Does Economic Growth Reduce Corruption? Theory and Evidence from Vietnam*

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Abstract

This paper tests whether economic growth reduces corruption, using cross-industry variation in growth rates in Vietnam and survey data from over 13,000 Vietnamese firms between 2006 and 2010. We employ two instrumental variables strategies, one based on growth in a firm's industry in other provinces within Vietnam and a second based on industry growth in neighboring China. In both specifications, we find growth causes a decrease in bribe extraction. We then model one mechanism that could generate such an effect; in our model, government officials' choice of how much bribe money to extract from firms is modulated by inter-jurisdictional competition. A key secondary prediction of the model is that the negative effect of growth on bribery is larger if firms are more mobile. We find empirical support for this prediction: Effects are larger for firms whose property rights to their land are transferable and who have operations in multiple provinces.

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1 Introduction

A striking fact about government corruption is that, no matter how you measure it, it is higher in poor countries. For example, the 10 least corrupt countries in the 2009 Transparency International Corruption Perceptions Index, such as New Zealand, the Netherlands, and Canada, had an average real GDP per capita of $36,700; the 10 most corrupt countries, such as Haiti, Turkmenistan, and Afghanistan, had an average real GDP per capita of $5,100. This relationship is easy to see in the raw data: Figure 1 shows scatter plots of the two major corruption indices, the Transparency International Corruption Index and the World Bank Control of Corruption Index, plotted against real (i.e., PPP-adjusted) GDP per capita, and shows a clear downward-sloping relationship between corruption and GDP.

The strong correlation between economic development and corruption does not appear to be an artifact of misplaced perceptions. Data on individual bribe payments from household surveys conducted in several countries show the same pattern (e.g., Mocan (2004)), as do survey data collected from firms around the world. Figure 2 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 once again, there is a downward-sloping relationship.

While there is a general consensus about the cross-sectional facts, we know relatively little about why corruption is lower in rich countries. One hypothesis is that the pattern reflects a negative causal effect of corruption on economic growth: Corruption discourages investment which, in turn, depresses growth. A large literature has explored this direction of causality (Mauro, 1995; Wei, 1999a). The implication of this hypothesis is that rooting out corruption could be critical in achieving higher growth in developing countries.

However, the correlation between income and corruption might also be due to the reverse causal link: Economic growth could reduce corruption, so as countries grow, corruption naturally declines. This prediction has a long history in political economy and is commonly summarized as the 'life-cycle of corruption' hypothesis (Huntington, 2002; Bardhan, 1997; Glaeser and Goldin, 2004; Laffont, 2006; Ramirez, 2014). Despite a long lineage, the life-cycle literature suffers from two limitations, which this paper seeks to address. First, there is limited evidence for a causal link from growth to reduced corruption. Second, the actual mechanism by which growth reduces corruption is poorly understood and analyzed, as most of the extant work takes place at the country level. The robustness of the country-level relationship is indeed interesting, but measures of corruption fundamentally result from the aggregation of multiple interactions between individuals. In this paper, we go further, asking how greater wealth alters the decision-making process of the actors (i.e., politicians, bureaucrats, firms, and citizens) that actually engage in the corrupt behavior. The firm-bureaucrat relationship is of particular importance because most existing measures of corruption are derived from firm-level surveys about interactions with regulators. Previous work has hinted at two possible channels. One mechanism focuses on the civil servant's side of the relationship, arguing that growth generates higher bureaucratic salaries, which raises the risks and reduces the incentives of partaking in petty bribery (Van Rijckeghem and Weder, 2001; Di Tella and Schargrodsky, 2003; Svensson, 2005; Gorodnichenko and Peter, 2007). Alternatively, Harstad and Svensson (2011) focus on the firm's decision making process, arguing that development leads to larger firms who find lobbying more attractive than bribery for avoiding regulatory constraints.

In this paper, we also develop and test a firm-level explanation of how growth affects the bribes that firms pay to government officials, namely competition among regional governments to attract and retain firms. This theory builds off a rich literature on the governance benefits of decentralization for generating competition between administrative units (Tiebout, 1956; Weingast, 1995; Inman and Rubinfeld, 1997; Fisman and Gatti, 2002). Key to our analysis is a stream of literature arguing that competition for residents and investors constrains the rent seeking impulses of local governments, leading to less distortions in policy (Brennan and Buchanan, 1980; Jin, Qian, and Weingast, 2005).

