. Then the total bribe and bribe tax in each case would be, respectively:

[7] We use common fixed costs for simplicity. The outcome does not change if the fixed costs are heterogeneous and are scaled by a common parameter, e.g., firm i's fixed cost is $a_i f$ where f is common and a_i's are different.

[8] If all firms' marginal costs are the same, $N = \lfloor (A - c)/\sqrt{f} - 2 \rfloor$, where |_._| denotes the greatest integer function. We treat N as a continuous variable.

	Fixed costs reduction	Marginal cost reduction
Total bribe:	$\Delta f N$	$\Delta c N q_i = \Delta c N \frac{a-c}{N+1}$
Bribe tax:	$\frac{\Delta f N}{p q_i} = \frac{\Delta f (N+1)^2}{(A-c)(A+Nc)}$	$\frac{\Delta c q_i}{p q_i} = \frac{\Delta c}{p} = \frac{\Delta c (N+1)}{A+Nc}$

Obviously, both total bribe and bribe tax increase in *N* (and, therefore, decrease in *f*) in both cases.

We conclude that when the number of competitors is determined by technological fixed costs a la Bliss and Di Tella (1999) or when corruption is cost-reducing, the bribe tax is likely to be positively related to the degree of competition.

Of course, as noted by Bliss and Di Tella (1997) among others, the number of competitors and the degree of corruption are in general endogenous and that's how most papers model these two phenomena. In particular, the standard approach is to assume that in one way or another (e.g., via an entry fee bribe, or regulation, or by issuing licenses) the officials can restrict entry into the relevant industry and create rents that can be extorted. The officials then determine the extent of their restrictive action in order to maximize their bribe revenue. Recent examples of such papers include Campos et al. (2010), Emerson (2005), Dutta and Mishra (2004), and Aidt and Dutta (2001). Generally, an entry fee imposed by corrupt officials on firms that want to enter the market may reduce competition relative to a completely free entry case. However, causality here goes from corruption to competition rather than the other way around. Moreover, when regulations (or taxes) exist, corruption may result in greater entry than would be the case if regulators were honest, because paying bribes may be less costly for at least some firms than following regulations. Dutta and Mishra (2004) provide one example when in the presence of regulations wealth inequality can lead to both greater corruption and increased product market competition.[9]

To summarize, most models of the effect of product market competition on corruption have ambiguous implications with respect to the sign of this relationship, making the empirical investigation of this issue particularly relevant. Moreover, it is likely that greater technological fixed costs reduce both bribes and competition and that cost-reducing corruption increases in the number of competing firms (or, equivalently, decreases in fixed costs). This implies that the outcome of an empirical test of the relationship between competition and corruption depends on whether corruption measures used in the test reflect largely cost-reducing or extortion variety of corruption. Also, such tests need to take into account the potential endogeneity between corruption and product market competition.

The existing empirical work claims to show that product market competition reduces corruption. This work, however, is based mostly on cross-country data and suffers from serious econometric problems.[10] Particularly important is the fact that the existing empirical studies are not able to disentangle adequately the impact of competition on corruption from the reverse effect. Also, it is unclear whether corruption measures used in these studies reflect rent extortion or cost reducing corruption. In the

[9] Regulations may, of course, be a result of corruption, but presumably some taxes and regulations would also exist without corruption.

[10] Dutta and Mishra (2004) use a subset of the firm-level data from a precursor to the survey that we use in the next section, but their empirical work is limited to motivating their theoretical model. Their entire empirical exercise consists of regressing the ratio of corrupt to non-corrupt firms in a survey of 23 economies in transition on the number of firms in each country sample and the Gini index for the country. (They assume that the number of firms in the survey reflects the number of firms in the country.) Also, they do not claim that causality runs from the degree of competition to corruption. Also, Campos et al. (2010) use a survey of Brazilian manufacturing firms to show that corruption is positively associated with incumbent firm performance. They argue that this presents an indirect evidence of corruption acting as a barrier to entry. Here again, causality runs from corruption to competition. Also, competition in their empirical work is reflected in a highly indirect way by assuming that incumbent firm performance is inversely related to the strength of competition.

next section we use firm-level data and rely on capacity utilization and on a proxy for fixed costs to alleviate, if not eliminate, the problems plaguing the existing empirical literature on this issue. Contrary to the results based on cross-country studies, our data that measure mostly cost-reducing corruption suggest that product market competition either does not affect the extent of corruption or is associated with greater corruption, measured as the ratio of bribes to firm sales (i.e., bribe tax). The results are particularly strong when we adjust for the potential endogeneity between corruption and competition.

3. The Data and Estimation Approach

In order to test the relationship between competition in product markets and corruption faced by the firms we rely on the firm-level Productivity and the Investment Climate Private Enterprise Survey (PICS). This World Bank sponsored survey was administered to several thousand firms in a number of countries, mostly in 2002-2005. After dropping observations that do not contain information on the variables relevant to our analysis, we end up using usually from about 2,200 to 9,000 observations on manufacturing firms, depending on regression specification.

Our dependent variable is a measure of corruption that we refer to as the *bribe tax*. It equals a fraction of annual sales paid in bribes reported by firm *i* in country *c* and in year *t*.[11] Note that bribe tax reflects "informal payments to public officials to 'get things done' with regard to customs, taxes, licenses, regulations, services etc." (see Table 1). That is, at least on its face, this question is likely to be interpreted as being about cost-reducing corruption rather than extortion of rents. According to our theory, this

[11] As is common practice in surveys, the questions about the extent of corruption concern "unofficial payments" typically made by "firms like yours" rather than by the respondent himself. See Table 1.

measure should be positively influenced by the strength of competition. Also note that many of the firms in the survey reported zero values for bribe tax. Therefore, we run the following Tobit regressions:

$$BRIBE\_TAX_{ict} = \gamma_0+\gamma_1(COMPETITION_{ict})+\gamma_2 X_{ict}+\gamma_3 Z_{ct}+\varepsilon_{ict}\,, \qquad (1)$$

where $BRIBE\_TAX_{ict}$ represents a measure of corruption (a fraction of annual sales paid in bribes) reported by firm i in country c and in year t,[12], X_{ict} is a vector of other firm characteristics, and Z_{ct} is a vector of country, 15 broad manufacturing sectors, and year fixed effects.

