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Firm Growth and Corruption:

Empirical Evidence from Vietnam[*]

Jie Bai, Seema Jayachandran, Edmund J. Malesky, and Benjamin A. Olken

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Abstract

This paper tests whether firm growth reduces corruption, using data from over 10,000 Vietnamese firms. We employ instrumental variables based on growth in a firm's industry in other provinces within Vietnam and in China. We find that firm growth reduces bribes as a share of revenues. We propose a mechanism for this effect whereby government officials' decisions about bribes are modulated by inter-jurisdictional competition. This

mechanism also implies that growth reduces bribery more for more mobile firms; consistent with this prediction, we find a larger effect for firms with transferable rights to their land or operations in multiple provinces.

It is a well-known fact that government corruption is higher in poor countries than rich countries. For example, the 10 least corrupt countries according to the 2009 Transparency International Corruption Perceptions Index had an average real (i.e., PPP-adjusted) GDP per capita of $36,700; the 10 most corrupt countries had an average real GDP per capita of $5,100. This pattern is confirmed in surveys of firms. Figure 1 plots the fraction of firms surveyed by the World Bank Enterprise Survey that reported they were expected to give gifts to public officials in order to "get anything done" against real GDP per capita, and shows a clear, downward-sloping relationship.

A less well-known fact is that within countries, smaller firms pay higher bribes as a percentage of income. Figure 2 shows, using the same World Bank Enterprise Survey, that not only overall, but even looking only *within* countries, smaller firms appear to pay higher bribes as a share of revenue. Since firms in poor countries tend to be much smaller on average than firms in richer countries (Tybout, 2000; Hsieh and Olken, 2014), it is possible that the link between firm size and corruption explains part of the association between economic development and corruption.

This paper investigates this potential link between firm growth and reduced corruption, using microdata on around 10,000 firms from Vietnam collected over a six-year period. We begin by testing, at the province-by-industry level, whether firms in indus-

tries with faster employment growth experience faster reductions in the bribe rate (i.e., bribes paid as a share of revenue).[1] Because it is also possible that reduced corruption could cause growth (e.g., Mauro, 1995; Wei, 1999a), we instrument for industry-level growth with average employment growth rates by industry in other provinces of Vietnam or in neighboring China. We find that growth reduces the bribe rate.

We then discuss a potential mechanism based on firm size that may underlie the relationship between growth in an industry and reductions in bribe rates: competition among regional governments to attract and retain firms. For government officials choosing how much to extract from a firm in bribes, what puts a check on bribe extraction is that if the amount is too high, a firm will move elsewhere. The government chooses a percentage of a firm's revenues to extract as bribes, trading off higher bribe income generated by a higher bribe rate against the increase in the firm's incentive to leave.

In such a model, an exogenous increase in firm productivity increases firm size which, in turn, reduces the proportion of firm revenues that are extracted as bribes, as long as moving costs are concave in firm size. With concave moving costs, for a fixed bribe rate, a firm's net benefit of moving (reduced bribes minus moving costs) increases as the firm grows. To offset this greater incentive of firms to move, the government will respond by reducing the proportion of revenues that it extracts as bribes. Our

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[1]Industry growth includes both the intensive margin of firm growth and the extensive margin of firm entry, and it is theoretically possible that growing industries could actually experience declining average firm size. We show in our data, however, that growth in an industry overall indeed leads to growth in firm size: about 53% of the total increase in employment in an industry comes from growth of existing firms.

empirical finding discussed above matches this prediction.

Another prediction of this mechanism, if corrupt officials can price-discriminate among firms (as in, e.g., Svensson (2003)), is that the negative effect of growth on corruption will be heterogeneous, depending on individual firms' abilities to move. Intuitively, if firms are completely tied to one region, then inter-regional competition as a check on the level of bribes vanishes. We show that this intuition also holds for how *growth* affects bribes: Economic growth reduces corruption by a greater amount if firms are more able to move elsewhere.

We test for the predicted heterogeneous patterns in our Vietnamese data. We argue that Vietnam is a natural setting to test the predictions, given that virtually all business-government interactions occur at the provincial, rather than national, level, so competition between provinces may be at play. To capture heterogeneity in moving costs, we use variation in whether firms possess a Land Use Rights Certificate, which gives them secure and transferable property rights over their land. These property rights make firms more mobile, since they increase their ability to sell their land and relocate should they wish to do so.[2] We test whether having more secure and transferable property rights enhances the negative effect of growth on corruption and find that it indeed does. When a firm owns the plot of land on which it operates and has official permits for that land—so that it is presumably more mobile—economic growth has a stronger negative effect on bribes. These results are robust to controlling for a

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[2]Several recent papers have documented an analogous positive effect of property rights over land on migration for individuals, showing that land titling in Mexico increased both domestic (de Janvry *et al.*, 2012) and international (Valsecchi, 2011) migration.

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propensity score that predicts having land use permits as a function of a variety of other firm characteristics.

We also find similar patterns using a second measure of mobility: having operations in multiple provinces. Firms with a presence in multiple provinces can more easily scale back operations in one province and shift elsewhere where they might be subject to less corruption. Thus, economic growth should put more downward pressure on bribes for this group. We find empirical support for this prediction as well.

While the data are consistent with the inter-jurisdictional competition mechanism, it is by no means the only potential mechanism for the negative effect of growth on bribery. We discuss several alternative models, such as a fixed cost of anti-corruption efforts or changes in industry concentration associated with the employment shock. A key differentiating factor is that these other models do not generally explain the fact that the responsiveness of bribes to shocks is stronger for firms that appear more mobile. While no other model seems able to explain the complete set of facts we find — so the mechanism we propose is likely at play — other mechanisms no doubt also contribute to the overall effect of growth on bribery that we estimate empirically.

This paper builds on several strands of the literature. While many papers starting with Mauro (1995) argue that corruption impedes growth, there is much less work on the reverse direction, namely the idea that corruption may subside as countries grow (notable exceptions include Treisman (2000) and Gundlach and Paldam (2009)). This paper provides micro-evidence along these lines, along with suggestive evidence of one potential channel. Our model of inter-jurisdictional competition builds on the

analysis of the problem of local governments setting tax rates (Epple and Zelenitz, 1981; Epple and Romer, 1991; Wilson, 1986), and in the corruption context, the idea that competition can reduce bribe rates (Shleifer and Vishny, 1993; Burgess *et al.*, 2012). In particular, our model is most directly related to the hypothesis advanced by Menes (2006), who noted in her qualitative study of US cities that the ability of firms to relocate to other jurisdictions was one potential reason why urban corruption in the pre-Progressive era was not more severe.

The remainder of the paper is organised as follows. Section 1 describes our data and background information on Vietnam. Section 2 describes the empirical strategy, and section 3 presents the results on the overall effect of growth on bribery. Section 4 discusses verbally how inter-jurisdictional competition could generate the pattern documented in section 3 and further predicts that the growth-bribery effect varies with a firm's mobility. Section 5 empirically tests the additional prediction and discusses alternative mechanisms through which growth could affect bribery. Section 6 concludes. The formal theoretical model and robustness checks are available in an online appendix.

1   Setting and data

1.1   Background on Vietnam

Vietnam provides a unique opportunity to study the effect of firm growth on bribery and how competition among subnational governments to attract firms affects bribery.

In 1986 Vietnam initiated the *Doi Moi* (Renovation) economic reforms, which eliminated the role of central planning in the economy and opened its borders to international capital and trade flows (Riedel and Turley, 1999). Since that time, the country has achieved an average annual growth rate of 7%, ranking it among the very fastest growing countries in the world over the period. Today, there are well over 350,000 private companies in Vietnam, operating in a range of sectors from food processing and light manufacturing to sophisticated financial services.

The amount of corruption remains substantial in Vietnam. Most international perceptions-based indices put Vietnam around the 30th percentile of corruption (where lower is more corrupt). Similarly, Transparency International's Global Corruption Barometer reports that 44% of Vietnamese report paying a bribe in 2011 (Transparency International, 2011).

Existing research has noted that corruption in Vietnam takes three main forms: grease or speed money to fulfil basic tasks or services; the illegal privatization of state property; and the selling of state power (Vasavakul, 2008). While all are undoubtedly important, the first is the most directly observable and is the focus of our paper. The key recipients are the traffic police, land cadres, customs officers, and tax authorities." These same offices were highlighted as the most corrupt in an internal study prepared by the Party's Internal Affairs Committee (Central Committee of Internal Affairs, 2005). Gueorguiev and Malesky (2011) document that the same types of bribes are common for firms, finding that 23% of businesses paid bribes to expedite business registration, 35% paid bribes when competing for government procurement contracts, and 70% paid

bribes during customs procedures. Firms in Vietnam appear to accept these payments as part of the cost of doing business (Rand and Tarp, 2012).

An important institutional feature of Vietnam is that corruption is largely subnational. Via a series of laws in the early 1990s, most business-government interactions were decentralised to the provincial level, including business registration, environmental and safety inspections, labor oversight, local government procurement, and land allocation. Provincial departments of line ministries are "dual subordinate," meaning they report both to the provincial executive (the People's Committee Chairman, or PCOM), as well as the relevant national line ministry. In practice, however, appointments of department directors and budget allocations are set by the PCOM, closely aligning department interests with those of the province. Moreover, proximity matters. The PCOM interacts with department directors regularly, while the line ministries are hundreds of kilometers away in Hanoi. As a result, many studies have documented that the provincial government, more than the central government, is the relevant level of government when thinking about the institutional climate facing firms, including the degree of bribe extraction (Meyer and Nguyen, 2005; Tran *et al.*, 2009; Malesky, 2008). Formal taxation is a notable exception; taxes on firms are determined at the national, not provincial level.

Importantly, the powers of the provincial leadership over subordinate departments and subprovincial governments (district and commune) also mean that corruption is relatively centralised within individual provinces. The provincial leadership has the ability to control the bribe schedule of the province both directly and indirectly. Provincial

leaders can punish corrupt subordinates with jail time or revoke their party membership. They can also reduce the incentive for subordinates to bribe by changing their own behaviour, such as lowering their own cut of each activity, or not insisting on bribes by subordinates for appointment to provincial government positions (which increases the motivation and need for the subordinate to take money). More indirectly, they can control the bribes extracted by subordinates through policy changes that reduce opportunities for bribes, such as reducing the number of required certificates and regulatory inspections, formalising specific waiting periods for documents, and increasing transparency about the responsibilities of subordinate officials to businesses and citizens. Indeed, one of the incentives to create the Provincial Competitiveness Index (PCI) survey in the first place was to measure these differences in governance that affect corruption and thereby motivate provincial leaders to reform their activities (Malesky, 2008, 2011).

As with all measures of governance in Vietnam, there is a high degree of subnational variation in firms' responses about corruption in the data we use. Figure 3 shows the distribution across provinces of the average response by firms for two corruption questions from the PCI survey in 2011, the last year of our sample period. In the worst-scoring province, 79% of private firms reported that firms in their line of business were subject to bribe requests. In the best-scoring province, a substantially smaller 21% claimed such activities were common. Similarly, high inter-provincial variation is observed for the share of revenue paid in bribes by firms, the main dependent variable in our analysis. In 2010, 37.5% of firms in the most corrupt province said bribe payments

exceeded 2% of their annual revenue, compared to 5.5% in the lowest province.

1.2 Description of Data

To examine the effect of growth on corruption, we use two firm-level data sets, the Vietnam PCI Survey (Malesky, 2011), and the annual enterprise survey collected by the General Statistics Office (GSO) of Vietnam, henceforth referred to as the PCI and GSO data, respectively. For each data set, we have five years of repeated cross-sectional firm-level data from 2006 to 2010. We also use aggregate employment data at the industry-year for 2006 to 2010 from the Chinese Yearbook of Labor Statistics.[3]

The PCI survey is a comprehensive governance survey of formal sector firms across Vietnam's 63 provinces. The PCI (as well as the GSO) regard formal firms as those with an official registration certificate from their provincial Department of Planning and Investment, thereby excluding household operations without such documentation. The PCI survey team randomly sampled from a list of at least partly private companies with a tax code provided by the province's tax authority. Stratification was based on firm size, age, and broad sector (agriculture, services, construction and industry) in order to accurately reflect the population of firms in each province. The PCI survey contains basic firm-level information, including the firm's ISIC 2 digit industry code, location (province), year of establishment, total assets, and total employment.

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[3]The PCI survey is conducted in the early part of each calendar year (March-June). Information about firms' business and operations refer to the previous calendar year. For variables regarding bribe payment, it is reasonable to think that firms are also reporting based on the past year. We therefore lag the PCI survey by one year before merging with the GSO or Chinese Yearbook data. The 2006 to 2010 timeframe thus corresponds to the PCI surveys conducted in early 2007 through early 2011.

What makes the PCI survey well-suited for our study is that it has a module on corruption and red tape faced by the firm. The most relevant question that matches our theoretical predictions is the amount of unofficial payments to public officials the firm makes, expressed as a percentage of its revenue. To the best of our knowledge, this data set is the only frequently repeated cross-section of firms' corruption experiences that is representative at the sub-national level in the developing world.

For our analysis, we merge the PCI firms with aggregate employment information constructed from the GSO survey at the industry-province-year level.[4] For industry, we use the ISIC alphabetical category. The GSO data also include all formal sector firms in Vietnam, both private and state-owned. We restrict our sample to private firms in order to match the PCI sample. The sampling strategy for small size firms (firms with fewer than 10 employees) for the GSO survey varies from year to year. Therefore, to ensure that we have a consistent and well-defined measure for a province-industry's economic conditions in a given year, we exclude the small firms with fewer than 10 employees when constructing the industry-province-year employment and before merging with the PCI. Panel A of Table 1 presents summary statistics for all the merged firms in the PCI data. For our main analysis, we restrict the PCI sample to firms with 10 or more employees reported for the previous year in order to match the GSO sample. We used lagged employment since it is determined prior to our bribe measure.[5] Our final

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[4]In Appendix B, we describe the cross validation procedure we use to assess the matching between the two datasets. The results, shown in Table A1, are reassuring: PCI firms are a reasonably representative sample of firms in the GSO data and the industry codes we merge on are comparable across the two data sets.

[5]Current and lagged employment have a correlation coefficient of 0.96. We impute lagged employment with current employment for firms with missing lagged employment (except for new firms).

analysis data set contains 10,901 firms that meet this sample inclusion criterion. Panel B of Table 1 reports the summary statistics for the final analysis sample. Results on the full sample of firms are presented in Appendix A.

The key dependent variable is constructed from the PCI question that asks the firm its unofficial payments as a percentage of total revenue. The question is categorical, with the following possible responses: $0, < 1\%, 1 - 2\%, 2 - 10\%, 10 - 20\%, 20 - 30\%, > 30\%$. Figure 4 shows the histogram of this variable. We transform the variable into a scalar by assigning each response the middle of the corresponding bin, using 0.5% for the $< 1\%$ category and 35% for the $> 30\%$ category. The mean of this variable is 3.4%. While this may seem small, recall that this is a percentage of revenues, not profits. If firms averaged 10% net profit margins, for example, this would be the same magnitude as a 34% profit tax. (In the empirical section below, we also consider an alternative specification using ordered probit models that allows the model to determine appropriate breakpoints; results are similar).

The PCI requires general managers or owners to complete and mail in the survey, although there is no way to formally guarantee that the task was not delegated to a subordinate. Over 65% of respondents list their position as CEO, Director, or Owner, suggesting that the respondents would generally be in a position to know about bribe-payments, and that delegation is not a major threat to our analysis.

The median firm in our final sample has been in business for four years and has between 10 and 49 employees, which is nearly identical to the GSO census aggregates.[6]

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[6]We use the GSO fine-grained data on employment to impute the mean and median employment

Figure 5 shows the relationship between the bribe rate and firm size in our sample. Larger firms appear to be paying a smaller percentage of their revenues in bribes. (Larger firms might still pay a larger amount per firm in bribes, but the relevant metric for gauging the size of the distortion – and the prediction in the theoretical model discussed below – is the bribe rate.)