Our argument departs from previous work on sub-national competition in that we are not interested in studying the impact of changes or variance in decentralization. Taking the level of decentralization in our research setting as given, we argue that exogenous shocks to the growth and mobility of firms strengthen their hands in bargaining with local officials, which ultimately reduces their bribe schedules. The decision problem we model of a bureaucrat setting a bribe rate is analogous to the problem of local governments setting tax rates (Epple and Zelenitz, 1981; Epple and Romer, 1991; Wildasin, 2003; Wilson, 1986). A recent study by Diamond (2012) uses a similar framework to study the effect of workers' migration elasticity on the magnitude of rent extraction by state and local governments. Where we differ from her study and many previous tax competition papers is in the comparative statics we are interested in: We derive (and test) not just the determinants of the level of rents (taxes or bribes) but also the effects of economic growth in such an environment, which, to our knowledge, has not been a focus of the tax literature but could also apply in that context. In addition, the normative implications of a higher bribe rate differ from those of a higher tax rate, both because the bribe revenue accrues to bureaucrats rather than being used for public goods or redistribution and because the need to hide corrupt activities might generate inefficiencies (Shleifer and Vishny, 1993).

To test our theory we estimate the growth-bribery relationship using firm-level data from Vietnam and within-country variation in growth. We find that growth reduces the bribe rate that firms pay. Next, we empirically test and confirm other predictions of our inter-jurisdictional competition model. These findings contribute to the large literature on the effects of economic growth on institutional performance, providing the first empirical evidence that we know of for the idea that inter-regional competition could reduce corruption and showing that this effect is enhanced by mobility.[1] (Acemoglu, Johnson, and Robinson, 2005; Glaeser, La Porta, Lopez-de Silanes, and Shleifer, 2004). More broadly, we provide some of the first micro empirical estimates of the life-cycle hypothesis of growth and corruption. Our estimates are based on within-country variation over time, but they provide some of the best evidence to date that speak to country-level trends in corruption: Our finding that economic growth reduces bribery is consistent with the idea that countries might "grow" their way out of corruption. While the results here are from a relatively short time period, and are estimated using heterogeneity in growth rates within a single country, they provide suggestive evidence that it may not be necessary to root out corruption to spur growth, but rather corruption might subside as a country grows.[2]

The empirical analysis uses the Provincial Competitiveness Index (PCI) survey, an annual survey of firms that asks how much the firm paid in bribes to government officials as a percentage of its revenues (Malesky, 2011). We construct a repeated cross-section across province-industries from 2006 to 2010, comprised of data on about 13,000 individual firms, and examine how the bribe-paying rate varies with firms' growth (or more precisely, with their predicted growth).

The PCI survey is designed to study the investment environment across Vietnam's 63

[1]From a theoretical perspective, Rose-Ackerman (1978) and Shleifer and Vishny (1993) are among the first to argue that competition between bureaucrats can reduce corruption, though they consider a different framework than the one we present here. The closest analogue to the ideas developed here is 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. Burgess et al. (2012) show in the context of illegal logging in Indonesia that Cournot-style competition between jurisdictions can decrease the price of bribes, though in their context that actually leads to more corrupt activity, rather than less.

[2]At the cross-country level, the most related work is Treisman (2000), who finds that per-capita income, instrumented by distance to the Equator, negatively predicts corruption. Treisman (2007), however, notes that this relationship does not necessarily hold once one uses microdata-based measures of corruption of the sort we examine here. Gundlach and Paldam (2009) use a different biogeographical instrument with similar results.

provinces and therefore collects data on a representative sample of firms in each province. The survey instrument asks respondents to reflect on their interactions with provincial officials, allowing us to treat each province as a jurisdiction in which bureaucrats determine how much to extract from local firms. The reason the PCI specifically asks about dealings with provincial officials is that bureaucratic corruption is largely decentralized in Vietnam, with provincial governments, as opposed to the central government, wielding the most power to extract bribes from firms (Meyer and Nguyen, 2005; Cung, Tuan, Van, and Dapice, 2004; Tran, Grafton, and Kompas, 2009). Moreover, provincial leaders have several levers to keep bureaucratic subordinates in line, so the bribe schedule in a province is set in a fairly centralized manner. These institutional features inform our theoretical and empirical frameworks, in which we treat the province as the relevant geographic unit for bribe extraction and inter-provincial competition as a force that can keep corruption in check. There is also suggestive evidence of corruption as a factor in firms' location decisions: The most recent wave of the PCI collected data from some firms on what might prompt them to relocate, and 20 percent of them cited the quality of local governance.