As we mentioned earlier, competition and corruption are likely to be endogenous. In particular, corrupt officials may attempt to limit competition among firms they oversee. In order to adjust for this possibility, we instrument competition by either the firm's or broad industry's capital-labor ratio and by the firm's capacity utilization. We view capital-labor ratio as a proxy for the firm's fixed costs – one of Bliss and DiTella's parameters that determine the strength of competition faced by the firm. Obviously, it is not a perfect proxy for fixed costs, but it is probably a fairly good proxy and it does most likely represent a so-called innocent entry barrier. Such barriers arise due to industry characteristics and result from profit maximization that does not necessarily include strategic behavior.[13] Other things equal, the higher the capital-labor ratio the more difficult it is to enter the industry.

[12] As is common practice in surveys, the questions about the extent of corruption concern "unofficial payments" typically made by "firms like yours" rather than by the respondent himself. See Table 1.
[13] Of course, a firm might wish to overinvest strategically in its capacity in order to deter entry. Such investment might also increase the firm's capital-labor ratio.

One might argue that it would be better to use survey-based capital-labor ratio for the industry rather than for a particular firm as a measure of competition within the industry. Unfortunately, as we noted earlier, the survey has only 15 rather broad categories of manufacturing industries such as “Textiles” or “Metals and Machinery” that have a wide range of capital-labor ratios among respondent firms. For example, in Electronics, firms’ capital-labor ratios have ranged from 0 to over $250,000 per employee, with a mean of about $610 and standard deviation of almost $7,600. Also, capital-labor ratios for a given industry in a given country obtained from the survey are not necessarily reflective of purely technological characteristics of the industry, but maybe influenced by the country’s economic environment just as much as ratios for individual firms. The problematic nature of using capital-labor ratio averages from the survey’s broad industries is highlighted by the fact that these averages are *positively* related to the strength of competition reported by the firms in these industries.

Another possibility would be to use capital-labor ratios for the corresponding US industries as instruments. These ratios are fairly strongly negatively related to competition reported by respondent firms. However, when we use US capital-labor ratios and capacity utilization reported by firms as instruments, the instrumental regressions fail the overidentification tests in some specifications. [14] Presumably this happens because US capital-labor ratios serve a role similar to broad industry dummy variables and as such may influence the degree of corruption via channels other than competition.

[14] Interestingly, the US capital-labor ratios are negatively correlated with the industry averages of these ratios from the enterprise survey with the coefficient of correlation of about -.22. This result further undermines the validity of using PICS-based capital-labor ratios of the broad industrial sectors for our purposes.

Therefore, we contend that the respondent firm's capital-labor ratio provides the best indication of fixed costs in its narrowly defined industry while we use dummy variables for broad industry categories available from the survey as control variables. The firm's own capital-labor ratio may be endogenous to bribes, because, for example, the process of obtaining licenses for installing or use of fixed capital may be corrupt. If this is the case, however, capital-labor ratio would be positively related to the bribe tax while in our data the relationship is strongly negative. Moreover, the number of licenses would presumably depend on the total assets of the firm rather than on the capital-labor ratio. As a robustness check we also use capital-labor ratios for the US industries corresponding to the 15 broad sectors listed in the survey. The US industry ratios have the advantage that they are clearly exogenous to the corruption environment facing firms in the survey. However, these capital-labor ratios do not necessarily reflect the technology in a more narrow industries of the firms in the survey and US technologies may not be the same as those used in other countries.

We construct our firm capital-labor ratio variable as a logarithm of one plus a ratio of the firm's fixed assets to its employment. PICS has two measures of fixed assets: "machinery and equipment" and "plant, property, and equipment." We use book value of the former measure, because it has about five times as many observations as the other measure. In the survey, this book value is expressed in local currency units (LCU). We convert it into constant purchasing power parity (PPP) US Dollars using the ratio for the appropriate year of the country's GDP in current LCU and its GDP in constant 2000 PPP

US Dollars.[15] The (logarithm of) US capital-labor ratios are calculated for 2004 and are defined as the amount of capital in current US dollars per employee.

The use of our proxy for the firms' fixed costs (the firm's capital-labor ratio) and a measure of capacity utilization is supported by the fact that they are not only negatively related to the measures of competition available from the survey (the number of firm's competitors, a crude measure of the price elasticity of demand, firm's market share, and the firm's gross profit margin) but they also pass instruments validity tests for our measures of competition in the competition-corruption relationship. In particular, they easily pass overidentification tests, implying that capital-labor ratio is unlikely to be related to corruption through channels other than their tendency to restrict competition.

In addition to capital-labor ratio, we also use the survey measure of capacity utilization by the firm as an instrument for competition. While in the models of strategic behavior of firms extra capacity is typically viewed as entry deterrence, the more common effect of low capacity utilization is greater competition. Bertrand competition is particularly natural in the low capacity utilization environment. A casual look at the US market for air travel suggests as much. Conversely, high capacity utilization usually weakens competition. For example, Tirole (1992) several times mentions capacity constraints as a reason for noncompetitive behavior and "softer" competition.[16] Therefore, we expect capacity utilization to be negatively related to the strength of competition. At the same time, one could argue that firms that shield themselves from competition with the help of corrupt officials might have relatively predictable demand

[15] We also used GDP in constant 2000 USD. The results were similar to those presented in the paper and are available upon request.