In addition to corruption activities, the PCI also has variables related to the firm's property rights status that we use to measure the firm's mobility, such as whether the firm owns the land that it occupies and whether the firm has a Land Use Rights Certificate. We will describe these variables in more detail when we discuss the empirical results. The second proxy for mobility we have in the data is whether the firm operates in multiple provinces. While the majority of firms are wholly located in one province, multi-province firms are reasonably common, with 31.4% having operations in provinces besides their main location.

Table 1 also summarises several control variables we use, including the proportion of registration documents the firm has (a proxy for a firm's general propensity to complete formal paperwork), whether the firm was formerly a household firm, whether it is a former state-owned enterprise, whether the owner is a government official, and whether the government has an ownership stake in the firm.

Our empirical strategy uses aggregate shocks to a firm's industry size in other provinces of Vietnam, or in China, to predict firm growth in a given province and

level within the PCI ranges. The median size of firms in the GSO that are between 10 and 49 employees is 19 employees.

industry. In the final merged data set, we have 18 distinct industry categories (see Table A2 for a description of the industries). The main GSO variable we use in the analysis is the log of aggregate employment in the industry-province-year, which is also summarised in Table 1.

To construct our China-based instruments, we use the China Labor Statistical Yearbook to calculate industry-year specific total employment in China. The Yearbooks report the number of employed persons by industry, including employment in state-owned enterprises (SOEs), collectives, foreign joint ventures, and private firms/individual workers in urban areas. Note that industry-level employment data is not available for rural areas during this period. Industry codes are based on the Chinese GuoBiao (national code) system, and are broadly consistent with the broad alphabetical code in ISIC Revision 4.

2   Empirical strategy

The hypothesis we aim to test is that firm growth has a negative effect on bribes, or more specifically, bribes as a percentage of the firm's revenues ($Bribes$). Suppose we had a measure of firm productivity A_{ipjt} for firm i in industry i in a particular province, p, and time, t. One could in principle test the hypothesis via OLS as follows:

$$Bribes_{ipjt} = \alpha + \beta A_{ipjt} + \epsilon_{ipjt} \tag{1}$$

The dependent variable is the amount that firm i paid in bribes as a percentage of its revenue in year t. The prediction is that β in Equation (1) is negative, so that on average productivity growth reduces bribes.

There are two issues with estimating Equation (1) directly. The first is a data problem: we do not directly observe TFP or output prices in the data, so, empirically, we use total employment in the province-industry-time cell ($Employ_{pjt}$) as a proxy.[7] Under the assumption that factor prices are constant, changes in employment reflect changes in A (this is true, for example, in the model we present in Appendix C), so to the extent we can find a measure of employment that is exogenous with respect to the bribe rate b, we can replace A with $Employ$ and test the same predictions. The exogenous variation in $Employ$ available in our setting is at the industry-province-year level, rather than the firm level.

Our independent variable is *aggregate* employment growth in a given industry-province-year cell, rather than firm size. Whether aggregate growth is driven by growth in firm size is an empirical matter; changes in $Employ_{pjt}$ could be driven by entry, or by growth in existing firms, or some combination. For our IV strategy using Chinese data (described below), only aggregate employment data are available, so we are not able to calculate average firm size. However, we can decompose aggregate growth with the Vietnam firm-level data, and we find that there is correlated growth along both margins: Predicted total employment is highly correlated with both average firm size in

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[7]The reason we cannot calculate TFP directly is that we do not have reliable measures of revenue, capital stock, and wages in our data.

the GSO data and the number of firms. Specifically, if we regress log mean employment and log total number of firms in province-industry-year group on employment in the rest of Vietnam $\log(Employ_{p-jt})$, controlling for province-industry and year fixed effects (which is the setup for our first IV strategy described below), the coefficients are 0.341 and 0.301 respectively; both are significant at the 1% level. Mathematically, the sum of the two coefficients is equal to the coefficient when regressing the endogenous variable, log total employment in the province-industry-year group, on $\log(Employ_{p-jt})$. Hence, the ratio of each of the two coefficients to their sum tells us how much a shock to $\log(Employ_{p-jt})$ affects the intensive versus extensive margin. In our setting, about 53% of employment growth (=0.341/0.642) is on the intensive margin. An important point to keep in mind is that, while our theoretical predictions and interpretation of the empirical results focus on the intensive margin, i.e. firm growth, our empirical results are not able to distinguish between these two margins.

Once we have *Employ* as a proxy for industry-level productivity growth, a second issue remains which is that employment levels are potentially endogenous to the bribe level b. Thus, we estimate Equation (1) via two IV strategies, as described below.

2.1   Rest-of-Vietnam IV

The first instrumental variable strategy we use is employment in the firm's industry in Vietnamese provinces other than its own, controlling for common national year fixed effects and province-by-industry fixed effects. The IV strategy is predicated

on industry-specific employment (or TFP) shocks in an industry being similar across provinces (i.e., on there being a strong first stage). For example, for an industry that supplies to the world market, an increase in output prices would correspond to an increase in A_{ijt}.

A key identification assumption is that industry-specific bribe-setting is determined independently by each province. In particular, we are ruling out a large-scale national crackdown on corruption specific to an industry in a given year, which would violate this assumption (note that a national crackdown across all industries would be absorbed by year effects and would not be a problem for our identification strategy; likewise, different average levels of corruption in different regions or industries would be absorbed in region-by-industry fixed effects and would not be a problem). The assumption matches the institutional context of corruption in Vietnam as discussed in Section 2.1 in which corruption is largely a provincial matter.

Our first stage specification using the leave-one-out Vietnam IV is as follows:

$$\log(Employ_{pjt}) = \alpha + \beta \log(Employ_{p^-jt}) + \nu_{pj} + \mu_t + \epsilon_{pjt}. \tag{2}$$

The outcome variable, $\log(Employ_{pjt})$, is log total employment for industry j in year t in province p. The variable $\log(Employ_{p^-jt})$ is log total employment for firms in industry j and year t in all provinces other than p. We control for province-industry (pj) and year (t) fixed effects, so the specification is capturing differential changes in employment across industries over time, netting out common national time trends and

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different average levels by province-industry cell.

The corresponding second stage equation is:

$$Bribes_{ipjt} = \alpha' + \beta'\log(\widehat{Employ}_{pjt}) + \nu'_{pj} + \mu'_t + \epsilon'_{ipjt}. \tag{3}$$

The IV varies at the industry-province-year level but we implement two-way clustering at the province and industry-year level to correct for possibly correlated errors across time and industry and because most of the variation in the IV (and all of the variation in the case of our China IV) is at the industry-year level.

2.2 China IV

One concern with the rest-of-Vietnam IV is that it could be correlated with common industry-year specific shocks that affect both firm growth and bribe payments, such as a time-specific national regulatory change or a national industry-specific crackdown on corruption. These could be either for exogenous reasons, or potentially an endogenous response of one province to another (as in the model we present in Appendix C), in which firms best-respond to one another's bribe policy). Thus, we also implement a second identification strategy using growth rates from outside of Vietnam that is not as subject to these concerns.

For our second IV strategy, instead of instrumenting for Vietnamese employment in a particular industry in a particular province with employment in other provinces of Vietnam, we instrument using employment in China. The idea is that many indus-

tries in Vietnam and China are subject to the same global business cycles and price and technology shocks, and hence industry-level growth is correlated across the two countries. But, because China is so much larger than Vietnam, it is unlikely that there would be reverse causation where changes in a particular industry's corruption level in Vietnam would substantially affect employment growth in China.

Specifically, we estimate the following first-stage regression:

$$\log(Employ_{pjt}) = \alpha + \beta \log(EmployChina_{jt}) + \nu_{pj} + \mu_t + \epsilon_{pjt}, \qquad (4)$$

where we again include province-industry and year fixed effects and cluster at the province and industry-year level.

2.3   Multiple IVs

The first stage equations described above constrain the effect of a shock to A or $Employ$ in the rest of Vietnam to be the same across industries, and, similarly, the effect of a shock to an industry in China on Vietnamese firms to be the same across industries. In principle, some industries can have positively correlated growth rates between provinces in Vietnam or between China and Vietnam (say, due to common worldwide demand shocks), and some industries can have negatively correlated growth rates (say, because provinces or the two countries compete for a fixed amount of global business). Thus, we also allow the first stage coefficients to vary by industry. The first stage allowing

for different β's for each industry j is as follows for the China case:

$$\log(Employ_{pjt}) = \alpha + \beta_j \log(EmployChina_{jt}) + \nu_{pj} + \mu_t + \epsilon_{pjt}. \tag{5}$$

Allowing the first stage coefficient to vary by industry is equivalent to having one instrument per industry, e.g., $\log(EmployChina_{jt})$ interacted with an industry dummy. The multiple-IV specification for the rest-of-Vietnam approach is analogous.

In practice, for the rest-of-Vietnam IV strategy, the constraint of a uniform β across industries is reasonable, and the single IV has more precision. For China, the multiple IV first stage fits the data better and yields more precise results.

In the next section, we present our results on the effect of growth on bribery, using both the rest of Vietnam and China approaches, and using both a single and multiple instruments.

3   Results

This section presents evidence that a positive shock to aggregate productivity decreases unofficial payments by firms.

3.1   First Stage Results

To estimate the first stage regressions, we use the GSO data and compute total employment for each pjt (province-industry-year) cell. For the within-Vietnam IV, the

instrument also uses the GSO data and is aggregated at the p^-jt level. For the China IV, the Chinese Yearbook is used and the data vary at the jt level. For industries, we classify firms into their alphabetical ISIC code (18 industries in total).[8] Each observation in the first-stage regressions we present is a pjt combination.

We report the first stage results from estimating Equations (2) and (4) in Table 2. We report standard errors with two-way clustering at the province and industry-year level throughout. As seen in column 1, the first stage coefficient is positive and significant at the 1% level using the within-Vietnam IV; the F-statistic is 26.9. The coefficient on $\log(Employ_{p^-jt})$ is 0.642. This means that for a 10% increase in total employment in other provinces for industry j in year t, there is a 6.42% increase in one's own province. Theoretically, if the aggregate shock propagates to all regions equally, we should observe a coefficient of 1; the coefficient of 0.642 suggests that much but not all of the temporal variation in productivity in Vietnam is aggregate to an industry.

Column 2 shows the first stage for the China IV. The first stage coefficient is remarkably similar at 0.622. The coefficient is significant at the 5% level, but the standard error is substantially larger than for the Vietnam IV, which is not surprising because provinces in Vietnam might be more likely to supply the same markets and thus respond to the same demand shocks, merging between data sets is more prone to error with the China approach because the Chinese industry codes differ slightly from the Vietnamese ones, and the composition of firms in the Chinese data is somewhat

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[8]We have an equally strong first stage using the finer two-digit ISIC codes, but the broader alphabetical codes are more robust to differences in classification across the GSO and PCI data sets, and for the Chinese data, the data are aggregated at the coarser level.

different (e.g., it comprises only urban firms). The F-statistic is 3.89. Because of this low (for an instrument) F-statistic, we focus more on the multiple-IV variant when using the China IV strategy, because it has a stronger first stage.

The multiple-IV first stages for both Vietnam and China are reported in Table A3.[9] The F-statistics for the set of instruments are 7.99 using Vietnam and 8.37 using China. For Vietnam, the single IV gives a stronger first stage, while with China, the multiple-IV approach gives a stronger first stage. We report the results for all four permutations, which yield similar second-stage results, but in the discussion, we focus mostly on the single-IV Vietnam results and multiple-IV China results.

3.2   Effect of Employment Growth on Bribes

The IV results are shown in Table 3. The top panel presents the within-Vietnam instrument and the bottom panel, the China instrument. All specifications control for province-industry and year fixed effects, and standard errors are clustered at the province and industry-year levels.

Starting with the top panel, column 1 uses the single instrument and has a coefficient of -1.704, which is significant at the 5% level. Growth in firm employment leads to a drop in the rate of bribe extraction from firms. The coefficient magnitude

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[9]The positive first-stage coefficients for transportation and storage, information and communication, financial and insurance activities, real estate, professional and scientific activities, education, health, and administration could reflect global business cycles, common interest rate shocks, and synchronicity in public service provision.

The negative first-stage coefficient for mining and quarrying is surprising but could result from inter-regional competition for global demand, which outweighs the effect of common global market shocks.

suggests that a 10% increase in a firm's employment level leads to a 0.18 percentage point decline in the bribe rate. Column 2 uses multiple IVs (one per industry) and finds a similar result.

Panel A, columns 3 and 4 report the reduced form results. Our outcome variable, which measures the degree of corruption firms face, is the unofficial payments as a percentage of revenue. As discussed above, it is a categorical variable, which we linearise by using the middle of each category. We estimate two versions of the reduced form estimate, one using the linearised variable and one using an ordered probit specification that allows the regression to determine the precise cardinalization of each of the categories. The results in column 3 show that the coefficient for $\log(Employ_{p^-jt})$ is -1.203, and significant at the 5% level. Column 4 reports the results from an ordered probit specification. The coefficient is again negative and significant at the 5% level. The ordered probit results suggest that the negative relationship shown is not merely driven by the linear functional form.

To interpret magnitudes, note that column 1 implies that a doubling of total employment in the industry is associated with a 1.2 percentage point reduction in informal payments, or about 35% of the mean level. Translated into an elasticity, this suggests an elasticity of the informal payment rate (i.e., the share of revenues devoted to informal payments) with respect to predicted firm size of about -0.5. Since this elasticity is substantially less than 1 in absolute value, it implies that while the share of firm revenues paid in bribes declines as A increases, total unofficial payments, which is the bribe rate multiplied by revenues, increase. While the bribe rate is the key parameter

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that determines aggregate distortions due to corruption, it is worth noting that given this elasticity, the amount of corruption in absolute dollar terms actually increases even though the rate does not.

The fact the estimates imply that bribes as a percentage of revenue fall, but that the total magnitude of bribes rises, suggests that bribes are indeed responding to changes in firm size – we can reject both the null that bribes are constant in levels (i.e. each firm pays a fixed bribe regardless of size), and also the null that bribes as a percentage of revenue are constant or reported to be constant (i.e. bribes as a share of revenue is falling). The fact that bribes as a share of revenue falls, but the absolute level of bribes rises, is consistent with the theoretical model presented in Appendix C and discussed briefly in section 4.

The results in Panel B using the China instrument are similar to the those in Panel A, though as discussed above, the single-instrument version of the Chinese IV version is less precisely estimated. The single-IV estimate, reported in column 1, is -1.509, similar in magnitude to the within-Vietnam analogue, though the coefficient is not statistically significant. Column 2 of Panel B uses multiple IVs, and the coefficient is -1.149 and significant at the 5% level. Both the point estimate and precision are remarkably similar across the Vietnam and China specifications.

The point estimate for China of -1.149 in column 2 implies that a 10% increase in employment leads to -0.115 percentage point decline in bribe rate, or a doubling of employment leads to 0.8 percentage point decrease in the bribe rate, which is 23.5% of the mean level. The implied elasticity of the informal payment rate with respect to

predicted firm size is -0.34, similar though slightly smaller than the elasticity of -0.5 we estimate using the single within-Vietnam IV. The reduced form OLS and ordered probit results reported in column 3 and 4 are negative but insignificant.

To recap, across our different IV specifications—using industry employment elsewhere in Vietnam, or alternatively industry employment in China as predictors of firm size—we find that growth has a negative effect on the degree of government officials' bribe extraction from firms.

4   Inter-jurisdictional competition as a mechanism

One mechanism that could generate the finding in the previous section is competition among jurisdictions to retain or attract firms. Consider a model in which governments choose how much to extract from firms to maximise their bribe revenue. We develop and solve such a model, and it generates the prediction that bribes as a fraction of revenues decrease with firm growth under reasonable assumptions. This model is not the only explanation for the empirical fact presented in the previous section, but is one possible explanation. Moreover, the model has other testable predictions which we will investigate empirically in the next section.