As shown in Figure 3, during our study period of 2006 to 2010, nationally Vietnam was growing rapidly, and corruption as measured in the PCI was falling. These time trends are suggestive, but do not isolate the causal impact of growth on corruption. To test for a causal relationship, we use detailed micro data and track how shocks to predicted firm profitability affect the bribes that provincial officials extract from the firm. Our proxy for firm profitability is aggregate employment at the industry-province-year level constructed from a census of firms conducted by Vietnam's General Statistical Organization (GSO).[3]

The key challenge is to isolate exogenous variation in firm profitability or its proxy, industry size. To do so, we use two complementary instrumental variables (IV) strategies. The first strategy uses industry size in the rest of Vietnam, excluding the firm's province itself, as an IV. The logic of this "leave one out" estimator is that there are shocks to TFP or factor prices within an industry that are common across Vietnam, while the unobserved determinants of bribery (e.g., the corruption level of local bureaucrats) that could generate bias in a simple OLS setup are, by and large, specific to the province and not common across Vietnam.

One possible concern with this identification strategy is that some omitted factors could

[3]Growth in aggregate employment arises from both growth in the number of firms and employment growth of existing firms. Our theoretical predictions are about the growth of existing firms. Empirically, most of the growth in aggregate industry employment at the province-year level occurs via the growth of existing firms. See footnote 11 for further details.

be nationwide, such as national industry-specific corruption crackdowns, or that changes in the corruption environment in one province could affect firm growth rates in other provinces. Although a comprehensive review of Vietnamese policy at the time suggests national industry-specific corruption crackdowns are generally not going to be an issue in our context, we also use a second empirical strategy in which we instrument for growth in Vietnam with industry-specific growth in neighboring China, calculated using the China Labor Statistical Yearbook. Industry-wide performance in China, like industry-wide performance in the rest of Vietnam, is a strong predictor of a Vietnamese firm's performance. Because China is substantially larger than Vietnam, it seems unlikely that growth of Chinese firms would be endogenously affected by time-and-industry-specific corruption crackdowns or other policy changes in Vietnam. Thus, this IV is less subject to exogeneity concerns. Meanwhile, the advantages of the within-Vietnam IV are that it has a stronger first stage (similar first stage coefficient but more precision) and we can match across data sets at the industry level with more accuracy.

Using these IV strategies, we find that when a firm's predicted growth increases, the rate of bribe extraction decreases. The two IVs produce remarkably similar estimates. To the best of our knowledge, this provides the first within-country causal evidence that economic growth leads to lower corruption.

After providing empirical evidence of a negative effect of growth on bribery, we present a model of one possible channel through which the effect could occur. We develop a simple neoclassical model based on the idea of inter-regional competition. In our model, government officials choose 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.

The model predicts, under reasonable assumptions about firms' moving costs, that an exogenous increase in firm productivity reduces the proportion of firm revenues that are extracted as bribes. Specifically, the assumption needed is that moving costs are concave in firm size. If this is true, then for a fixed bribe rate, a firm's net benefits of moving (reduced bribes minus moving costs) increase 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. Bribes become a smaller part of the economy as firms grow. Our empirical finding discussed above matches this prediction.

The model also predicts that if corrupt officials can price-discriminate among firms (as in, e.g., Svensson (2003)), this 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 then test for the heterogeneous patterns predicted by the model. To capture heterogeneity in moving costs, we use variation in whether firms possess a Land Use Rights Certificate (LURC), which gives them secure and transferable property rights over their lands. These property rights make firms more mobile, since they increase their ability to sell their lands and relocate should they wish to do so.[4] 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 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 interjurisdictional competition mechanism in our model, 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 enforcement 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 model we lay out is likely at play – it is also important to note that other mechanisms likely contribute to the overall effect of growth on bribery that we estimate empirically.

Beyond the contributions to the life-cycle hypothesis and decentralization literature, our finding that better property rights for firms coupled with economic growth can reduce cor-

[4]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, Emerick, Gonzalez-Navarro, and Sadoulet, 2012) and international (Valsecchi, 2011) migration.

ruption adds to the literature on the economic benefits of property rights. Strong theoretical and empirical evidence exists for the relationship between property rights, domestic investment, and growth (North, 1991; De Long and Shleifer, 1993; Weingast, 1995; Goldstein and Udry, 2008; Jones, 1981; Acemoglu and Johnson, 2005; Olson, 2000). De Soto (1989) and De Soto (2000) famously predicted that through the provision of land titles, entrepreneurs in the informal sector could be transformed into an important source of economic growth in the developing world. Since the publication of that piece, convincing evidence has been found that allocation of land rights increases household investment (Galiani and Schargrodsky, 2010), belief in the power and fairness of the market (Di Tella, Galiani, and Schargrodsky, 2007), and the number of hours dedicated to productive work (Field, 2007). We provide a new dimension to the literature on the economic benefits of property rights by demonstrating how land titling can restrain the grabbing hand of local authorities in the presence of economic growth.