[16] E.g., pp. 211, 217, 218, and 410. Also, outside of monopoly setting, the public good nature of entry deterrence may significantly weaken incentives to increase capacity as a means of preventing entry; see Waldman (1987).

and achieve high capacity utilization. If this is the case, then capacity utilization would be endogenous to corruption and, therefore, would not be a good instrument for our purposes. Because of this argument, we view capital-labor ratio as a more reliable instrument, although we believe that capacity utilization is only very modestly affected by the degree of corruption. We present the IV regression results both for one instrument (capital-labor ratio) and for two instruments for those specifications where capital-labor ratio is a sufficiently strong instrument. As we demonstrate in the next section, the results are broadly similar, although two-instrument regressions perform better in terms of statistical significance and strength of instruments tests. Also, the presence of two instruments allows for overidentification tests.

The survey has several measures of the intensity of competition faced by respondents: number of competitors, national and local market share, the extent of customer reaction on price increase, and markup over firm's costs. Each of these measures has advantages and disadvantages. We calculate the first measure as the logarithm of one plus the number of competitors the firm has. PICS breaks down competitors into three categories -- domestic private, domestic state, and foreign. We add up these numbers to obtain total number of competitors. For each category, there is the actual number of competitors and also a code with nine different intervals for the number of competitors. The interval code is meant to be used when the respondent cannot indicate the precise number of competitors. We create a combined measure that uses the specific number of competitors if it is present and the number inferred from the code if the specific number of competitors is absent. In the latter case, we use midpoints of the coded intervals and we use 30 competitors for the "more than 20" open-ended interval.

Some respondents indicated very large numbers of competitors (e.g., hundreds of thousand). Given our use of logarithms, this does not generate significant difficulties. Nonetheless, we also obtained the results when we use 30 for all cases where the specific number of competitors was stated to be over 30. These results are similar to those that use an unadjusted number of competitors and we do not present them here. They are available upon request. The main problem with the number of competitors as a measure of competition is that a dominant firm that has some small competitors may not be threatened by them in any significant way. At the same time, the theory of contestable markets suggests that even a complete absence of competitors may not reflect the lack of strong potential competition if entry costs are relatively low.

Another measure evaluates customer reaction to a 10% price increase. This variable has four values: 1 if customers would buy the same quantity as before; 2 if demand would be slightly lower; 3 if the demand would be much lower; and 4 if the customers stop buying. In other words, higher values of this variable presumably reflect greater competition faced by the firm. The limited set of values of this variable complicates our ability to instrument it and the difficulty of estimating the consequences of a hypothetical price increase makes the results of the regressions that use this variable somewhat difficult to interpret.

The third variable potentially relevant to competition is market share reported by the firm. The survey asks about both local market share and national market share. (In our regressions, we use logarithm of one plus reported market share in percentages.) It is unclear, however, which of the two shares is most appropriate for our purposes, not to mention the fact that the firm might be competing mostly in international markets. This ambiguity is a serious flaw and we view these market share variables as the least reliable of the measures of the strength of competition. In order to alleviate the problem with the relevant market share, we calculate another variable equal to the maximum of the two market shares. Our assumption here is that the greatest market share would typically be the most relevant one. For example, if a firm has zero national market share and positive local market share, it is presumably the local share that is most relevant to the degree of competition faced by the firm. We present our results for the national market share and for the maximum of the two shares. We do present the local market share results because there are relatively few observations on the local market share and in no regression the coefficient of local market share is statistically significant.

Finally, we calculate the price markup over costs reported by the firm. This markup is calculated as the ratio of the difference between total market value of production and the firm's costs to the firm's costs. In those cases when the respondent did not report total market value of production we used total sales instead. This measure has two main disadvantages. First, the firm's costs presumably do not include bribes. Therefore, firms that pay high bribes to reduce their costs may appear as enjoying high markups while in reality their bribe-inclusive markups may be modest. This possibility makes interpretation of results somewhat uncertain and it also suggests that markups may be endogenous to bribe tax. Another difficulty with this measure is that there are a few observations where markup is negative and very high (in hundreds or even thousands) by absolute value. Given that positive markups are always less than unity, a few negative outliers can be extremely influential. Also, highly negative markups may indicate a reporting error. For these reasons we replace all markups that are less than -0.1 by -0.1.

We also control for various firm characteristics that can be expected to influence the degree of corruption engaged in by the firm. In our main regressions these firm-specific control variables include the percentage of government ownership (*State Owned*), the percentage of foreign ownership (*Foreign Owned*), firm size measured by a logarithm of one plus employment, age of the firm, and the share of sales the firm exports directly. In addition, all of our regressions include country and year fixed effects. The regressions that do not use industry-wide capital-labor ratios also include industry fixed effects.

A description of all our variables and the summary statistics are presented in Tables 1 and 2, respectively. Table 3 shows pairwise correlations of firm-level variables.

4. The Results

Tobit regressions

We begin by Tobit estimation of equation (1) using our four measures of competition (we treat national market share and "maximum" market share as essentially one measure of the degree of competition) . The results are presented in Table 4. All regressions in this table control for country, year, and broad manufacturing sector fixed effects, and adjust for arbitrary correlation within country-manufacturing sector groups (clustering).[17]

Tobit estimates provide a mixed picture. The coefficients of the number of competitors and markup (Columns 1 and 4) are not statistically significant, customer

[17] That is, each cluster is comprised of firms from the same country and the same broad manufacturing sector. See Table 1 for the list of countries and 15 manufacturing sectors. The results of regressions that adjust for possible clustering are close to those without clustering, which is not surprising, given that the intra-group correlation of the bribe tax is less than 0.1.

reaction coefficient suggests a positive relationship while market share coefficients are consistent with negative relationship between corruption and competition. As we will see, however, reverse causality plays an important role. Also, we reiterate that market share variables in PICS are not reliable measures of competition, because it is unclear which market share (local, national or even international) is most relevant for each firm.