The full model is available in Appendix C, but here we describe the intuition and results in a bit more detail. The government in each province sets a bribe rate, which is the percentage of a firm's revenues that it must pay in bribes. Next, firms in each province choose whether to stay in the province or relocate to the other province.

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Finally, firms choose their factors of production, they produce, and the government collects bribes.

The firm will choose to stay in its current province if and only if profits there are greater than its profits in a new province, less moving costs. One can consider shocks to productivity that generate firm growth. With a positive shock to firm productivity and hence firm size, if moving costs scale up less than one-for-one with firm size, then firm growth will lead to a decrease in the equilibrium bribe rate (Prediction 1). When a firm grows, a given bribe rate imposes a larger cost on the firm, making it more prone to leave for a lower-corruption locale. This force drives down the equilibrium bribe rate due to inter-regional competition. However, at the same time, the cost of moving rises as firms expand in size to take advantage of the higher productivity. This instead drives up the equilibrium bribe rate. If moving costs do not scale up too steeply, then the first effect dominates and growth decreases the bribe rate.

In practice, there are likely some fixed costs of moving, so it seems reasonable that total moving costs are indeed concave in firm size. Prediction 1 then matches the key result of the paper shown in the previous section.

It is worth noting that another prediction is that the *total amount of bribes* extracted from the firm will increase with a positive productivity shock. To see this, note that the firm's moving decision is a tradeoff between its total moving costs and its total bribes. When a firm grows, the firm's moving costs increase, and thus the government can retain the same firms even with a higher total bribe extraction. This prediction also holds in the data, as discussed in the previous section.

Next, we consider how the effect of a productivity shock on bribes varies across firms with different observable-to-the-bureaucrat moving costs. We will focus on the firm's property right status or multi-province operations as determinants of its moving costs in the empirical analysis in the next section. The model prediction is that the bribe rate falls more after a positive shock to productivity for firms with low observable moving costs (Prediction 2). The intuition is that the fraction of such firms who are on the margin of moving is larger, so a given change in bribes will induce a larger number of them to leave.

Before turning to the empirical test of Prediction 2, it is worth noting the analogy between bribes and taxes. For firms, a bribe is an additional payment to government, analogous to a tax. Our model is therefore similar to models of inter-regional tax competition. The key distinction of our results compared to the previous literature is that we focus not just on the equilibrium level of taxes/bribes, but also examine how the level of bribes changes with productivity shocks. It is this comparative static that generates predictions about how growth affects the amount of corruption in the economy. Our result on how the relationship between productivity shocks and the equilibrium bribe rate varies based on the firm's ease of relocating to another jurisdiction is also novel in the literature, to the best of our knowledge.

Also worth noting is that to the extent that taxes follow similar patterns to bribes, another implication of the model is that taxes on firms should also be lower in rich countries than in poor countries. There is suggestive evidence along these lines: Gordon and Li (2009) show that for poor countries (with per-capita GDP below $745), corpo-

rate income taxes represent 7.5% of GDP, whereas for rich countries (with per-capita GDP above $9,200), corporate income taxes represent only 4.5% of GDP, although they suggest a different explanation than the one proposed here.

Finally, we discuss the exclusion restriction of our two instrumental variable strategies in light of the model. Results 1 and 2 consider the effect of a *common* shock to all jurisdictions (provinces). To the extent that the rest-of-Vietnam employment (summed across all other regions) reflects the common component, it is a valid instrument for testing the effect of an aggregate shock (i.e., the two predictions of the model). However, the rest-of-Vietnam instrument could also reflect shocks idiosyncratic to all other provinces, but not a province itself. One could imagine that shocks to other provinces can affect the bribe setting in a province (if that information is public), with officials reacting to the changed desirability of other provinces. This is particularly so for shocks to places where firms are likely to move to. Conversely, a shock to bribes in one province could affect employment in other provinces through firm relocation. Either of these channels would be a problem for the excludability of employment in other provinces as an instrument for employment in province i in equation (3).

To address this concern, we perform an additional robustness check by constructing the rest-of-Vietnam IV using total employment in the same industry in other *regions* instead of other *provinces*. To the extent that firms are more likely to move within their own region, this additional analysis helps to alleviate the concern of the above-mentioned bribe setting responses which would violate the exclusion restriction–provincial governments are less likely to respond to idiosyncratic shocks in other regions

since incumbent firms are less likely move there; therefore the alternative instrumental variable strategy seeks to capture the effect of aggregate industry-year shocks which affect the equilibrium bribe rate as in our model. The result shown in Table A7 is qualitatively similar to Table 3.[10] Moreover, as long as firms are less mobile across national boundaries, which seems highly plausible, the China instrumental variable strategy also helps to address these concerns.

5 Heterogeneous effects by firms' moving costs

We presented evidence in section 3 that economic growth (specifically, an increase in firm employment) reduces the rate of bribe extraction. The inter-jurisdictional competition idea described in the previous section generates this prediction, but is not the only explanation for why an increase in employment reduces bribes. For example, it is possible that bureaucrats simply have diminishing marginal utility of income relative to the risk of being caught and going to jail, so that as it becomes easier to extract revenues, they reduce rates. However, a key prediction of inter-jurisdictional competition, as opposed to potential alternative explanations, is that the effect of an increase in firm productivity on the bribe rate should be greater in magnitude when firms are

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[10]We also investigated the extent to which these results would still hold even with mild violations of the exclusion restriction, using the 'plausibly exogenous' methodology of Conley *et al.* (2012), in which they allow the instrument Z to affect the outcome directly through the equation $Y = X\beta + Z\gamma + \epsilon$ for a range of γ values. The results are reported in Table A8. We find that the IV estimates of the effect of firm growth on bribes remain negative even if we allow for reasonably sized violations of the exclusion restriction (i.e. up to γ as large as β.)

more mobile. [11]

We test that prediction with the following estimating equation:

$$Bribes_{ipjt} = \alpha + \beta A_{ipjt} + \gamma A_{ipjt} \times MovingCost_{ipjt} + \delta MovingCost_{ipjt} + \nu_{pj} + \mu_t + \epsilon_{ipjt} \quad (6)$$

The prediction is that γ in Equation (6) is positive, so that the reduction in bribes as firm growth increases is smaller for firms with higher moving costs. Again, we estimate the equation using both of our IV strategies.

As measures of $MovingCost$, we use two firm characteristics. First, we use variation across firms in their property rights over the land they operate on, and, second, we use variation in whether the firm is based in one province or multiple provinces.

5.1 Property Rights

In Vietnam, firms can have three types of tenure over the land on which they operate: renting, owning the land with official land use rights, and owning the land without official land use rights.[12] Specifically, for firms that have purchased their land, they may or may not have a land use rights certificate (LURC). Firms, intending to strengthen their property rights, submit the LURC application and related documents, such as map of the area and business plan, to the provincial Land Use Right Registration Of-

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[11]The idea that firms that are less mobile are treated differently by local officials in Vietnam is consistent with Rand and Tarp (2012), who show using different data that firms that appear less mobile pay higher bribes.

[12]Note that while we use the term "own," the more precise term would be "purchased" since in Vietnam, firms can purchase land, but in a technical sense, the state still owns all of the land.

fice. Conditional on having purchased land, having an LURC makes it easier for the firm to move, because the firm can sell or trade its certificate if it decides to relocate to another province, whereas land without an LURC can easily be expropriated by local authorities (Kim, 2004; Do and Iyer, 2003), making it harder to sell.

It is not ex ante obvious whether firms that rent face higher or lower relocation costs than those that own. For example, renters cannot recoup the value of any improvements they made to the property and may be locked into hard-to-renegotiate long-term leases, but they do not face transaction costs from having to sell property. What is clear though is that conditional on owning, transaction costs are lower for those with an LURC. We therefore examine heterogeneity across these different levels of moving costs: firms that rent land versus purchase land, and conditional on having purchased land, firms that have LURCs versus those that do not.

We estimate a model that interacts $\log(Employ_{pjt})$ with these measures of property rights. In general, since we have a repeated cross-section of firms, not a panel, there is a potential endogeneity problem if we use θ at the firm level (e.g., firms could adjust their θ in response to a shock in A). For the LURC variable, we know the year the firm acquired the certificate, so we can also use lagged values of LURC ownership to address this concern.[13] In addition to interacting these measures of movings costs with $\log(Employ_{pjt})$, we also show the results controlling for the interaction of $\log(Employ_{pjt})$ with average firm size in the industry to isolate the effects of land own-

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[13]Unfortunately, we do not know the year the firm purchased its land, so we cannot do the analogous exercise for land ownership. In Table A9, we show the results using contemporaneous LURC.

ership status from other general industry characteristics, in case land ownership and LURC status are correlated with firm size. We also examine a host of other controls below, all interacted with $\log(Employ_{pjt})$, to capture the fact that having an LURC is not randomly assigned (e.g. LURC firms may be more willing to pay bribes to obtain permits, are older, etc).

The first two columns of Table 4 use a single IV and compare firms that own land and have an LURC against the omitted category of all other firms, both those that are renting and those that own land without an LURC. In Panel A, the coefficient on the interaction with $\log(Employ_{pjt})$ in column 1 is -0.292 and significant at the 5% level, suggesting that indeed firms with LURCs have the largest reduction in bribe rates as predicted employment increases.

To interpret the magnitudes, recall that the average effect of increasing employment on reduced corruption from Table 3 is -1.704. The results in column 1 suggest that the impact is about 17% (=0.292/1.704) larger in magnitude for firms with an LURC than those without one.

As shown in column 2, the coefficient on the LURC interaction is insensitive to whether we control for industry average firm size interacted with $\log(Employ_{pjt})^{14}$, suggesting that the land ownership and LURC variables are really picking up something about the firm's property rights rather than industries with larger or smaller firms.

Columns 3 and 4 also include the interaction between the firm owning land and

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[14]The industry average firm size is computed as the average employment (with the categorical variable recoded using the GSO data to calculate the within-category mean, as detailed in Appendix D) among PCI firms in the same industry pooled over all years.

$\log(Employ_{pjt})$. The coefficient on the interaction of the firm owning land and having an LURC and $\log(Employ_{pjt})$ is now the additional impact of owning an LURC conditional on owning land, i.e., comparing firms that own land and have an LURC with those that own land and do not have an LURC. The LURC interaction term in this specification is the most direct test of the theoretical prediction. The interaction coefficient of -0.12 is negative (column 4), consistent with the prediction, but quite noisily estimated.[15]

Columns 5 to 8 repeat columns 1 to 4, but using multiple IVs for Vietnam, and the estimates are broadly similar. Panel B then presents the results using the Chinese IV. It is reassuring that the results are similar using different IV strategies and are robust to controlling for firm size. Nonetheless, possessing an LURC is not randomly assigned, and could be correlated with other firm characteristics. Possessing an LURC is indeed correlated with a variety of other firm characteristics (Table A11), but, reassuringly, the findings are robust to controlling one-by-one for the interaction of these possible correlates of property rights with $\log(Employ_{pjt})$, as well as controlling for the interaction of propensity scores for having an LURC and owning land with $\log(Employ_{pjt})$ (Tables A12 and 13).

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[15]We have also estimated ordered probit reduced form specifications with broadly similar results; see Table A10.

5.2 Firms Operating in Multiple Provinces

The PCI data provide a second proxy for firm mobility that we can use to test for heterogeneous effects: having operations in multiple provinces. Of the firms in the sample, 31.4% have operations in at least two provinces. These firms with some of their operations elsewhere likely have a more credible threat to wholly move to another province or simply focus their expansion plans elsewhere, making them more observably mobile to provincial officials. Of course, these may be different on other dimensions as well, but this nevertheless provides another way of testing the idea that bribes are more elastic with respect to firm size for these plausibly more mobile firms.

Table 5 examines heterogeneity based on multi-province operations. The proxy for $MovingCost$ is dummy for operating in at least one other province besides the province where the firm is headquartered. The interaction coefficients are both -0.26 in columns 1 and 2 (significant at the 1% level). The main effect of $\log(Employ_{pjt})$ in column 1 is -1.704, so the interaction coefficient implies that having multi-province operations increases the negative effect of growth on the bribe rate by 15%.

We find similar results, reported in Panel B, using the Chinese IV. Focusing on the multiple-IV results in column 3 and 4, the effect of growth on bribery is stronger for mobile firms, with the result significant at the 1% level.

Tables A14 and A15 present the battery of robustness checks. For the preferred specifications of the single-IV Vietnam approach and the multiple-IV China approach, the results are essentially similar.

To summarise our main empirical results, first, we showed in section 3 that positive productivity shocks for firms reduce corruption. Second, in this section we presented evidence that corruption falls more in response to positive shocks when firms are more elastic in their location choices. This second finding is seen both when using firms' property rights over their land as a proxy for their relocation costs and when using multi-province operations as a proxy for the ability to relocate.

5.3   Alternative Models

There are other potential models that predict a negative correlation of growth and the bribe rate besides inter-jurisdictional competition. The first and most direct way to distinguish between the inter-jurisdictional model and these other models is that we find that the relationship between growth and bribery is diminished for firms that are less likely to relocate outside their province. This is a direct prediction of inter-jurisdictional competition, but is not predicted by most other models. For example, if some bribes are fixed fees (say, those bribes paid at an office, where the inspector does not observe firm size) and some bribes are a fixed proportion of revenue (say, those paid in response to inspections at the plan), this would generate the pattern that the share of revenue paid in bribes would fall as firms grow. Such a simple model, however, predicts that this elasticity would be larger for more mobile firms.

Appendix E directly considers several other explanations for the finding that growth reduces bribes, specifically (i) growth increases product-market competition (ii) industry-

specific crackdowns on bribery (iii) economies of scale in rooting out bribery and (iv) diminishing returns to bureaucrats from income from bribes. The results are shown in Table A16. To the extent we can examine quantitative and qualitative predictions of these alternative models, we do not find that they are able to explain the empirical patterns.

These other mechanisms could well be in operation too, explaining some of the overall effect of growth on bribery. But, the positive evidence in support of inter-jurisdictional competition and the limited evidence in support of other models suggests that the mechanism we highlight is an important factor in why economic growth reduces corruption in Vietnam.

6   Conclusion

This paper examines whether firm growth leads to lower corruption, using firm-level data from Vietnam, and establishes two empirical facts. First, industry-level growth reduces the proportion of firm revenues extracted by government officials as bribes. Second, this reduction in corruption is larger for firms that can more easily relocate.

These facts map to the two main contributions of the paper. The first is an important empirical contribution: Despite much interest in the relationship between corruption and growth, we provide some of the first rigorous causal evidence on the effect of growth on corruption. We do so by applying an often-used identification strategy that uses shocks outside of a subnational region (either in other regions, or in a neighboring

country) as a source of exogenous variation in the region. This strategy is applicable to Vietnam because previous work shows that corruption is decentralised in Vietnam, and provincial governments independently determine the level of bribes extracted from firms in their jurisdiction. The general framework that we have developed in this paper can also be applied in other countries where corruption activities are highly localised, such as China.

Our second contribution is to lay out a mechanism through which productivity growth reduces corruption that operates through firm size: Competition among provinces to retain or attract firms. If a firm is more able to relocate, a government will be more cautious about extracting bribes from it. Less obvious is how a change in economic activity affects corruption in this environment. There are offsetting forces, but under plausible assumptions, growth leads to a decline in bribe extraction. We also derive the prediction that this decline is larger for more mobile firms, consistent with our second empirical fact described above.