It is also of some interest to consider the relationship between corruption and the other firm-level characteristics. Among these, foreign ownership and state ownership have consistently negative signs (one exception is a small and statistically insignificant positive coefficient of foreign ownership in the markup specification) and are statistically significant in some specifications. Foreign owners may be reluctant to engage in corruption if these foreign owners come from countries with relatively strong anti-corruption laws and traditions (including laws against corruption practices engage in abroad). They also may not always know which officials can be bribed relatively safely. There are, however, opposite arguments as well. Some foreign-owned firms may choose to pay large bribes simply because they are not skilled in the alternative ways of lobbying in the local culture.[18] It appears that in our data, the first set of reasons dominates. State ownership is likely to be associated with fewer bribes to state officials simply because state owners might have alternative ways of influencing other state officials. This reasoning underlines the ambiguous property rights literature (Li, 1996; Che and Qian,

[18] Rose-Ackerman (1978) contains the following example. "A Washington Post article described the Asian perspective. Some Asian businessmen contend 'that their American partners often insist on paying a lot of money in bribes because they cannot be bothered to do things in the time-honored way of endless talk over tea. They therefore end up paying several times more in bribes than is necessary or even acceptable.' " (p. 90, footnote 6).

1998).[19] Larger cities as well as capitals are positively linked to corruption in all but one equation and in all specifications at least one of their coefficients is statistically significant. In most specifications, export share in sales has a negative coefficient, but usually it is not statistically significant. This is somewhat surprising, given that exporting necessitates interactions with customs, i.e., an additional group of officials. Firm size also does not appear to be significantly associated with corruption. Finally, the age of the firm has a negative coefficient that is statistically significant for two out of our four specifications. This might be due to older firms being able to work out relatively stable arrangement with corrupt officials that involve lower bribes. All these issues deserve a more detailed inquiry and discussion, but they are not the focus of this paper.

Instrumental variables estimation

Clearly, the potential simultaneity bias between corruption and the intensity of product market competition represents a problem in estimating the relationship between them. Note, however, that this simultaneity is likely to bias the estimates of the coefficients of the number of firm's competitors and of customer reaction in Tobit estimates of equation (1) downwards and the coefficients of market shares and of markups upwards. We expect, therefore, that the IV estimates of equation (1) should show a more definite positive relationship between the degree of competition and corruption. The results below strongly support these expectations. In all specifications, the IV estimates are consistent with a positive relationship between competition and corruption and when we use only firm-level instruments, the coefficients of our measures

[19] It is quite possible, however, that the propensity of enterprises with state ownership to engage in bribing depends on the nature of state ownership (e.g., whether the owner is local government or central government). Unfortunately, our data do not distinguish among different types of state ownership.

of competition are highly statistically significant in all but one specification. The lone exception is customer reaction specification that is particularly difficult to instrument because of the discrete nature of this measure of competition.

We first discuss the results obtained by using firm capital-labor ratio as one of the instruments and later present the estimates that use capital-labor ratio for US industries. We run both IV GMM regressions and IV Tobit regressions. Even though IV Tobit is clearly more appropriate in our case, IV GMM regressions are also useful because they provide a richer set of diagnostics for the quality of our instruments. Table 5 contains the estimates of the relationship between our measures of competition and our instruments (firm's capital-labor ratio and capacity utilization) that form the first-stage estimates of the IV GMM regressions. (First stage regressions for IV Tobit are essentially the same.) These regressions show that both instruments are negatively and statistically significantly related to the strength of competition, no matter which measure of competition we use. This suggests among other things that the surveyed firms do not tend to use excess capacity as a barrier to entry. Instead, excess capacity leads to stronger competition while capacity constraints soften it.

Table 6 shows the second stage estimates of the IV GMM regressions. All regressions include (partialled out) fixed effects for country, year, and broad manufacturing sector, and adjust for clustering on country-manufacturing sector groups. The most remarkable result is that market shares that had positive coefficients in the non-instrumental regressions now have negative coefficients that are statistically significant at 1% level. The number of competitors and markups are also significant at 1% level.

The instruments are quite strong in the specifications with the number of competitors and with national and maximum market shares. In these regressions, the F-statistic for excluded instruments is comfortably greater than 10 (see Table 6). In the customer reaction and markup equations, however, the instrument strength is only moderate. In all specifications, the instruments comfortably pass overidentification tests (Hansen J statistic), supporting our view that both capital-labor ratio of the firm and its capacity utilization affect corruption mainly via their impact on the strength of competition.

The IV Tobit estimates of the competition-corruption relationship have the same signs as IV GMM estimates, but with the exception of the markup specification, IV Tobit coefficients of the competition measures are smaller by absolute value than the corresponding IV GMM coefficients. Statistical significance is similar in both approaches.

In terms of economic importance, the Tobit results imply that the elasticity of the bribe tax both with respect to the number of competitors and with respect to market share measures is somewhat greater than 0.5 by absolute value. For our markup measure, a 0.1 decrease in it (less than one half of its standard deviation of 0.23) results in an increase of about 6 percentage points (or more than one standard deviation) of the bribe tax if calculations are done at its mean of 1.5%. In other words, the effect of competition on corruption is quite significant both statistically and from the economic point of view. In fact the effect of the markup on bribes tax appears to be unreasonably large, suggesting that the true value of the markup coefficient is probably below its point estimate.

IV Tobit procedure in Stata does not provide overidentification tests. However, we can mimic them by running the regressions with one instruments and checking statistical significance of the other instrument in the second stage regression. Neither capital-labor ratio nor capacity utilization is statistically significant in any of the second stage regressions with one instrument.[20] This result is consistent with overidentification tests reported by the IV GMM procedures and both support the validity of both instruments.

While overidentification tests suggest that firm capital-labor ratio affects corruption largely through its effect on competition, the issue of potential endogeneity between firm capital-labor ratio and corruption remains open. Therefore, we also estimate equation (1) using capital-labor ratio for US industries as one of the instruments. Tables 8 and 9 present the results of the first and second stages of IV GMM regressions, respectively, with US industry capital-labor ratios as one of the instruments. The advantage of using the US ratios is that they are presumably mostly technologically determined and are clearly exogenous to the corruption environment facing firms in other countries. There are drawbacks too, however. As mentioned earlier, the industry definitions in the survey are too broad and may not adequately reflect the technological constraints of respondent firms and, therefore, their competitive environment. In addition, we cannot use industry fixed effects in this case. The data show that US capital-labor ratios provide for strong instruments in the number of competitors and in market share specifications, but not in the other two specifications. Also, as Hanson J-statistics in Table 9 demonstrate, these IV regressions fail the overidentification test in market share regressions. This implies that broad industrial sector capital-labor ratios are likely to

[20] Note that IV Tobit fails to produce estimates when capacity utilization is the single excluded instrument.

affect corruption through channels other than competition in this case. Aside from the problems with overidentification tests, the signs of the competition measures in these regressions are consistent with a positive relationship between competition and corruption, but in the number of competitors and in market share specifications the relevant coefficients are not statistically significant. Similar results obtain for IV Tobit regressions (see Table 10).

5. Conclusion

We study the relationship between product market competition and corruption. Most of the existing theoretical literature arrives at ambiguous results with respect to this relationship. We argue, however, that the link between product market competition and corruption to a large extent depends on the nature of the latter. While surplus-shifting corruption might indeed be negatively linked to the of strength competition, cost-reducing corruption is likely to be promoted by competition. Nonetheless, the empirical work on this issue that has generally dealt with broad measures of corruption has uniformly claimed to show that stronger product market competition is associated with lower corruption. In contrast, our estimates suggest that stronger competition is associated with greater cost-reducing corruption. This result is particularly strong when we adjust for the potential endogeneity between corruption and competition.

An important advantage of our approach over the existing empirical work is the use of firm-level instead of cross-country data. Firm-level data let us utilize information specific to the competitive and institutional environment of particular firms rather than rely on countrywide measures that reflect the degree of competition and corruption in highly aggregated and sometimes indirect ways. In addition, our data allow for the use of apparently valid instruments to deal with the potential simultaneity between competition and corruption. Finally, large number of observations and the ability to employ various firm-level controls and country, year, and manufacturing sector fixed effects adds to the reliability of our results.

Our findings do not necessarily contradict the existing literature, but rather call for a more nuanced view of corruption emphasizing the need to distinguish between surplus-shifting and cost-reducing corruption.

We certainly do not view our results as an argument against promoting product market competition among firms. The effect of competition even on cost-reducing corruption depends significantly on the factors that restrict competition. For example, if competition is restricted by excessive regulations, the removal of these regulations is likely to both reduce corruption and facilitate competition. Our findings do imply that *other things being equal* competition by itself does not tend to reduce corruption and may even promote it. Moreover, whatever effect competition has on corruption, it is presumably dwarfed by its well known welfare improving properties. Our results suggest, however, that corruption reduction is not necessarily one of them.

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Table 1. Variables and Sources

Variable	Definition and Source
Source for firm-level variables: World Bank Productivity and Investment Climate Survey, 2002-2005; the survey form is available at World Bank (2002)	
Bribe Tax	Logarithm of one plus the percentage of annual sales paid in bribes as indicated in the answer to the following question: We've heard that establishments are sometimes required to make gifts or informal payments to public officials to "get things done" with regard to customs, taxes, licenses, regulations, services etc. On average, what percent of annual sales value would such expenses cost a typical firm like yours? ____ %
Capacity utilization	Answer to the question: What was this establishment's average capacity utilization over the last year? (in %)
Capital	Dummy variable that has a value of 1 if the firm (establishment) is located in the country's capital and a value of zero otherwise.
Capital-labor Ratio reported by firms	Logarithm of one plus the ratio of the net book value of machinery and equipment (including transport) to the number of employees. The book value is converted from local currency units to the constant 2000 US Dollars using the ratio of the country's GDP in local currency to the country's purchasing power parity GDP in USD.
Capital-labor Ratio of US industries	Logarithm of the 2005 ratio of the industry's capital assets in thousands of 2000 US$ to the number of employees. Calculated from the US Bureau of Labor Statistics Capital Tables (http://www.bls.gov/mfp/mprdload.htm) and the Survey of US Manufacturers (http://factfinder.census.gov/servlet/IBQTable?_bm=y&-ds_name=AM0431GS102).
City size	Logarithm of the population of the city where the firm (establishment) is located. City size is calculated as midpoints of the following intervals: 250,000-1million; 50,000-250,000; less than 50,000 population. Population of 1.5 million was assumed for cities categorized as "Over 1 million population" by the respondents. Population of capital cities was obtained from *World Urbanization Prospects: The 2005 Revision*, United Nations Publications, 2006.
Customer reaction	Answers to the question: If you were to raise your prices of your main product line or main line of services 10% above their current level in the domestic market (after allowing for any inflation) which of the following would best describe the result assuming that your competitors maintained their current prices? (select one of the options below). *1. Our customers would continue to buy from us in the same quantities as now* *2. Our customers would continue to buy from us, but at slightly lower quantities* *3. Our customers would continue to buy from us, but at much lower quantities* *4. Our customers would stop buying from us.*
Employment	Logarithm of the number of firm's employees
Export	The percentage of the firm's sales that are exported directly (as opposed to being exported via a distributor).
Firm Age	Logarithm of the difference between 2006 and the year the firm was established.
Foreign Owned	The percentage of foreign ownership of the firm.
Manufacturing sector	A dummy variable for one of the following 15 broad manufacturing sectors: Textiles, Leather, Garments, Food, Beverages, Metals and machinery, Electronics, Chemicals and pharmaceutics, Wood and furniture, Non-metallic and plastic materials, Paper, Sporting goods, Auto and auto components, Other transport equipment, Other manufacturing
Market share (local and national)	Logarithm of one plus market share determined from answers to the following: a. Within your main product line, what share of the local market in your city or town is made up by the sales of your establishment? ____ %