Our results have several implications for understanding the determinants of corruption in developing countries. The finding that firm growth reduces bribery suggests that some aspects of corruption might decline naturally as a country grows even without explicit anti-corruption efforts, at least if overall economic growth entails growth in firm size. Moreover, the mechanism of inter-jurisdictional competition offers several ways that national governments might expedite the decline in corruption. One option involves focused improvements in governance in one region, as suggested by Wei (1999b) and Fisman and Werker (2010); the competitive pressure that we discuss

would lead these improvements to spill over to other regions. More directly tied to our empirical findings, strengthening property rights so that firms can more easily recoup the value of their land if they move would strengthen the competition among jurisdictions and hence the corruption-reducing effect of growth. More generally, reducing any barriers to firm mobility, for example related to business registration, would amplify the negative effect of growth on corruption.

While we have implemented the idea of firm growth and firm mobility as forces for reducing corruption within a country, similar factors could be at play across countries. For example, multinationals face a choice of which countries to locate in or to source their products from. As they grow, it becomes more worthwhile to pay a cost to move to a country with lower corruption, which could lead countries to reduce bribe rates to prevent too many firms from leaving. This effect will be larger in industries with low switching costs across countries, like textiles, than in industries with high switching costs, such as mining. We leave exploration of these issues for future work.

Harvard University

Northwestern University

Duke University

Massachusetts Institute of Technology

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Figure 1: Relationship Between GDP and Corruption Using Survey Data from Firms
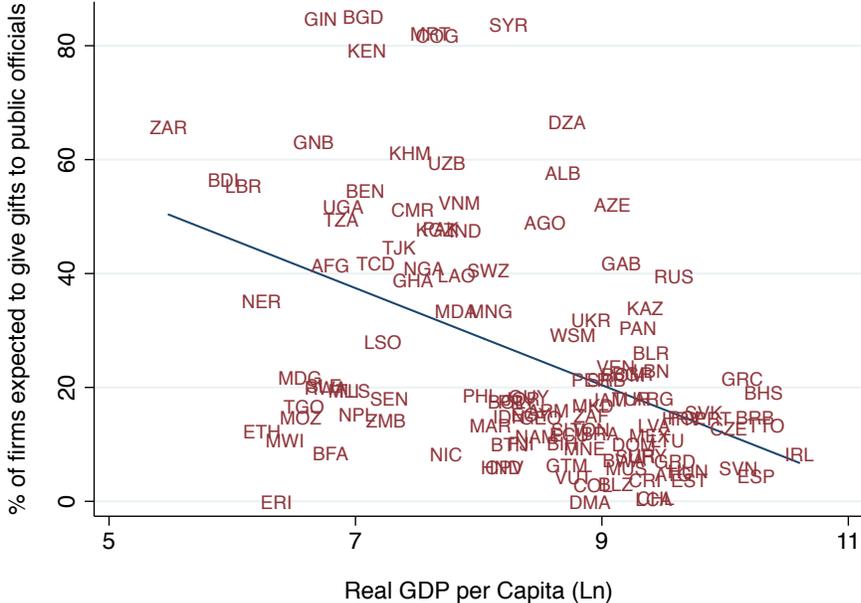
This figure plots the percentage of firms who expect to give gifts to public officials to get things done for 122 countries in the World Bank Enterprise Survey. For each country, we use the year that the country is most recently surveyed. The x-axis is the log of PPP-adjusted GDP per capita (Chain Series), at 2005 constant prices.

Figure 2: Relationship Between Firm Size and Bribes as a Share of Revenue
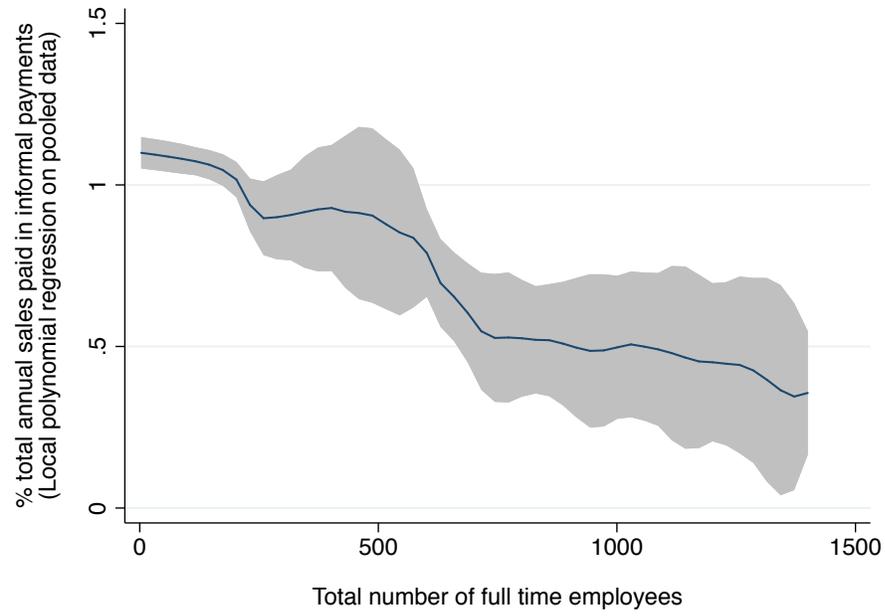
(a) World cross-section
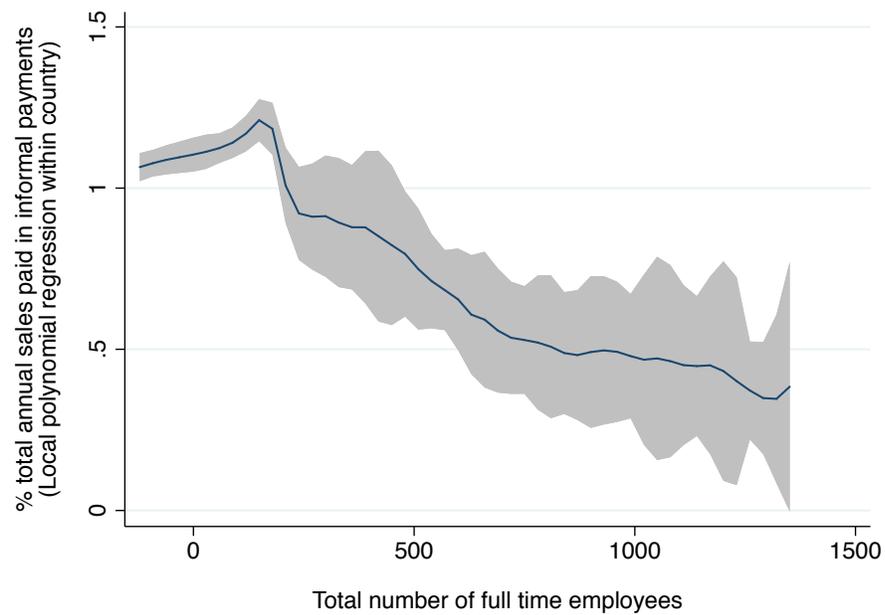
(b) Within-country variation only

Figure 3: Variation in Corruption across Provinces in Vietnam
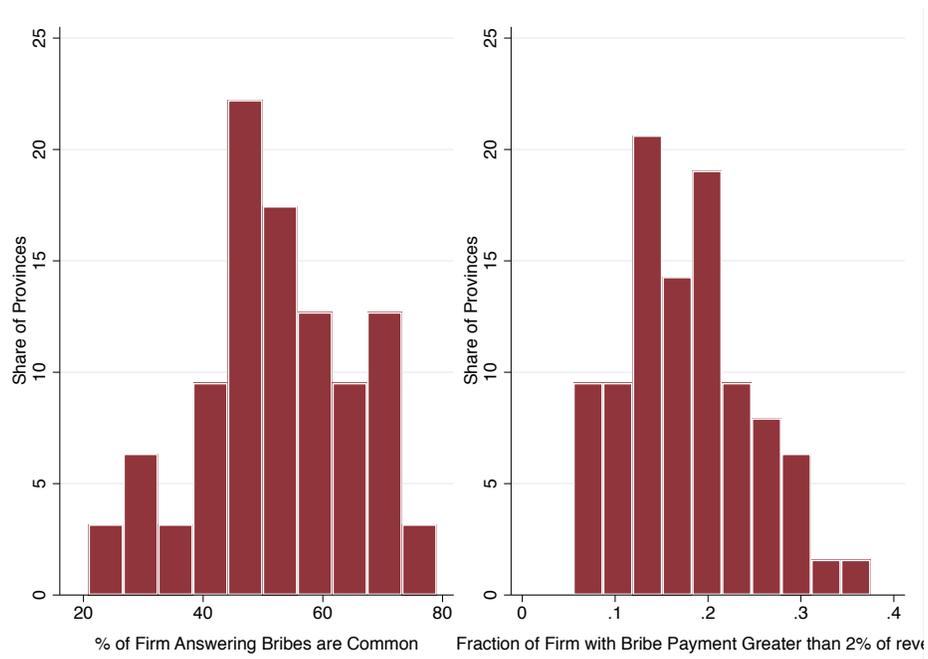
This figure plots the distribution of corruption across provinces in Vietnam, using data from the 2011 PCI survey. The bribe variables are averages across all firms surveyed within a province. The variable in the left panel is a dummy that equals 1 if the firm responds "strongly agree" or "agree" to the following statement:"It's common for firms like mine to pay informal charges." The variable in the right panel is a dummy that equals 1 if the firm paid more than 2% of revenues as bribes to public officials.

Figure 4: Histogram of Bribe Rate
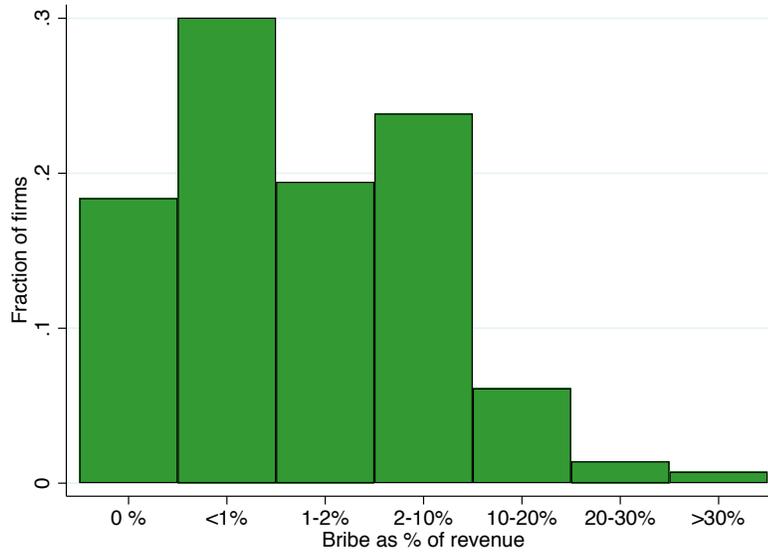
This figure plots the histogram of the bribe rate paid by PCI firms in our final analysis sample (i.e. firms with at least 10 lagged employees and merged with GSO–see Section 2.2 for details of the sample construction).

Figure 5: Cross-Sectional Relationship Between Bribe Rate and Firm Employment
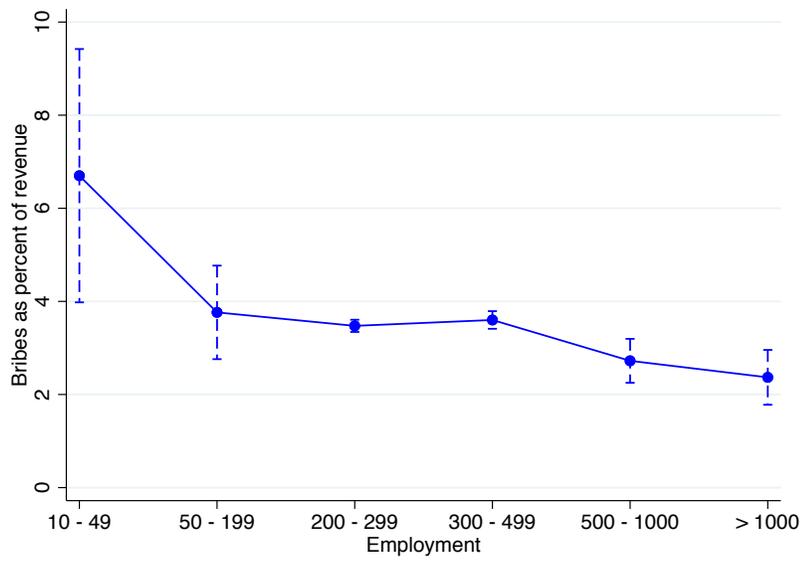
This figure plots the mean bribe rate as a percentage of revenue for each employment size category as well as the 95% confidence interval. The sample contains PCI firms in our final analysis sample (i.e. firms with at least 10 lagged employees and merged with GSO–see Section 2.2 for details of the sample construction).

Table 1: Summary Statistics of Firms

	Observations	Median	Mean	Std Dev
Panel A. Full Sample of PCI Firms				
Bribes as percentage of revenue (%)	20268	.5	3.238	5.404
Years since establishment	19771	5	6.071	5.914
Number of employees (PCI)	19119	19.3	60.938	202.139
Mean employment (GSO, mean for industry-year-province level)	20268	15.827	31.216	31.842
Log employment (GSO, aggregate for industry-year-province)	20268	8.947	8.888	1.835
Log of business premise size (hectare)	10094	6.027	6.463	2.138
Land ownership (dummy)	20268	1	.736	.441
Land use right certificate (dummy)	19427	1	.574	.495
Land ownership without land use right certificate (dummy)	19427	0	.151	.358
Number of other provinces in which firm operates	20268	0	.432	.961
Firm currently operates in more than one province (dummy)	20268	0	.258	.437
Share of registration documents held	16037	.167	.267	.305
Former household firm (dummy)	20265	1	.623	.485
Former SOE (dummy)	20265	0	.061	.24
Owner is a government official (dummy)	20265	0	.113	.317
Government holds positive share (dummy)	20265	0	.028	.166
Panel B. Restricted Sample of Large PCI Firms				
Bribes as percentage of revenue (%)	10901	1.5	3.401	5.397
Years since establishment	10682	5	6.869	6.579
Number of employees (PCI)	10818	19.3	101.277	260.532
Mean employment (GSO, mean for industry-year-province level)	10901	44.244	65.629	52.366
Log employment (GSO, aggregate for industry-year-province)	10901	8.909	8.82	1.884
Log of business premise size (hectare)	5358	6.908	7.237	2.194
Land ownership (dummy)	10901	1	.731	.443
Land use right certificate (dummy)	10479	1	.587	.492
Land ownership without land use right certificate (dummy)	10479	0	.134	.34
Number of other provinces in which firm operates	10901	0	.545	1.07
Firm currently operates in more than one province (dummy)	10901	0	.314	.464
Share of registration documents held	8612	.167	.258	.289
Former household firm (dummy)	10900	1	.562	.496
Former SOE (dummy)	10900	0	.104	.305
Owner is a government official (dummy)	10900	0	.141	.348
Government holds positive share (dummy)	10900	0	.044	.206

Note: Panel A reports the summary statistics for all PCI firms during the sample period. Panel B reports the same summary statistics for firms with 10 or more lagged employees reported for the year before the survey. See Appendix D for variable descriptions.

Table 2: First Stage Results

	Dep. var.: Log Vietnamese employment in industry-year (in own province)	
Log Vietnamese employment in industry-year (excluding own province)	0.642*** (0.124)	
Log Chinese employment in industry-year		0.622** (0.315)
Observations	3,367	3,367
F-stats	26.94	3.886
Province–industry and year fixed effects	✓	✓

Note: Each observation is a province-industry-year. The dependent variable is log Vietnamese employment in industry-year in own province. The independent variable is log Vietnamese employment of the same industry-year in all provinces other than own, and log Chinese employment of the same industry-year. Both variables are calculated using the GSO Enterprise Survey data. Industry refers to an ISIC alphabetical industry code. The regression controls for province-industry and year fixed effects. Standard errors are two-way clustered at the province and industry-year level. *** implies significance at 0.01 level, ** 0.5, * 0.1.