	b. Within your main product line, what share of the national market is made up by the sales of your establishment? ____ %
Market share (maximum)	The maximum of the above two measures of market share.
Markup	The ratio of the difference between total market value of production and production costs (raw materials, energy, manpower, interest and financial fees, overhead, and "other" costs) to total market value of production. In cases where total market value of production was not reported but total sales were, total sales were used. Markup values lower than -0.1 were replaced by -0.1.
Number of Competitors	Logarithm of one plus the sum of the numbers of domestic private, domestic state, and foreign competitors in the domestic market. In cases where one or two of these three categories of competitors contain missing values, zero competitors is assumed for the respective categories. If all three categories are missing, the variable is coded as missing value. When specific number of competitors is not indicated by the respondent, the number is inferred from the categorical variable that has three intervals for the number of competitors being more than 10 (11-15, 16-20, and more than 21). For the last open-ended interval, 30 competitors is assumed.
State Owned	The percentage of state ownership of the firm.
Countries and years used in our benchmark regressions (number of observations per country)	Algeria, 2002 (63), Bangladesh, 2002 (896), Cambodia, 2003 (9), Chile, 2004 (632), China, 2002 (448), Costa Rica, 2005 (238), Ecuador, 2003 (52), Egypt, 2004 (755), El Salvador, 2003 (279), Eritrea, 2002 (23), Guatemala, 2003 (357), Guyana, 2004 (135), Honduras, 2003 (286), Indonesia, 2003 (513), Kyrgyzstan, 2003 (78), Lithuania, 2004 (29), Madagascar, 2005 (172), Malawi, 2005 (103), Mauritius, 2005 (105), Moldova, 2003 (45), Nicaragua, 2003 (328), Oman, 2003 (41), Pakistan, 2002 (115), Philippines, 2003 (577), Poland, 2003 (60), South Africa, 2003 (455), Sri Lanka, 2004 (351), Tajikistan, 2003 (54), Tanzania, 2003 (80), Turkey, 2005 (620), Uzbekistan, 2003 (69), Vietnam 2005 (703), Zambia, 2002 (57)

Table 2. Summary Statistics

Variables	Mean	Std. Dev.	Min	Max	Observations
Bribe Tax	1.50	4.98	0	100	13,917
Capacity utilization	74.9	21.4	0	100	13,624
Capital	0.335	0.472	0	1	13,917
Capital-labor Ratio (firm)	1,943	31,924	0	1,411,296	6,170
Capital-labor ratio (US; $1000's)	91.9	53.1	32.3	218.1	13,705
City size	1,106,274	1,814,561	1260	1.11e+7	13,917
Customer reaction	2.58	1.07	1	4	8,273
Employment	187.2	584.5	1	19,453	13,917
Export	15.7	30.0	0	100	13,917
Firm Age	21.6	19.4	1	264	13,917
Foreign Owned	9.93	27.3	0	100	13,917
Market share (national)	26.1	30.9	0	100	5,507
Market share (maximum)	30.7	31.4	1	100	5,619
Number of Competitors	103	737	0	40,000	4,871
Markup	0.110	0.234	-0.1	0.999	2,706
State Owned	5.07	20.6	0	100	13,917

Note: Summary statistics are presented for the actual variable values (not their logarithms) for the observations that are used in at least some of the regressions.

Table 3. Pairwise correlations

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Bribe Tax	1.00															
2. Cap. util.	-.072	1.00														
3. Capital	.100	-.028	1.00													
4. K/L (firm)	-.089	.033	-.106	1.00												
5. K/L (US)	-.049	.008	-.018	.155	1.00											
6. City size	-.016	-.057	.305	.027	.081	1.00										
7. Cust. reac.	.005	-.076	-.011	.002	-.010	-.024	1.00									
8. Empl-t	-.004	.079	.041	.059	.056	.021	-.026	1.00								
9. Export	-.003	.084	.040	-.003	-.122	-.086	-.016	.392	1.00							
10. Age	-.081	-.090	-.021	.062	.087	.057	.020	.277	.021	1.00						
11. For. own.	-.024	.057	.012	.051	.063	.029	-.012	.255	.264	-.038	1.00					
12. Market share (nat.)	.052	.084	.116	.101	.195	-.044	-.115	.155	-.053	.097	.043	1.00				
13. Market share (max.)	.054	.076	.096	.091	.149	-.061	-.121	.062	-.107	.078	.016	.907	1.00			
14. Markup	.041	.080	.065	.135	-.058	-.053	-.283	-.027	-.020	-.046	.087	.036	.096	1.00		
15. # Comp.	.108	.051	.147	-.085	-.138	-.170	.035	.077	.076	-.078	-.132	-.206	-.215	.096	1.00	
16. St. own.	-.029	-.045	-.032	.048	.078	.015	-.036	.213	-.015	.207	-.074	.050	.016	-.029	.001	1.00

Note: correlations presented in the above table are among variables actually used in the regressions, including those that were converted into logarithms.

Table 4. Tobit regressions

Dependent variable: *Logarithm of one plus bribe tax*

Variable name	(1)	(2)	(3)	(4)	(5)
Number of competitors	.023 (.015)	-	-	-	-
Market share (national)	-	.049*** (.018)	-	-	-
Market share (maximum)	-	-	.046** (.018)	-	-
Customer reaction	-	-	-	.042** (.018)	-
Markup	-	-	-	. -	-.003 (.230)
Capital city	.087 (.055)	.044 (.058)	.064 (.058)	.172*** (.059)	.593*** (.172)
City size	.032** (.015)	.033* (.018)	.036** (.018)	.022 (.017)	-.047 (.060)
Foreign ownership	-.003*** (.001)	-.002** (.001)	-.002** (.001)	-.001 (.001)	.000 (.002)
State ownership	-.002 (.001)	-.004*** (.001)	-.004*** (.001)	-.005*** (.001)	-.007 (.004)
Employment	.015 (.018)	.025 (.019)	.018 (.019)	-.018 (.015)	.003 (.042)
Exports (direct)	-.001* (.001)	-.001 (.001)	-.001 (.001)	-.001 (.001)	.003 (.002)
Firm age	-.060* (.036)	-.052 (.035)	-.056 (.036)	-.088*** (.032)	-.149** (.069)
Pseudo R-squared	.119	.111	.109	.063	.104
Observations	4706	5334	5446	8142	2706
Left-censored observations	2317	3052	3138	5107	1947

Notes: (1) All regressions use country, year, and manufacturing sector fixed effects;
(2) *, **, *** indicate significance levels of 10%, 5%, and 1%, respectively.