Table 3: Effect of Economic Performance on Bribes

Dependent variable: Firm's bribe payment as percentage of revenue

	Single IV (1)	Multiple IV (2)	RF: OLS (3)	RF: Ordered Probit (4)
Panel A. Rest-of-Vietnam IV				
Log Vietnamese	-1.704**	-1.366*		
employment in industry-year (in own province)	(0.677)	(0.715)		
Log Vietnamese employment			-1.203**	-0.151**
in industry-year (excluding own province)			(0.494)	(0.0676)
Panel B. China IV				
Log Vietnamese	-1.509	-1.149**		
employment in industry-year (in own province)	(0.965)	(0.575)		
Log Chinese			-1.310	-0.209
employment in industry-year			(0.926)	(0.165)
Province–industry and year fixed effects	✓	✓	✓	✓

Note: The dependent variable is the firm's bribe payment as percentage of revenue. This variable is categorical in the data and we recode each category with the corresponding cell mean (see Appendix D for details). The table shows the results for firms with 10 or more lagged employees reported for the year before the survey. (The results for the full sample is shown in Table A4.) Industries refer to ISIC alphabetical industry codes. All regressions control for province-industry and year fixed effects. Standard errors are two-way clustered at the province and industry-year level. *** implies significance at 0.01 level, ** 0.5, * 0.1.

Table 4: Heterogeneous Effects Based on Firms' Property Rights

Dependent variable: Firm's bribe payment as percentage of revenue

	Single IV				Multiple IV			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Rest-of-Vietnam IV								
Log Vietnamese employment in industry-year (in own province)	-1.986**	0.978	-2.116**	0.978	-1.127	0.00315	-1.431**	-0.0553
	(0.843)	(2.696)	(0.902)	(2.775)	(0.688)	(2.006)	(0.645)	(2.016)
Firm owns its land			-0.331*	-0.340*			-0.318**	-0.317**
X log Vietnamese employment in industry year (in own province)			(0.180)	(0.187)			(0.125)	(0.126)
Firm owns land and has LURC	-0.292**	-0.314**	-0.101	-0.119	-0.262***	-0.264***	-0.0882	-0.0915
X log Vietnamese employment in industry year (in own province)	(0.116)	(0.128)	(0.124)	(0.133)	(0.0900)	(0.0911)	(0.117)	(0.119)
Observations	9,535	9,535	9,535	9,535	9,535	9,535	9,535	9,535
Panel B. China IV								
Log Vietnamese employment in industry-year (in own province)	-1.321	1.182	-1.098	0.744	-0.889	0.881	-1.174**	0.879
	(1.376)	(2.839)	(1.305)	(2.638)	(0.606)	(1.945)	(0.560)	(1.921)
Firm owns its land			-0.542***	-0.562***			-0.223*	-0.223*
X log Vietnamese employment in industry year (in own province)			(0.165)	(0.163)			(0.132)	(0.133)
Firm owns land and has LURC	-0.404***	-0.423***	-0.102	-0.104	-0.252**	-0.257**	-0.120	-0.126
X log Vietnamese employment in industry year (in own province)	(0.135)	(0.151)	(0.150)	(0.152)	(0.105)	(0.107)	(0.116)	(0.119)
Observations	9,535	9,535	9,535	9,535	9,535	9,535	9,535	9,535
Control for average firm size X log Vietnamese employment in industry-year (in own province)	NO	YES	NO	YES	NO	YES	NO	YES
Province-industry and year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓

Note: This table shows the IV results for heterogeneous effects based on firms' property rights. The interaction term is the product of log Vietnamese employment in industry-year in own province and firm-level property rights variables. Column 1 to 4 use single instrument, and column 5 to 8 use multiple instruments. Panel A shows the results using rest-of-Vietnam IV, and Panel B shows results using China IV. All regressions control for the main effects of the property right variables, but only the interaction coefficients are reported in this table. The even columns control for for average firm size in the industry interacted with the endogenous variable. The sample contains firms with 10 or more lagged employees reported for the year before the survey. (The results for the full sample is shown in Table A5.) All regressions control for province-industry and year fixed effects. Standard errors are two-way clustered at the province and industry-year level. *** implies significance at 0.01 level, ** 0.5, * 0.1.

Table 5: Heterogeneous Effects Based on Firms' Operation Locations

Dependent variable: Firm's bribe payment as percentage of revenue

	Single IV		Multiple IV	
	(1)	(2)	(3)	(4)
Panel A. Rest-of-Vietnam IV				
Log Vietnamese employment in industry-year (in own province)	-1.469**	0.206	-0.981	-0.378
	(0.642)	(1.884)	(0.674)	(1.649)
Firm currently operates in more than one province	-0.265***	-0.263***	-0.219**	-0.220**
X log Vietnamese employment in industry-year (in own province)	(0.0967)	(0.0926)	(0.103)	(0.103)
Observations	10,901	10,901	10,901	10,901
Panel B. China IV				
Log Vietnamese employment in industry-year (in own province)	-1.108	0.782	-0.728	0.448
	(0.979)	(1.932)	(0.529)	(1.668)
Firm currently operates in more than one province	-0.361**	-0.344**	-0.239***	-0.241***
X log Vietnamese employment in industry-year (in own province)	(0.154)	(0.150)	(0.0904)	(0.0904)
Observations	10,901	10,901	10,901	10,901
Control for average firm size X log Vietnamese employment in industry-year (in own province)	NO	YES	NO	YES
Province-industry and year fixed effects	✓	✓	✓	✓

Note: This table shows the IV results for heterogeneous effects based on firms' operation locations. The sample contains firms with 10 or more lagged employees reported for the year before the survey. (The results for the full sample is shown in Table A6) All specifications are the same as in Table 4. Standard errors are two-way clustered at the province and industry-year level. *** implies significance at 0.01 level, ** 0.5, * 0.1.

ONLINE APPENDICES FOR "FIRM GROWTH AND CORRUPTION"

- Appendix A: Additional tables

- Appendix B: Validation of matching between PCI and GSO

- Appendix C: Model

- Appendix D: Description of key variables

- Appendix E: Testing alternative models

Appendix A Tables

Table A 1: Cross-Validation of PCI and GSO Data

	Firms with ≥ 10 lagged employees		All firms	
	Log VN mean in PCI	Log VN median in PCI	Log VN mean in PCI	Log VN median in PCI
	(1)	(2)	(3)	(4)
Log VN mean in GSO	0.520***		0.528***	
	(0.040)		(0.033)	
Log VN median in GSO		0.474***		0.440***
		(0.045)		(0.041)
Observations	4484	4484	5760	5760
Province–industry and year FE	✓	✓	✓	✓

Note: Each observation is a province-industry-year. The dependent variable is log mean or log median firm-level employment for each province-industry-year group in the PCI data. The independent variable is the corresponding variable computed using the GSO data. For both datasets, we keep only private firms. Since the firm employment variable in PCI is categorical, we compute the empirical mean and median for each category from the GSO data and apply these to the PCI data. All specifications control for province by industry (broad level) and year fixed effect. Robust standard errors are clustered at the province level and reported. *** implies significance at 0.01 level, ** 0.5, * 0.1.

Table A 2: Industry Codes and Descriptions

ISIC Rev 4 Code	Description
A	Agriculture, forestry and fishing
B	Mining and quarrying
C	Manufacturing
D	Electricity, gas, steam and air conditioning supply
E	Water supply; sewerage, waste management and remediation activities
F	Construction
G	Wholesale and retail trade; repair of motor vehicles and motorcycles
H	Transportation and storage
I	Accommodation and food service activities
J	Information and communication
K	Financial and insurance activities
L	Real estate activities
M	Professional, scientific and technical activities
N	Administrative and support service activities
P	Education
Q	Human health and social work activities
R	Arts, entertainment and recreation
S	Other service activities

The alphabetical industry codes and descriptions are based on International Standard Industrial Classification (ISIC) of All Economic Activities, Rev.4. The list includes the 18 industries that appear in our sample.

Table A 3: First Stage Results: Multiple IV

	Dep. var.: Log Vietnamese employment in industry-year (in own province)	
	Rest-of-Vietnam IV	China IV
Interaction coefficient for Agriculture	0.0532	-0.800
	(0.338)	(0.931)
Interaction coefficient for Mining and Quarrying	-1.343*	-4.052
	(0.690)	(3.398)
Interaction coefficient for Manufacturing	-0.474	-0.488
	(0.353)	(1.023)
Interaction coefficient for Electricity and Gas Supply	-0.107	0.0971
	(0.175)	(8.336)
Interaction coefficient for Water Supply	0.169	1.883
	(0.211)	(1.384)
Interaction coefficient for Construction	0.183	0.574
	(0.220)	(0.571)
Interaction coefficient for Wholesale and Retail Trade	0.216	0.611
	(0.168)	(0.415)
Interaction coefficient for Transportation and Storage	0.379*	3.180*
	(0.207)	(1.776)
Interaction coefficient for Accommodation and Food Service	0.170	0.653
	(0.174)	(0.542)
Interaction coefficient for Information and Communication	0.282*	1.303
	(0.152)	(0.868)
Interaction coefficient for Financial and Insurance Activities	0.269	1.372*
	(0.202)	(0.771)
Interaction coefficient for Real Estate Activities	0.759***	3.357***
	(0.195)	(0.992)
Interaction coefficient for Professional and Scientific Activities	0.396***	2.014**
	(0.153)	(0.872)
Interaction coefficient for Administration and Support Activities	0.625***	1.576***
	(0.176)	(0.508)
Interaction coefficient for Education	0.446***	12.37***
	(0.165)	(4.275)
Interaction coefficient for Human Health and Social Work	0.498***	3.714***
	(0.146)	(1.001)
Interaction coefficient for Arts, Entertainment and Recreation	0.166	4.249
	(0.186)	(3.937)
Interaction coefficient for Other Service Activities	-0.187	0.0148
	(0.226)	(0.522)
Observations	3367	3367
F-stats	7.986	8.369
Province–industry and year fixed effects	✓	✓

Note: Each observation is a province-industry-year. The dependent variable is log employment in industry-year in own province. The independent variable is the rest-of-Vietnam IV and China IV interacted with industry dummies. Industry refers to an ISIC alphabetical industry code. We include the interaction term for all 18 industries. The regression controls for province-industry and year fixed effects. Standard errors are two-way clustered at the province and industry-year level. *** implies significance at 0.01 level, ** 0.5, * 0.1. The F-test statistic for province level clustering is reported in this table and the corresponding test statistics for industry-year level clustering is higher for both the rest-of-Vietnam IV and China IV.

Table A 4: Effect of Economic Performance on Bribes (All Firms)

Dependent variable: Firm's bribe payment as percentage of revenue

	Single IV	Multiple IV	RF: OLS	RF: Ordered Probit
	(1)	(2)	(3)	(4)
Panel A. Rest-of-Vietnam IV				
Log Vietnamese	-1.239*	-0.934		
employment in industry-year (in own province)	(0.702)	(0.774)		
Log Vietnamese employment			-0.907*	-0.127*
in industry-year (excluding own province)			(0.537)	(0.0689)
Panel B. China IV				
Log Vietnamese	-0.784	-1.072		
employment in industry-year (in own province)	(1.300)	(0.667)		
Log Chinese			-0.501	-0.121
employment in industry-year			(0.849)	(0.140)
Province–industry and year fixed effects	✓	✓	✓	✓

Note: This table repeats the same regression analysis in Table 3 on the full sample of PCI firms (without size restriction). The corresponding RHS variable and IV are also constructed on the full sample firms in the GSO survey (aggregated to province-industry-year). *** implies significance at 0.01 level, ** 0.5, * 0.1.

Table A 5: Heterogeneous Effects Based on Firms' Property Rights (All Firms)

Dependent variable: Firm's bribe payment as percentage of revenue

	Single IV				Multiple IV			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Rest-of-Vietnam IV								
Log Vietnamese employment in industry-year (in own province)	-1.295	1.497	-1.313	1.487	-1.062	1.315	-1.310*	1.199
	(0.840)	(1.293)	(0.844)	(1.281)	(0.754)	(1.174)	(0.792)	(1.165)
Firm owns its land			-0.151	-0.142			-0.235**	-0.228*
X log Vietnamese employment in industry year (in own province)			(0.133)	(0.137)			(0.113)	(0.118)
Firm owns land and has LURC	-0.175	-0.204*	-0.0871	-0.121	-0.139	-0.149*	-0.0119	-0.0270
X log Vietnamese employment in industry year (in own province)	(0.113)	(0.116)	(0.106)	(0.109)	(0.0851)	(0.0846)	(0.0881)	(0.0886)
Observations	17,499	17,499	17,499	17,499	17,499	17,499	17,499	17,499
Panel B. China IV								
Log Vietnamese employment in industry-year (in own province)	-0.540	1.102	-0.290	1.179	-1.178*	1.555	-1.421*	1.457
	(1.311)	(2.557)	(1.322)	(2.164)	(0.679)	(1.065)	(0.737)	(1.068)
Firm owns its land			-0.371**	-0.390**			-0.0860	-0.0798
X log Vietnamese employment in industry year (in own province)			(0.166)	(0.179)			(0.109)	(0.112)
Firm owns land and has LURC	-0.281**	-0.321**	-0.0695	-0.0943	-0.148	-0.163*	-0.102	-0.120
X log Vietnamese employment in industry year (in own province)	(0.126)	(0.163)	(0.137)	(0.155)	(0.0967)	(0.0971)	(0.101)	(0.100)
Observations	17,499	17,499	17,499	17,499	17,499	17,499	17,499	17,499
Control for average firm size X log Vietnamese employment in industry-year (in own province)	NO	YES	NO	YES	NO	YES	NO	YES
Province-industry and year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓

Note: This table repeats the same regression analysis in Table 4 on the full sample of PCI firms (without size restriction). The corresponding RHS variable and IV are also constructed on the full sample firms in the GSO survey (aggregated to province-industry-year). *** implies significance at 0.01 level, ** 0.5, * 0.1.

Table A 6: Heterogeneous Effects Based on Firms' Operation Locations (All Firms)

Dependent variable: Firm's bribe payment as percentage of revenue

	Single IV		Multiple IV	
	(1)	(2)	(3)	(4)
Panel A. Rest-of-Vietnam IV				
Log Vietnamese employment in industry-year (in own province)	-1.195*	1.746	-0.890	1.413
	(0.713)	(1.067)	(0.743)	(0.945)
Firm currently operates in more than one province	-0.171*	-0.147*	-0.159	-0.157
X log Vietnamese employment in industry-year (in own province)	(0.0893)	(0.0837)	(0.101)	(0.101)
Observations	20,268	20,268	20,268	20,268
Panel B. China IV				
Log Vietnamese employment in industry-year (in own province)	-0.672	1.193	-1.015	1.522*
	(1.286)	(2.596)	(0.634)	(0.840)
Firm currently operates in more than one province	-0.304**	-0.181	-0.130*	-0.126*
X log Vietnamese employment in industry-year (in own province)	(0.144)	(0.205)	(0.0772)	(0.0765)
Observations	20,268	20,268	20,268	20,268
Control for average firm size X log Vietnamese employment in industry-year (in own province)	NO	YES	NO	YES
Province-industry and year fixed effects	✓	✓	✓	✓

Note: This table repeats the same regression analysis in Table 5 on the full sample of PCI firms (without size restriction). The corresponding RHS variable and IV are also constructed on the full sample firms in the GSO survey (aggregated to province-industry-year). *** implies significance at 0.01 level, ** 0.5, * 0.1.

Table A 7: Robustness Check: Exclusion Restriction of the Rest-of-Vietnam IV

	Dep. var: Bribe as % of revenue
Log Vietnamese employment in industry-year	-1.163**
(excluding own region)	(0.453)
Constant	18.43***
	(5.690)
Observations	10,898
Province-industry and year fixed effects	✓

Note: This table reports the reduced form results using the alternative construction of the rest-of-Vietnam IV. In particular, we construct total employment in the same industry in other *regions* (as opposed to other provinces as in Table 3). The regression controls for province-industry and year fixed effects. Standard errors are two-way clustered at the province and industry-year level. *** implies significance at 0.01 level, ** 0.5, * 0.1.

Table A 8: Plausibly Exogenous Instruments: 95% Interval Estimates

	(1) Coefficient	(2) 95CI lower bound	(3) 95CI upper bound
Main IV estimate (Column 1 Table 3)	-1.704	-3.03	-0.38
Clustering s.e. at jt:			
δ=0		-3.4	-0.008
δ=0.05		-3.059	-0.308
δ=0.1		-2.802	-0.527
δ=0.15		-2.546	-0.743
δ=0.3		-1.792	-1.383
δ=0.5		-2.216	-0.817
Clustering s.e. at r:			
δ=0		-3.37	-0.037
δ=0.05		-3.033	-0.378
δ=0.1		-2.798	-0.616
δ=0.15		-2.565	-0.851
δ=0.3		-1.882	-1.543
δ=0.5		-2.43	-1.004

Note: This table presents 95% confidence intervals for the effect of economic performance on bribes using the "Union of CI" method proposed in Conley *et al.* (2012) across various prior settings. The "Union of CI" intervals impose the prior information that the support of γ, the direct impact of the instrument on the outcome, is $[-2\delta|\beta|, 2\delta|\beta|]$, where β is our original IV estimate (-1.7 in column 1 of Table 3) and δ ranges from 0 to 0.5. In our main analysis, standard errors are two-way clustered at industry-year (jt) and region (r) level. For the plausibly exogenous tests, there isn't a clear theoretical guidance to perform the inference for two-way clustered standard errors. Therefore, we report the results for both ways. For each, we also report the IV estimate for $\gamma = 0$ (i.e., $\delta = 0$).

Table A 9: Heterogeneous Effects Based on Firms' Property Rights (Contemporaneous Measure of LURC)

Dependent variable: Firm's bribe payment as percentage of revenue

	Rest-of-Vietnam Singe IV				China Multiple IV			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log Vietnamese employment in industry-year	-1.910**	1.046	-2.095**	1.055	-0.967	0.973	-1.260**	1.021
(in own province)	(0.840)	(2.707)	(0.904)	(2.784)	(0.599)	(1.976)	(0.585)	(1.944)
Firm owns its land X log Vietnamese employment			-0.326*	-0.350*			-0.218	-0.222
in industry year (in own province)			(0.188)	(0.203)			(0.151)	(0.153)
Firm owns land and has LURC X log Vietnamese	-0.309**	-0.321**	-0.0935	-0.0904	-0.263**	-0.266**	-0.114	-0.116
employment in industry year (in own province)	(0.140)	(0.145)	(0.164)	(0.170)	(0.120)	(0.121)	(0.155)	(0.157)
Observations	9,535	9,535	9,535	9,535	9,535	9,535	9,535	9,535
Control for average firm size X log Vietnamese	NO	YES	NO	YES	NO	YES	NO	YES
employment in industry-year (in own province)								
Province-industry and year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓

Note: This table shows the IV results for heterogeneous effects based on firms' property rights using contemporaneous Measure of LURC. The sample contains firms with 10 or more lagged employees reported for the year before the survey.

Table A 10: Heterogeneous Effects Based on Firms' Property Rights (Ordered Probit)

Dependent variable: Firm's bribe payment as percentage of revenue

	Firms that rent their land		Firms that own land without LURC		Firms that own land with LURC	
	(1)	(2)	(3)	(4)	(5)	(6)
Log Vietnamese employment in industry-year	-0.0402		0.923		-0.432*	
(excluding own province)	(0.219)		(0.573)		(0.241)	
Log Chinese employment in industry-year		-0.148		0.0210		-0.0379
		(0.636)		(0.813)		(0.386)
Observations	2,928	2,928	1,399	1,399	4,428	4,428
Province-industry and year fixed effects	✓	✓	✓	✓	✓	✓

Note: This table reports the reduced form results using the ordered probit model for firms in three categories: (1) firms that rent their land; (2) firms that own land without an LURC; (3) firms that own land with an LURC. The sample contains firms with 10 or more lagged employees reported for the year before the survey. All regressions control for province-industry and year fixed effects. Standard errors are two-way clustered at the province and industry-year level. *** implies significance at 0.01 level, ** 0.5, * 0.1.

Table A 11: Propensity Score Regressions for LURC and Operation Locations

	Firm has LURC	Number of other provinces in which firm operates	Firm currently operates in more than one province
	(1)	(2)	(3)
Share of registration documents held	0.605***	0.511***	0.490***
	(0.098)	(0.094)	(0.091)
Former HH firm (dummy)	0.432***	-0.058	-0.051
	(0.056)	(0.055)	(0.054)
Former SOE (dummy)	0.192**	0.250***	0.275***
	(0.092)	(0.088)	(0.085)
Owner is government official (dummy)	0.440***	0.391**	0.305**
	(0.163)	(0.153)	(0.143)
Government holds positive share (dummy)	-0.354***	0.116	0.115
	(0.125)	(0.118)	(0.114)
Log of business premise size (hectare)	0.264***	0.024	0.027*
	(0.018)	(0.017)	(0.016)
Years since establishment	0.052***	0.007*	0.009**
	(0.005)	(0.004)	(0.004)
Observations	7074	7872	7872

Note: Column 1 shows the logit regression coefficients of LURC (dummy) on various predictors of obtaining the certificate, including share of registration documents held, former household firm (dummy), former SOE (dummy), owner being a government official (dummy), government holding positive share (dummy), log of business premise size, and firm's age. Column 2 and 3 show the (ordered) logit regression results for firm's operation location variables on the same set of explanatory variables. The sample contains firms with 10 or more lagged employees reported for the year before the survey. *** implies significance at 0.01 level, ** 0.5, * 0.1.

Table A 12: Robustness Check: Heterogeneous Effects Based on Firms' Property Rights (Single IV)

Dependent variable: Firm's bribe payment as percentage of revenue

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Includes characteristic [. . .] and interaction with log Vietnamese employment in industry-year (in own province)							
	share of registration documents held	former HH firm	former SOE	government official	government share	premise size	years of establishment	propensity scores for having LURC and owning land
Panel A. Rest-of-Vietnam IV								
Log Vietnamese employment in industry-year	0.00285	1.023	0.841	1.226	1.011	0.650	1.135	1.377
(in own province)	(2.870)	(2.772)	(2.789)	(2.807)	(2.758)	(3.044)	(2.865)	(2.951)
Firm owns land and has LURC X log Vietnamese	-0.102	-0.122	-0.116	-0.105	-0.119	-0.216	-0.0855	-0.130
employment in industry year (in own province)	(0.142)	(0.130)	(0.133)	(0.130)	(0.132)	(0.156)	(0.127)	(0.164)
Firm owns its land X log Vietnamese employment	-0.438**	-0.338*	-0.349*	-0.337*	-0.342*	-0.252	-0.373*	-0.385*
in industry year (in own province)	(0.195)	(0.190)	(0.186)	(0.183)	(0.189)	(0.207)	(0.205)	(0.212)
Observations	7,671	9,534	9,534	9,534	9,534	8,874	9,347	7,074
Panel B. China IV								
Log Vietnamese employment in industry-year	-0.623	0.695	0.639	1.193	0.813	1.476	0.671	1.080
(in own province)	(2.218)	(2.658)	(2.637)	(2.845)	(2.646)	(2.264)	(2.440)	(2.737)
Firm owns land and has LURC X log Vietnamese	-0.0825	-0.0810	-0.0898	-0.0891	-0.103	-0.190	-0.0546	-0.120
employment in industry year (in own province)	(0.168)	(0.145)	(0.150)	(0.153)	(0.151)	(0.183)	(0.143)	(0.209)
Firm owns its land X log Vietnamese employment	-0.682***	-0.601***	-0.570***	-0.575***	-0.566***	-0.517***	-0.592***	-0.695***
in industry year (in own province)	(0.174)	(0.170)	(0.165)	(0.161)	(0.165)	(0.195)	(0.178)	(0.198)
Observations	7,671	9,534	9,534	9,534	9,534	8,874	9,347	7,074
Control for average firm size X log Vietnamese	YES	YES	YES	YES	YES	YES	YES	YES
employment in industry-year (in own province)								
Province-industry and year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓

Note: This table shows the single IV results for heterogeneous effects based on firms' property rights after controlling for other firm characteristics. Column 1 to 8 controls for the following explanatory variables and their interactions with log Vietnamese employment in industry-year in own province: share of registration documents held, former household firm (dummy), former SOE (dummy), owner being a government official (dummy), government holding positive share (dummy), log of business premise size, firm's age, and the corresponding propensity score(s) for having LURC and/or owning land. The sample contains firms with 10 or more lagged employees reported for the year before the survey. All regressions control for the main effects of the property right variables, but only the interaction coefficients are reported in this table. All regressions control for province-industry and year fixed effects. Standard errors are two-way clustered at the province and industry-year level. *** implies significance at 0.01 level, ** 0.5, * 0.1.

Table A 13: Robustness Check: Heterogeneous Effects Based on Firms' Property Rights (Multiple IV)

Dependent variable: Firm's bribe payment as percentage of revenue

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Includes characteristic [...] and interaction with log Vietnamese employment in industry-year (in own province)							
	share of registration documents held	former HH firm	former SOE	government official	government share	premise size	years of establishment	propensity scores for having LURC and owning land
Panel A. Rest-of-Vietnam IV								
Log Vietnamese employment in industry-year	0.117	0.109	-0.386	0.0878	-0.0225	-0.320	0.0849	0.475
(in own province)	(2.356)	(1.994)	(1.985)	(1.999)	(2.003)	(2.610)	(2.039)	(2.362)
Firm owns land and has LURC X log Vietnamese	-0.0855	-0.0896	-0.0835	-0.0751	-0.0837	-0.165	-0.0869	-0.128
employment in industry year (in own province)	(0.133)	(0.119)	(0.119)	(0.117)	(0.119)	(0.138)	(0.114)	(0.157)
Firm owns its land X log Vietnamese employment	-0.372***	-0.323**	-0.334***	-0.306**	-0.316**	-0.243*	-0.341**	-0.351***
in industry year (in own province)	(0.111)	(0.131)	(0.127)	(0.126)	(0.128)	(0.143)	(0.136)	(0.136)
Observations	7,671	9,534	9,534	9,534	9,534	8,874	9,347	7,074
Panel B. China IV								
Log Vietnamese employment in industry-year	0.647	1.051	0.564	1.109	0.917	0.795	1.110	0.970
(in own province)	(2.149)	(1.926)	(1.929)	(1.930)	(1.911)	(2.159)	(1.937)	(2.236)
Firm owns land and has LURC X log Vietnamese	-0.115	-0.116	-0.125	-0.112	-0.121	-0.212	-0.117	-0.158
employment in industry year (in own province)	(0.134)	(0.119)	(0.118)	(0.118)	(0.118)	(0.129)	(0.113)	(0.152)
Firm owns its land X log Vietnamese employment	-0.291**	-0.243*	-0.228*	-0.214	-0.215	-0.128	-0.242*	-0.229*
in industry year (in own province)	(0.123)	(0.137)	(0.131)	(0.131)	(0.134)	(0.138)	(0.138)	(0.137)
Observations	7,671	9,534	9,534	9,534	9,534	8,874	9,347	7,074
Control for average firm size X log Vietnamese	YES	YES	YES	YES	YES	YES	YES	YES
employment in industry-year (in own province)								
Province-industry and year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓

Note: This table shows the multiple IV results for heterogeneous effects based on firms' property rights after controlling for other firm characteristics (see footnote of Table A12). The sample contains firms with 10 or more lagged employees reported for the year before the survey. All regressions control for province-industry and year fixed effects. Standard errors are two-way clustered at the province and industry-year level. *** implies significance at 0.01 level, ** 0.5, * 0.1.

Table A 14: Robustness Check: Heterogeneous Effects Based on Firms' Operation Locations (Single IV)

Dependent variable: Firm's bribe payment as percentage of revenue

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Includes characteristic [. . .] and interaction with log Vietnamese employment in industry-year (in own province)							
	share of registration documents held	former HH firm	former SOE	government official	government share	premise size	years of establishment	propensity score for having multiple locations
Panel A. Rest-of-Vietnam IV								
Log Vietnamese employment in industry-year	-0.539	0.292	0.0605	0.447	0.245	-0.158	0.230	0.804
(in own province)	(2.186)	(1.859)	(1.889)	(1.943)	(1.872)	(1.708)	(1.951)	(2.162)
Firm currently operates in more than one province	-0.297**	-0.264***	-0.267***	-0.263***	-0.266***	-0.201**	-0.283***	-0.258*
X log Vietnamese employment in industry-year	(0.135)	(0.0921)	(0.0944)	(0.0923)	(0.0917)	(0.0912)	(0.0936)	(0.142)
(in own province)								
Observations	8,612	10,900	10,900	10,900	10,900	10,040	10,682	7,872
Panel B. China IV								
Log Vietnamese employment in industry-year	-0.554	0.767	0.623	1.090	0.825	0.810	0.805	2.027
(in own province)	(1.914)	(1.907)	(1.920)	(2.086)	(1.919)	(1.690)	(1.943)	(2.187)
Firm currently operates in more than one province	-0.383**	-0.338**	-0.343**	-0.337**	-0.345**	-0.274*	-0.367**	-0.339*
X log Vietnamese employment in industry-year	(0.190)	(0.150)	(0.152)	(0.147)	(0.148)	(0.158)	(0.155)	(0.199)
(in own province)								
Observations	8,612	10,900	10,900	10,900	10,900	10,040	10,682	7,872
Control for average firm size X log Vietnamese employment in industry-year (in own province)	YES	YES	YES	YES	YES	YES	YES	YES
Province-industry and year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓

Note: This table shows the single IV results for heterogeneous effects based on firms' operation locations after controlling for other firm characteristics (see footnote of Table A12). The sample contains firms with 10 or more lagged employees reported for the year before the survey. Standard errors are two-way clustered at the province and industry-year level. *** implies significance at 0.01 level, ** 0.5, * 0.1.

Table A 15: Robustness Check: Heterogeneous Effects Based on Firms' Operation Locations (Multiple IV)

Dependent variable: Firm's bribe payment as percentage of revenue

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Includes characteristic [. . .] and interaction with log Vietnamese employment in industry-year (in own province)							
	share of registration documents held	former HH firm	former SOE	government official	government share	premise size	years of establishment	propensity score for multiple locations
Panel A. Rest-of-Vietnam IV								
Log Vietnamese employment in industry-year	-0.425	-0.307	-0.716	-0.0649	-0.404	-1.035	-0.405	1.391
(in own province)	(2.048)	(1.574)	(1.633)	(1.738)	(1.615)	(2.184)	(1.661)	(2.133)
Firm currently operates in more than one province	-0.224*	-0.209**	-0.222**	-0.220**	-0.219**	-0.163	-0.250**	-0.203
X log Vietnamese employment in industry-year	(0.120)	(0.102)	(0.105)	(0.101)	(0.103)	(0.104)	(0.106)	(0.130)
(in own province)								
Observations	8,612	10,900	10,900	10,900	10,900	10,040	10,682	7,872
Panel B. China IV								
Log Vietnamese employment in industry-year	0.0657	0.481	0.0799	0.797	0.448	0.422	0.478	1.400
(in own province)	(2.010)	(1.599)	(1.659)	(1.753)	(1.629)	(1.708)	(1.645)	(2.082)
Firm currently operates in more than one province	-0.242**	-0.229***	-0.247***	-0.238***	-0.241***	-0.191**	-0.273***	-0.205
X log Vietnamese employment in industry-year	(0.119)	(0.0865)	(0.0919)	(0.0881)	(0.0900)	(0.0928)	(0.0908)	(0.126)
(in own province)								
Observations	8,612	10,900	10,900	10,900	10,900	10,040	10,682	7,872
Control for average firm size X log Vietnamese employment in industry-year (in own province)	YES	YES	YES	YES	YES	YES	YES	YES
Province-industry and year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓

Note: This table shows the multiple IV results for heterogeneous effects based on firms' operation locations after controlling for other firm characteristics. The sample contains firms with 10 or more lagged employees reported for the year before the survey. Standard errors are two-way clustered at the province and industry-year level. *** implies significance at 0.01 level, ** 0.5, * 0.1.