Table 5. Fist stages of GMM instrumental variables regressions for Bribe Tax

1st stage dependent variable →	No. of competitors	Customer reaction	Market share (national)	Market share (maximum)	Markup
Variable name	(1)	(2)	(3)	(4)	(5)
Capital-labor ratio (firm)	-.117*** (.024)	-.050*** (.018)	.089*** (.023)	.093*** (.022)	.006* (.003)
Capacity utilization	-.002 (.001)	-.004*** (.001)	.005*** (.001)	.005*** (.001)	.001*** (.000)
Capital city	.228*** (.081)	.076 (.087)	-.008 (.114)	-.197* (.112)	-.006 (.014)
City size	-.074*** (.023)	.011 (.030)	.106*** (.037)	.061 (.037)	.009** (.004)
Foreign ownership	-.004*** (.001)	.000 (.001)	.002 (.001)	.001 (.001)	-.000 (.000)
State ownership	.005*** (.001)	-.003 (.003)	-.002 (.001)	-.002 (.001)	-.001** (.000)
Employment	-.010 (.038)	.020 (.029)	.153*** (.034)	.106*** (.033)	-.000 (.004)
Exports (direct)	-.001 (.001)	.001 (.001)	-.006*** (.001)	-.008*** (.001)	.000 (.000)
Firm age	.012 (.041)	-.046 (.050)	.147*** (.034)	.135*** (.033)	-.013 (.008)
R-squared	.032	.013	.061	.052	.015
F-stat. for excluded instr. (p-value)	11.8 (.000)	10.1 (.000)	17.6 (.000)	24.5 (.000)	6.8 (.002)
Observations/clusters	3899/126	1629/91	3593/124	3675/125	2105/87

Notes: (1) All regressions use country, year, and manufacturing sector fixed effects and adjust for possible clustering on country and manufacturing sector groups;
(2) Robust (heteroskedasticity adjusted) standard errors of coefficients are in parenthesis;
(3) *, **, *** indicate significance levels of 10%, 5%, and 1%, respectively

Table 6. Second stage GMM instrumental variables regressions for bribe tax
(excluded instruments: firm's capital-labor ratio and capacity utilization)

Dependent variable: *Logarithm of one plus bribe tax*

Variable name	(1)	(2)	(3)	(4)	(5)
Number of competitors	.303*** (.088)	-	-	-	-
Customer reaction	-	.198 (.242)	-	-	-
Market share (national)	-	-	-.332*** (.108)	-	-
Market share (maximum)	-	-	-	-.316*** (.107)	-
Markup	-	-	-	-	-3.30*** (1.23)
Capital city	-.072 (.064)	.058 (.085)	.014 (.066)	-.041 (.072)	.172** (.086)
City size	.041** (.018)	-.005 (.025)	.064** (.026)	.048** (.024)	-.007 (.028)
Foreign ownership	.000 (.001)	-.001 (.001)	-.000 (.001)	-.001 (.001)	-.000 (.001)
State ownership	-.002*** (.001)	-.001 (.002)	-.001** (.000)	-.001** (.000)	-.006*** (.002)
Employment	-.000 (.013)	-.026 (.020)	.045* (.026)	.029 (.022)	-.003 (.019)
Exports (direct)	-.000 (.001)	-.002* (.001)	-.003*** (.001)	-.003*** (.001)	.001 (.001)
Firm age	-.023 (.017)	-.031 (.036)	.017 (.022)	.008 (.020)	-.084** (.038)
Hansen J-statistic (p-value)	.296 (.587)	2.13 (.144)	.241 (.623)	.222 (.637)	.541 (.462)
Observations/clusters	3899/126	1629/91	3593/124	3675/125	2105/87

Notes: (1) All regressions use country, year, and manufacturing sector fixed effects and adjust for possible clustering on country and manufacturing sector groups;
(2) Robust (heteroskedasticity adjusted) standard errors of coefficients are in parenthesis;
(3) *, **, *** indicate significance levels of 10%, 5%, and 1%, respectively

Table 7. Second stages of Tobit instrumental variables regressions for bribe tax (excluded instruments: firm's capital-labor ratios and capacity utilization)

Dependent variable: *Logarithm of one plus bribe tax*

Variable name	(1)	(2)	(3)	(4)	(5)
Number of competitors	.463** (.207)	-	-	-	-
Customer reaction	-	.555 (.561)	-	-	-
Market share (national)	-	-	-.615*** (.231)	-	-
Market share (maximum)	-	-	-	-.588*** (.232)	-
Markup	-	-	-	-	-12.4*** (4.38)
Capital city	-.035 (.112)	.171 (.188)	.090 (.130)	-.008 (.145)	.569** (.288)
City size	.062** (.028)	-.024 (.057)	.115*** (.045)	.087** (.040)	.016 (.116)
Foreign ownership	.000 (.001)	-.001 (.002)	-.001 (.001)	-.002 (.001)	.000 (.000)
State ownership	-.004*** (.001)	-.010 (.007)	-.002** (.001)	-.002** (.001)	-.018** (.009)
Employment	.028 (.024)	.005 (.047)	.126** (.055)	.099** (.047)	.028 (.070)
Exports (direct)	-.001 (.001)	-.003 (.003)	-.005** (.002)	-.006** (.003)	.008** (.003)
Firm age	-.062* (.036)	-.055 (.080)	.015 (.049)	.004 (.048)	-.299** (.140)
Observations/clusters	3899/126	1629/91	3593/124	3675/125	2105/87
Left-censored obs.	1886	902	1986	2051	1620
P-value for Wald exogeneity test	.038	.320	.003	.004	.004