Table A 16: Testing Alternative Models

	Herfindahl index for province-industry-year group	Bribes as % of revenue (excluding construction industry)	Bribes as % of revenue
	(1)	(2)	(3)
Log Vietnamese employment in industry-year	0.0421***	-1.744**	-1.746***
(in own province)	(0.00319)	(0.775)	(0.629)
Log Vietnamese province-year employment			0.884
			(3.335)
Observations	2,780	9,001	10,901
Province-industry and year fixed effects	✓	✓	✓

Note: This table shows the IV regression results for testing several alternative models. In Column 1, the dependent variable is the employment Herfindahl index constructed for each province-industry-year group. The index is normalised to be between 0 and 1, where a small index indicates a competitive industry. For this regression, we keep 1 observation per province-industry-year group. Column 2 shows the IV regression results using single rest-of-Vietnam IV where we exclude firms in the construction industry. For column 3, we include the province-year level total employment and instrument it using a predicted aggregate shock. In particular, the instrument is the weighted sum over all industries of industry-year employment in other provinces, normalised by the average over all years of total employment in the industry in other provinces. The weights are the average over all years of industry's share of employment in the given province. The sample contains firms with 10 or more lagged employees reported for the year before the survey. All regressions control for province-industry and year fixed effects. Standard errors are two-way clustered at the province and industry-year level. *** implies significance at 0.01 level, ** 0.5, * 0.1.

Appendix B   Validation of matching between PCI and GSO

This section assesses the quality of the matching across data sets used in our analysis. Ideally, we would have constructed our endogenous regressor (employment) using the same data set that has our outcome (bribe) data. However, as discussed above, the PCI data, which has information on bribes and firm mobility, is a sample, and does not include all firms. As such, while the PCI is suitable for examining how a typical firm changes, we cannot use it for accurately calculating aggregate shocks. For example, an increase in prices for goods sold by industry j (one source of an increase in A) might lead to entry of firms, so even though A increased, average firm size might decrease. For this reason, we use the GSO data, which is a census, to construct our measure of A. However, before proceeding, it is important to make sure that the PCI firms are a reasonably representative sample of all firms in the GSO data, and that the industry codes we merge on are comparable across the data sets. If not, then the reduced form results from regressing bribes as measured in the PCI data on the GSO-based instrumental variable could be spurious, or null results could reflect poorly matched data.

To cross-validate the two data sets and ensure that we are matching them appropriately, we compare mean and median firm employment among private firms for each pjt group. One issue with the PCI data is that employment is coded as a categorical variable: 10 to 50, 50 to 100, etc. To assign cardinal values to these bins, we compute the empirical mean and median employment for all firms in GSO for each of these PCI bins, and use these values to create the cardinal employment measure for the PCI firms. We then run the following

regression, with province-industry and year fixed effects:

$$\log(Employ_{pjt}^{\text{PCI}}) = \alpha + \beta \log(Employ_{pjt}^{\text{GSO}}) + \nu_{pj} + \mu_t + \epsilon_{pjt} \tag{B.1}$$

If the PCI firms are a perfect random sample of GSO firms, stratified by province, industry and year, we should have $\beta = 1$. We report the estimates in Table A1. We can see that the changes in mean employment in PCI and mean employment in GSO are positively correlated: β is 0.520 and significant at the 1% level. Similarly, the median employment in PCI and median employment in GSO are positively correlated and the coefficient is 0.474 and highly significant. The correlations are equally robust when we computed the mean and median on the full sample of firms. These results confirm that, while the match between the two data sets is not perfect, they are indeed comparable, even looking just over time at changes within a given province-industry cell.

Appendix C   Model

In this appendix, we formally present a model, which is verbally summarised in the paper, in which governments choose how much to extract from firms to maximise their bribe revenue. Governments balance the revenues they raise from extracting higher bribes from firms with an increased risk that by extracting too much from firms in their jurisdictions, some firms may choose to relocate to other jurisdictions with lower corruption. The model generates the prediction that bribes as a fraction of revenues should decrease with firm growth, which is the main empirical fact we present in our paper. The model also generates the prediction, confirmed in the data, that this relationship is especially strong for firms that can more readily move to another jurisdiction. Other mechanisms could also generate the prediction about the average relationship between firm growth and bribes, but do not easily explain the heterogeneity pattern we find.

For firms, a bribe is an additional payment to government, analogous to a tax. The model is therefore similar to models of inter-regional tax competition, where we think of a bribe payment as a type of tax. The key distinction of our model compared to the previous literature is that we focus not just on the equilibrium level of taxes/bribes, but also examine how the level of bribes changes with productivity shocks. It is this comparative static that generates predictions about how growth affects the amount of corruption in the economy. We also derive how the relationship between productivity shocks and the equilibrium bribe rate varies based on the firm's ease of relocating to another jurisdiction.

We assume that there are two provinces, denoted 1 and 2.[16] Each province is endowed

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[16]The same results apply in a context where we have a large number of jurisdictions, and firms everywhere face some fixed outside option.

with a unit mass of incumbent firms. Note that this assumption of no entry, which we adopt for tractability, implies that firm growth is equivalent to industry growth. In our empirical work, we examine the effects of industry growth, which combines both growth in firm size and growth in the number of firms.

Government and firms play a static game and move sequentially. First, the government in each province p sets a bribe rate b_p, which is the percentage of a firm's revenues that it must pay in bribes. Next, firms in each province choose whether to stay in the province or relocate to the other province. Finally, firms choose their factors of production, they produce, and the government collects bribes.

We begin by specifying the firm's problem, then the problem for local governments, and lastly characterise the equilibrium. Suppose all firms have the same two-factor Cobb-Douglas production function with diminishing returns to scale. We assume diminishing returns to scale in order to pin down firm size and generate profits in equilibrium. Capital and labor are perfectly elastically supplied at the same wage rate w and interest rate r in both provinces.[17] Denote the bribe rate set in period 1 in province p as b_p. We focus on the problem for firms in province 1 (naturally the analysis is symmetric for firms in province 2). A typical firm in province 1 solves

$$\max_{K \geq 0, L \geq 0} (1 - b_1) A K^\alpha L^\beta - wL - rK \tag{C.1}$$

where A is the total factor productivity of the firm. We can also think of A as encompassing the price of the products in the firm's industry. This maximization problem yields the

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[17]One can think of this as there being a homogeneous outside-good sector that is perfectly traded with regions having the same productivity in this sector. The model assumes symmetric regions and abstracts away from heterogeneous factor prices. The qualitative predictions we discuss in Proposition 1 and 2 do not hinge on this assumption.

following familiar results:

$$\frac{L^*}{K^*} = \frac{r}{w}\frac{\beta}{\alpha} \tag{C.2}$$

$$K^* = \left[\frac{r}{(1-b_1)A\alpha}\left(\frac{r}{w}\frac{\beta}{\alpha}\right)^{-\beta}\right]^{\frac{1}{\alpha+\beta-1}} \tag{C.3}$$

$$\pi^* = (1-b_1)AK^{*\alpha}L^{*\beta} - wL^* - rK^* \tag{C.4}$$

In addition to affecting the firm's decision of whether to move as described below, the bribe rate also affects the firm's optimal choice of capital and its profits: the higher the rate of bribe extraction b_1, the smaller the firm's capital stock and profits will be.

The firm will choose to stay in province 1 if and only if profits in province 1 are greater than profits in province 2 less moving costs, i.e. if $\pi^*_{f1} \geq \pi^*_{f2} - m$, where m is the firm's moving costs. To proceed, we need to impose some structure on the moving costs m. We specify the moving costs for firm i as

$$m_i = \theta A^\eta \epsilon_i. \tag{C.5}$$

The term A^η captures the fact that the moving costs should be increasing in firm size. For example, the firm's capital stock would need to be moved or sold and repurchased with transaction costs, and larger firms have a larger capital stock. Similarly, new employees would have to be recruited, hired, and trained, and larger firms have more employees. In the context of the model, A is directly related to firm size; higher TFP firms have a larger capital stock and more employees, and therefore larger moving costs.[18] The exponent $\eta \geq 0$

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[18]Note that all of our key results are robust to instead parameterising the moving costs in terms of the capital stock K^*, rather than in terms of A, but this is more complicated because K^* is endogenously determined, whereas A is an exogenous parameter of the model. Details for this alternative model are available upon request.

captures the degree to which moving costs are increasing in the size of the firm.

Conditional on firm size, moving costs vary across firms in two ways. First, the θ term captures the part of the firm's moving costs that is observable to the government, with higher θ corresponding to higher moving costs. In our empirical analysis, we focus on a firm's property rights status and whether it has operations in multiple provinces as proxies for the observable components of its moving costs. Second, moving costs include a stochastic term ϵ that varies across firms. While θ will be observable to the government in determining bribe rates, the idiosyncratic part of the moving costs ϵ is unobserved.

Putting the pieces together, a firm in province 1 chooses to stay if and only if

$$
\begin{aligned}
\pi_1^* \;&\geq\; \pi_2^* - \theta A^\eta \epsilon, \quad \text{or} \\
\epsilon \;&\geq\; \frac{\pi_2^* - \pi_1^*}{\theta A^\eta}
\end{aligned}
\tag{C.6}
$$

To simplify the algebra, we further assume that ϵ is uniformly distributed over $[0,1]$.[19] The equilibrium number of firms for a given θ in province 1 is therefore simply $1 - \frac{\pi_2^* - \pi_1^*}{\theta A^\eta}$.[20] Since the problem is symmetric for both provinces, this expression will be greater than 1 if $b_1 < b_2$ (firms are moving into province 1 from province 2), and less than 1 if $b_1 > b_2$ (firms are moving out of province 1 to province 2).

The two governments in period 1 set bribe rates, taking firms' response and the other province's bribe rate as given. To solve this, we consider the government in province 1. It

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[19]This assumption simplifies the algebra but is not essential; all of the key results go through for arbitrary distributional forms of the error term.

[20]Even though we have in mind a world of many firms with heterogenous θ, we are solving the model for a particular θ. After we obtain the equilibrium bribe rate, which is a function of θ, we will examine how bribes and the effect of firm growth on bribes vary with θ.

takes b_2 as given and solves,

$$\max_{b_1 \geq 0} b_1 A K^{*\alpha} L^{*\beta} \left(1 - \frac{\pi_2^* - \pi_1^*}{\theta A^\eta} \right) \tag{C.7}$$

Assuming a symmetric equilibrium, the first-order condition can be simplified to:

$$K^* + b_1^*(\alpha + \beta) \frac{dK^*}{db_1} + \frac{b_1^* K^*}{\theta A^\eta} \frac{d\pi_1^*}{db_1} = 0 \tag{C.8}$$

After some algebra, we get:

$$\left[\frac{1}{\theta} A^{1-\eta} \left(\frac{r\beta}{w\alpha} \right)^\beta K^{*\alpha+\beta} + \frac{\alpha + \beta}{1 - \alpha - \beta} \frac{1}{1 - b^*} \right] b^* = 1 \tag{C.9}$$

Note that we have suppressed the province subscript since $b_1^* = b_2^*$ in equilibrium.

Several aspects of the equilibrium condition in Equation (C.9) are worth noting. First, as θ goes to $+\infty$, or firms are completely immobile, the expression simplifies such that $b^* = 1 - \alpha - \beta$. This implies that the greater the diminishing returns to scale, the higher the bribe rate. Intuitively, if output is highly concave in capital, even when the bribe rate is reduced, firms will not expand their capital stock much due to diminishing returns. Thus, the elasticity of capital with respect to the bribe rate is low. The same applies to labor. Therefore, when the government increases the bribe rate, it can extract more revenue from firms without discouraging production. Hence, the optimal bribe rate is higher.

The second observation is that as θ decreases, so that moving costs decrease, inter-regional competition increases and the equilibrium bribe rate decreases. Thus far, the model captures the idea that increasing competition between political jurisdictions can drive down corruption, as in Shleifer and Vishny (1993) and **(alias?)**.

Next, we examine how the equilibrium bribe rate responds to increases in the productivity

of firms, i.e. increases in A. Taking the derivative with respect to $\log A$ on both sides of Equation (C.9) and re-arranging terms, we get our first result:

PROPOSITION 1. $\frac{db^*}{d \log A} < 0$ *if* $0 \leq \eta < \frac{1}{1-\alpha-\beta}$; $= 0$ *if* $\eta = \frac{1}{1-\alpha-\beta}$; *and* > 0 *if* $\eta > \frac{1}{1-\alpha-\beta}$.

Proof. : One way to prove the results is using standard first order condition and taking derivative by invoking implicit function theorem. Here we first make a transformation of variables to simplify the problem. First notice that by replacing K, L, A, θ by $rK, wL, \frac{A}{r^\alpha w^\beta}, \theta(r^\alpha w^\beta)^\eta$, we can assume $w = r = 1$ without changing the problem. This linear change of variable also preserves the signs of the derivatives in question.

We can rewrite the firm's objective function:

$$\pi_1^* = max_{K,L \geq 0}(1 - b_1)AK^\alpha L^\beta - K - L$$

which gives

$$K_1^* = \alpha \left[(1 - b_1)A\alpha^\alpha \beta^\beta\right]^{\frac{1}{1-\alpha-\beta}}$$

$$L_1^* = \beta \left[(1 - b_1)A\alpha^\alpha \beta^\beta\right]^{\frac{1}{1-\alpha-\beta}}$$

$$\pi_1^* = (1 - \alpha - \beta) \left[(1 - b_1)A\alpha^\alpha \beta^\beta\right]^{\frac{1}{1-\alpha-\beta}}$$

Substituting these into the government's problem, we are able to calculate the total bribe received by government in province 1:

$$B_1 = t(1 - \lambda(R_2 - R_1))(R_1^{\alpha+\beta} - R_1) \tag{C.10}$$

where

$$R_1 = (1 - b_1)^{\frac{1}{1-\alpha-\beta}} \tag{C.11}$$

$$R_2 = (1 - b_2)^{\frac{1}{1-\alpha-\beta}} \tag{C.12}$$

$$\lambda = \frac{A^{\frac{1}{1-\alpha-\beta}}}{\theta A^\eta}(1 - \alpha - \beta)(\alpha^\alpha \beta^\beta)^{\frac{1}{1-\alpha-\beta}} \tag{C.13}$$

$$t = (A\alpha^\alpha \beta^\beta)^{\frac{1}{1-\alpha-\beta}} \tag{C.14}$$

Instead of choosing $b_1, b_2 \in (0, 1)$, the two provinces could choose $R_1, R_2 \in (0, 1)$ as well. The FOC for (C.10) then yields

$$\lambda(R_1^{\alpha+\beta} - R_1) = [1 - \lambda(R_2 - R_1)] * \left[1 - (\alpha + \beta)R_1^{\alpha+\beta-1}\right] \tag{C.15}$$

The symmetric equilibrium $R_1 = R_2 = R^*$ must then satisfy

$$\lambda(R_1^{\alpha+\beta} - R_1) = 1 - (\alpha + \beta)R_1^{\alpha+\beta-1} \tag{C.16}$$

This gives the equilibrium bribe rate b^* via (C.11).