Notes: (1) All regressions use country, year, and manufacturing sector fixed effects and adjust for possible clustering on country and manufacturing sector groups;
(2) Robust (heteroskedasticity adjusted) standard errors of coefficients are in parenthesis;
(3) *, **, *** indicate significance levels of 10%, 5%, and 1%, respectively

Table 8. Fist stages of GMM instrumental variables regressions for Bribe Tax

1st stage dependent variable →	No. of competitors	Customer reaction	Market share (national)	Market share (maximum)	Markup
Variable name	(1)	(2)	(3)	(4)	(5)
Capital-labor ratio (US)	-.3193*** (.087)	-.043* (.023)	.328*** (.060)	.325*** (.057)	.011 (.009)
Capacity utilization	-.001 (.001)	-.005*** (.001)	.004*** (.001)	.004*** (.001)	.001*** (.000)
Capital city	.227*** (.069)	.001 (.041)	-.071 (.096)	-.168* (.097)	-.014 (.014)
City size	-.067*** (.021)	-.010 (.013)	.083** (.034)	.053 (.034)	.010** (.004)
Foreign ownership	-.005*** (.001)	-.000 (.000)	.003** (.001)	.002 (.001)	.000 (.000)
State ownership	.003** (.001)	-.001* (.001)	.000 (.001)	.001 (.001)	-.000 (.000)
Employment	-.009 (.037)	.004 (.010)	.129*** (.027)	.093*** (.026)	-.000 (.000)
Exports (direct)	-.000 (.001)	-.001* (.001)	-.004*** (.001)	-.006*** (.001)	.000 (.000)
Firm age	-.003 (.043)	-.011 (.023)	.146*** (.028)	.124*** (.033)	-.012* (.007)
R-squared	.039	.010	.066	.059	.013
F-stat. for excluded instr. (p-value)	7.4 (.001)	31.5 (.000)	22.4 (.000)	25.9 (.000)	7.0 (.001)
Observations/clusters	4530/144	8050/447	5247/344	5355/345	2561/112

Notes: (1) All regressions use country, year, and manufacturing sector fixed effects and adjust for possible clustering on country and manufacturing sector groups;
(2) Robust (heteroskedasticity adjusted) standard errors of coefficients are in parenthesis;
(3) *, **, *** indicate significance levels of 10%, 5%, and 1%, respectively

Table 9. Second stage GMM instrumental variables regressions for bribe tax
(excluded instruments: US capital-labor ratio and firm's capacity utilization)

Dependent variable: *Logarithm of one plus bribe tax*

Variable name	(1)	(2)	(3)	(4)	(5)
Number of competitors	.101 (.098)	-	-	-	-
Customer reaction	-	.175* (.098)	-	-	-
Market share (national)	-	-	-.095 (.072)	-	-
Market share (maximum)	-	-	-	-.083 (.070)	-
Markup	-	-	-	-	-2.53** (1.03)
Capital city	-.007 (.052)	.059* (.031)	.002 (.042)	-.000 (.043)	.247*** (.070)
City size	.029* (.015)	.011 (.008)	.037** (.015)	.032** (.015)	-.010 (.023)
Foreign ownership	-.001 (.001)	-.000 (.000)	-.001 (.001)	-.001** (.000)	-.000 (.001)
State ownership	-.001 (.001)	-.002*** (.000)	-.002*** (.001)	-.002*** (.001)	-.003** (.001)
Employment	-.011 (.010)	-.019*** (.006)	.010 (.015)	-.014 (.013)	-.011 (.015)
Exports (direct)	-.000 (.001)	-.001 (.000)	-.001* (.001)	-.001* (.001)	.001 (.001)
Firm age	-.016 (.014)	-.036*** (.013)	-.000 (.016)	.006 (.015)	-.072** (.029)
Hansen J-statistic (p-value)	2.58 (.108)	.121 (.728)	5.80 (.016)	5.42 (.020)	2.41 (.121)
Observations/clusters	4530/144	8050/447	5247/344	5355/345	2561/112

Notes: (1) All regressions use country and year fixed effects and adjust for possible clustering on country and manufacturing sector groups;
(2) Robust (heteroskedasticity adjusted) standard errors of coefficients are in parenthesis;
(3) *, **, *** indicate significance levels of 10%, 5%, and 1%, respectively

Table 10. Second stages of Tobit instrumental variables regressions for bribe tax (excluded instruments: US capital-labor ratios and capacity utilization)

Dependent variable: *Logarithm of one plus bribe tax*

Variable name	(1)	(2)	(3)	(4)
Number of competitors	.152 (.179)	-	-	-
Customer reaction	-	.531** (.237)	-	-
Market share (national)	-	-	-.216 (.177)	-
Markup	-	-	-	-8.60** (3.73)
Capital city	.059 (.092)	.171** (.074)	.024 (.083)	.508** (.234)
City size	.043* (.025)	.026 (.022)	.060** (.029)	.032 (.092)
Foreign ownership	-.002 (.001)	-.001 (.001)	-.001 (.001)	.002 (.002)
State ownership	-.002 (.001)	-.005*** (.001)	-.004*** (.002)	-.011* (.006)
Employment	.008 (.019)	-.018 (.017)	.007 (.035)	.017 (.055)
Exports (direct)	-.001 (.001)	-.001 (.001)	-.002 (.002)	.005* (.002)
Firm age	-.061* (.032)	-.088*** (.034)	.021 (.040)	-.254** (.102)
Observations/clusters	4530/144	8050/447	5247/344	2561/112
Left-censored obs.	2238	5037	2993	1883
P-value for Wald exogeneity test	.507	.037	.124	.020

Notes: (1) All regressions use country, year, and manufacturing sector fixed effects and adjust for possible clustering on country and manufacturing sector groups;
(2) Robust (heteroskedasticity adjusted) standard errors of coefficients are in parenthesis;
(3) *, **, *** indicate significance levels of 10%, 5%, and 1%, respectively