With that preliminary math completed, we can complete the proof. Re-arrange (C.16) and notice that the ratio

$$\phi := \frac{1 - (\alpha + \beta)R_1^{\alpha+\beta-1}}{(R_1^{\alpha+\beta} - R_1)}$$

is strictly increasing in R, because $R_1^{\alpha+\beta} - R_1$ is concave and hence log-concave in R. Therefore, (C.16) has a unique solution for fixed parameters (so fixed λ), and this solution is strictly increasing in λ. In other words,

$$\frac{dR^*}{d\lambda} > 0 \tag{C.17}$$

From (C.11), $b^* = 1 - (R^*)^{1-\alpha-\beta}$, and so $\frac{db^*}{dR^*} < 0$. Also from (C.13), $\frac{d\lambda}{dA}$ is positive when $\eta < \frac{1}{1-\alpha-\beta}$ and negative otherwise. Multiplying the three inequalities, we obtain

$$\frac{db^*}{dA} > 0, \text{when } \eta > \frac{1}{1-\alpha-\beta}$$
$$\frac{db^*}{dA} < 0, \text{when } \eta < \frac{1}{1-\alpha-\beta}$$

■

The critical factor that determines the sign of $db^*/d\log A$ is η, which characterises the concavity of the moving costs with respect to the capital stock. The intuition is that with a positive shock to A, for a given size, firms enjoy higher revenues and hence care more about the bribes they will pay and less about the moving costs. This tends to drive down the equilibrium bribe rate due to inter-regional competition. However, at the same time, the cost of moving rises as firms expand in size to take advantage of the higher productivity. This instead tends to drive up the equilibrium bribe rate. The two effects exactly cancel at $\eta = \frac{1}{1-\alpha-\beta}$.[21] If $\eta < \frac{1}{1-\alpha-\beta}$, then the first effect (inter-regional competition effect) dominates the second effect (moving cost effect), and the equilibrium bribe rate falls. Given that $1 - \alpha - \beta < 1$, a sufficient condition for $\frac{db^*}{d\log A} < 0$ is that moving costs scale up less than linearly with firm size, as proxied by A. Moving costs seem likely to fulfil this assumption in practice and, moreover, because $1 - \alpha - \beta$ can in fact be much less than 1, it seems plausible that $\eta < \frac{1}{1-\alpha-\beta}$ and therefore $db^*/d\log A < 0$ in most settings. The empirical evidence presented in the previous section matches this prediction of the model.

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[21] Though the specific cut-off value for η at which the sign of the comparative statics switches depends on the Cobb-Douglas functional form for production and the particular parameterization of the moving costs, the general intuition is robust: The more concave the moving costs with respect to firm size are, the more likely that equilibrium bribe rate decreases with A.

Proposition 1 specifies conditions when the *rate* of bribe extraction falls as A increases; the rate b is the size of the distortion to production. It is worth noting that another (testable) prediction is that the *total amount of bribes* extracted from the firm will increase when A increases. To see this note that the firm's moving decision is a tradeoff between its total moving costs and its total bribes. Since when A increases, the firm's moving costs increase, the government can retain the same firms even with a higher total bribe extraction.

Also worth noting is that to the extent that taxes follow similar patterns to bribes, another implication of the model is that taxes on firms should also be lower in rich countries than in poor countries. There is suggestive evidence along these lines: Gordon and Li (2009) show that for poor countries (with per-capita GDP below \$745), corporate income taxes represent 7.5% of GDP, whereas for rich countries (with per-capita GDP above \$9,200), corporate income taxes represent only 4.5% of GDP, although they suggest a different explanation than the one proposed here.

Next, we examine how the effect of a productivity shock on bribes varies across firms with different θ. We will focus on the firm's property right status or multi-province operations as the empirical analogue of θ, where higher θ corresponds to less transferable property rights or concentration of operations in one province and thus a higher cost of moving. The next proposition derives how the elasticity of bribes with respect to productivity varies with θ.

PROPOSITION 2. *The elasticity* $-\frac{d \log b^*}{d \log A}$ *is monotonically decreasing in θ if and only if* $0 \leq \eta < \frac{1}{1-\alpha-\beta}$. *That is,* $\frac{d^2 \log b^*}{d \log A d\theta} > 0$ *iff* $0 \leq \eta < \frac{1}{1-\alpha-\beta}$.

Proof. : From (C.11),

$$\epsilon_{R^*} = \frac{1}{1-\alpha-\beta} \frac{b^*}{1-b^*} \epsilon_{b^*} \tag{C.18}$$

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where $\epsilon_R = \frac{dR}{dA}\frac{A}{R}$ and $\epsilon_b = -\frac{db}{dA}\frac{A}{b}$. Taking the derivative of (C.16) with respect to A, we get (omitting stars)

$$\epsilon_\lambda := \frac{1}{1-\alpha-\beta} - \eta = \left[\frac{(\alpha+\beta)(1-\alpha-\beta)R^{\alpha+\beta-1}}{1-(\alpha+\beta)R^{\alpha+\beta-1}} + \frac{R-(\alpha+\beta)R^{\alpha+\beta}}{R^{\alpha+\beta}-R}\right]\epsilon_R \qquad (C.19)$$

Substitute (C.18) and (C.11) into (C.19), we have

$$\frac{\epsilon_\lambda}{\epsilon_b} = \left[(\alpha+\beta)R^{\alpha+\beta-2} + \frac{R^{\alpha+\beta-1}-1}{(1-\alpha-\beta)R}\right]\phi^{-1} \qquad (C.20)$$

It is easy to see that b^* (R^*) increases (decreases) with θ, and thus the right hand side increases with θ. Therefore,

$$\frac{d\epsilon_{b^*}}{d\theta} < 0, \text{ when } \epsilon_\lambda > 0 \Leftrightarrow \eta < \frac{1}{1-\alpha-\beta} \qquad (C.21)$$

∎

Intuitively, Proposition 1 implied that bribes fall when there is an increase in A, because more profitable firms are more willing to pay moving costs and escape from high bribe rates. Proposition 2 states that the bribe rate falls more after such a shock for firms with lower observable moving costs because the fraction of firms who are on the margin of moving is larger, so a given change in bribes will induce a larger number of them to leave.[22]

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[22]Note that Proposition 2 is stated in terms of elasticity or percentage change in the bribe rate (i.e. the change in $\log b$). The sign for the cross-partial of the level change (ie. $\frac{d^2 b^*}{dA d\theta}$) is in general indeterminant because though the elasticity falls with θ (under the condition in Proposition 2), the level of bribe also falls with θ. In particular, we can show that the relationship between $\frac{db^*}{dA}$ and θ is U-shaped and increasing as $\theta \to \infty$, and $\frac{d^2 b^*}{dA d\theta} > 0$ for a reasonable range of θ as assessed by the ratio of moving costs to revenue.

Appendix D Description of key variables

The key variables described in Table 1 are below. Note that each observation is a firm; the sample pools firms for the years 2006 to 2010. The PCI firms in our sample are firms with at least 10 employees, valid industry and bribe payment data and whose province-industry-year is represented in the GSO data.

- Bribes as percentage of revenue (PCI): This is a 7-point categorical variable drawn from question D6 of the annual PCI survey. Respondents answered within ranges: 1) 0%; 2) less than 1%; 3) 1-2%; 4) 2-10%; 5) 10-20%; 6) 20-30%; 7) over 30%. We recode each category with the corresponding cell mean with over 30% recoded as 35%.

- Years since establishment (PCI): Continuous variable that subtracts year of establishment from the year the firm completed the survey (2006 to 2010). Establishment only captures when the firm began doing business and has no legal connotation. A follow-up question asks when a firm registered as a formal business.

- Number of employees (PCI): This variable is categorical in PCI: for example, 10-49, 50-199, etc. We recode each category with the corresponding empirical cell mean in GSO.

- Mean employment (GSO, mean for industry-year-province level): Continuous measure collected in the GSO Enterprise Census.

- Log employment (GSO, aggregate for industry-year-province): Continuous measure collected in the GSO Enterprise Census.

- Log of business premise size (hectares) (PCI): Continuous measure collected in only the 2009 to 2011 surveys.

- Land ownership (dummy) (PCI): Dichotomous variable measuring whether a firm purchased (=1) or leases (=0) its main business premises.

- Land use right certificate (LURC, dummy) (PCI): Dichotomous variable measuring whether a firm possesses an LURC for its main business premises.

- Land ownership without land use right certificate (dummy) (PCI): Dichotomous variable, calculated from questions about whether a firm owns land and whether it has an LURC for that land.

- Number of other provinces in which firm operates (PCI): Count variable calculated from firm's response to a question asking it to record all provinces and national-level cities in which it has operations or branch offices, outside of its headquarters location.

- Firm currently operates in more than one province (dummy) (PCI): Dichotomous variable for whether firm listed operations in at least one province outside the province with its main headquarters.

- Share of registration documents held: Based on the following question: "In addition to the certificate of business registration, your business may need additional permits or business to be fully legal (e.g. mining licenses....). How many of these documents were required for your firm?' "Y" Variable defined as the number of registration documents held by the firm divided by the 95th percentile of the firm's industry (a proxy for formality).

- Former household firm (dummy) (PCI): Dichotomous variable for whether the firm operated as an informal business based on household premises before formal registration.

- Former SOE (dummy) (PCI): Based on questions asking whether the firm is a privatised former State Owned Enterprise (SOE). Equals 1 if the firm is either a locally or centrally managed SOE.

- Owner is a former government official (dummy) (PCI): Based on question asking whether the owner of the private enterprise is a former government official, army office, or SOE manager.

- Government holds a positive share (dummy) (PCI): Based on question asking whether shares of the firm are held by local or central government officials.

Appendix E   Testing alternative models

Empirical confirmation of several predictions of our model supports the idea that inter-jurisdictional competition is a mechanism through which economic growth can reduce bribery. However, there are also other potential models that predict a negative correlation of economic growth and the bribe rate. The first and most direct way to distinguish between the inter-jurisdictional model and these other models is that we find that the relationship between growth and bribery is diminished for firms that are less likely to relocate outside their province. This is a direct prediction of inter-jurisdictional competition, but is not predicted by most other models.

Nonetheless, it is possible that these heterogenous effects are picking up other firm characteristics besides property rights or multiple locations. Thus, it is important to consider several other possible explanations for the general pattern that economic growth reduces bribes, and to discuss the degree to which our evidence is, or is not, consistent with them.

E.1   Product-Market Competition

Economic growth could increase competition among firms, and this product market competition affects the amount of rents bureaucrats can capture. If firms have less market power and smaller rents, then bureaucrats may be less able to extract bribes from them. Ades and Di Tella (1999) present empirical evidence that product market competition reduces corruption, for example. To probe the possibility of this mechanism, we test the starting premise that the variation in economic growth that we analyse increases market competition. We regress the Herfindahl index, constructed using employment (our most accurate measure of firm size) from the GSO data, on employment, instrumented with industry employment

in the rest of Vietnam ($\log(Employ_{p-jt})$). We find that higher predicted employment leads to less, not more, competition, suggesting that the main mechanism through which growth reduces bribery in our context is not increased firm competition (Table A16, column 1).[23] However, Bliss and Di Tella (1997) present a model in which, counterintuitively, less competition among firms can lead to less bribery; it is possible that this mechanism of reduced competition among firms (higher rents for firms) leading to a reduction in bribe extraction is at play in our setting.

E.2 Spurious Effect of Industry-Specific Bribe Crackdowns

A second possibility we consider is that there are industry-specific crackdowns on bribes. As discussed earlier, this represents the fundamental identification assumption of the within-Vietnam analysis: There are no industry-specific crackdowns on bribes. The strongest evidence in support of our assumption is that when we use industry size in China to instrument for industry size in Vietnam, we find similar results, suggesting that internal reverse causality within Vietnam is not driving the results.

Moreover, the institutional structure of Vietnam, which we described in section 1.1 is such that bribery is decentralised to the province level, suggesting that national industry-level crackdowns are unlikely (recall that our identifying variation is essentially Vietnam-wide growth for an industry). In addition, we undertook a systematic review of the national anti-corruption website, which documents major anti-corruption efforts of the government. Over the study period, only one industry-specific anti-corruption campaign is documented,

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[23]Another option would be to test for changes in profit margins directly. However, the profit margin data in the GSO is known to be much less reliable than employment (Tran and Dao, 2013), as firms routinely underreport profits to avoid taxes. For example, in the GSO data, 38% of firms report a profit margin of less than 1% of revenues, with 23% of firms reporting 0 profits. Given these reporting issues, the PCI dataset does not ask about profits.

a crackdown in the construction industry in 2008. Table A16, column 2 shows that the main results are essentially unchanged when we re-run our main specification from column 1 of Table 3, but excluding the construction industry. As the fundamental identification assumption, it is difficult to establish empirically that there are no industry-specific shocks to bribes, but the qualitative evidence points against such an explanation for the patterns we find.

E.3   Fixed Cost of Anti-Corruption Enforcement

Another possibility is that there is a layer of oversight over bureaucrats aimed at rooting out corruption, such as an anti-corruption agency. The overseers face a fixed cost of enforcement, so as the total scale of bribery (in levels) goes up, it is easier to detect and punish bribery. Or said differently, it may be easier to detect a larger bribe. If so, then as firms grow, bureaucrats will adjust the bribe rate down.

While this explanation may be at work at the cross-country level, it does not seem to be a key factor explaining the results in this paper. In particular, since most regulatory activities are at the province level, if fixed costs were the main explanation, then the key factor determining bribes would be the overall size of economic activity in the province as a whole, not the size of particular industries.

To test this, column 3 of Table A16 reruns the main IV regression, but in addition to including log employment in a province-year in the particular industry, we also include the aggregate endogenous variable, which is log employment in the province-year in all industries. Because we have two endogenous regressors, we need two instruments. For the first, we use our standard single IV that is industry-year employment in the rest of Vietnam. The

second IV aggregates employment across all industries in the rest of Vietnam. To construct this aggregate instrument, we calculate the log of the weighted sum over all industries of employment in the industry in a given year in all provinces excluding province p itself (relative to the average over all years), where the weights represent the share of total employment in province p that comes from industry j. Specifically, define the weights for each industry j in province p as:

$$w_{pj} = \frac{1}{T} \sum_t \frac{Employ_{pjt}}{Employ_{pt}}. \tag{E.1}$$

Then the predicted log employment in province p at time t is:

$$predicted \log(Employ_{pt}) = \log \left[\sum_j w_{pj} \frac{Employ_{p^-jt}}{\left(\frac{1}{T} \sum_t Employ_{p^-jt} \right)} \right] \tag{E.2}$$

where the $\frac{1}{T} \sum_t Employ_{p^-jt}$ term is a normalization such that the weights to each industry are given exactly by w_{pj}. Note that with a single industry j in a province, $predicted \log(Employ_{pt})$ reduces exactly to $\log(Employ_{p^-jt})$.

Using this approach, the evidence in column 3 suggests that, the IV coefficient estimate on overall province employment, $\log(Employ_{pt})$, is insignificant, and the negative coefficient on industry-specific $\log(Employ_{pjt})$ is unchanged from our main specification. This suggests that the results are not being driven by aggregate changes in enforcement practices at the province level.

E.4 Diminishing Returns to Bribes

A final alternative explanation for the main effect we find is that bureaucrats have diminishing marginal utility of income relative to the risk of being caught and going to jail. Thus,

as it becomes easier to extract a given amount of bribe revenues, they reduce the rate. The reduced form effect of this mechanism would be similar to a fixed cost of anti-corruption enforcement within each province: A decline in bribes would be driven by aggregate employment in the province, not industry-specific employment. The results in column 3 of Table A16 suggest that this is not the entire explanation for our results.

E.5 Summary

In summary, to the extent we can examine quantitative and qualitative predictions of these alternative models, we do not find that other mechanisms can explain all the facts in the data. It still may well be that these other mechanisms are in operation and explain some of the overall effect of growth on bribery. But, the positive evidence in support of inter-jurisdictional competition and the limited evidence in support of other models suggests that the mechanism we highlight is at least one important factor in why economic growth reduces corruption in Vietnam.