The remainder of the paper is organized as follows. Section 2 describes our data and background information on Vietnam. Section 3 describes the empirical strategy, and section 4 presents the results on the overall effect of growth on bribery. Section 5 presents the model. Section 6 empirically tests the prediction that the growth-bribery effect varies with a firm's mobility and discusses alternative mechanisms through which growth could affect bribery. Section 7 concludes.

2 Setting and data

2.1 Background on Vietnam

Vietnam provides a unique opportunity to study the effect of growth on bribery and how competition among subnational governments to attract firms affects bribery. At its 6th Party Congress in 1986, the country initiated the *Doi Moi* (Renovation) economic reforms, which eliminated the role of central planning in the economy and opened the country's borders to international capital and trade flows (Fforde and De Vylder, 1996; Riedel and Turley, 1999). Since that time, the country has achieved an average annual growth rate of 7.3 percent, ranking it among the very fastest growing countries in the world over the period.

Three post-*Doi Moi* events are also critical for understanding Vietnam's economic development in the period we study. The Enterprise Law in 2000 created the formal legal basis for the private, corporate sector in Vietnam and eased registration into all non-restricted activities. One year after the Enterprise Law, Vietnam finalized the long-standing negotiations with the United States over their bilateral trade agreement (US-VN BTA), which granted Vietnam Most-Favored Nation (MFN) status in accessing US markets. Finally, in 2007 Vietnam joined the World Trade Organization. Combined, these reforms led the period we study to be one of dramatic expansion in private activity in Vietnam: 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 degree of economic growth over this period varied considerably across provinces, as shown in Figure 4.[5]

Despite this growth, there is still substantial corruption 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 percent 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 fulfill 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. Vasavakul (2008) writes that, "A number of studies on informal payments [by individuals] show informal bribery totals from 100,000 to 2.1 million VND (roughly 5 to 100 USD) [per individual per year]. 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 percent of businesses paid bribes to expedite business registration, 35 percent paid bribes when competing for government procurement contracts, and 70 percent 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 decentralized to the provincial level. These include business registration, environmental and safety inspections, labor oversight, local government procurement, and land allocation. In practice, 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

[5]Figure 4 uses provinces' reports of their GDP, which, when aggregated, give a higher national GDP and growth rate than the official national statistics, which are likely more accurate. Thus, while the figure demonstrates the heterogeneity in growth across provinces, the levels shown are likely inaccurately high.

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; Cung, Tuan, Van, and Dapice, 2004; Tran, Grafton, and Kompas, 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 centralized 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 behavior, 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, formalizing specific waiting periods for documents, and increasing transparency about the responsibilities of subordinate officials to businesses and citizens. Indeed, one of the incentives for the creation of the 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 5 shows the distribution across provinces of the average response by firms for two corruption questions from the PCI survey in 2010, the last year of our sample period. In the worst-scoring province, 77 percent of private firms reported that firms in their line of business were subject to bribe requests. In the best-scoring province, a substantially smaller 15 percent 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, 60 percent of firms in the most corrupt province said bribe payments exceeded 2 percent of their annual revenue, compared to 0 percent in the lowest province.

2.2 Description of data

To examine the effect of growth on corruption, we use two firm-level data sets from Vietnam, the Vietnam PCI Survey (Malesky, 2011), and the annual enterprise survey collected by the General Statistics Office 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.[6]

The PCI survey is a comprehensive governance survey of formal sector firms across Vietnam's 63 provinces.[7] The survey team randomly sampled from a list of at least partly private companies registered with each 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.

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 (which maps almost precisely to b in the model we develop in section 5). 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.

Table 1 presents summary statistics for the firms in the PCI data. For the analysis, we merge the PCI firms with aggregate information from the GSO survey at the industry-province-year level. For industry, we use the ISIC alphabetical category. Thus, the PCI firms in our sample are those with non-missing data on industry whose province-industry-year is represented in the GSO data. Our final analysis data set contains 13,160 firms that meet this sample inclusion criterion.

[6]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 past year's experiences. 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.

[7]In 2008, Ha Tay province was merged with Hanoi, reducing the number of provinces from 64 to 63.

The key dependent variable is constructed from the PCI question that asks the firm its unofficial payments as a percentage of total revenue, which corresponds to b in our model. The question is categorical, with the following possible responses: 0, $< 1\%$, $1 - 2\%$, $2 - 10\%$, $10 - 20\%$, $20 - 30\%$, $> 30\%$. We transform this into a scalar variable 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 percent 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 the survey, although there is no way to formally guarantee that the task was not delegated to a subordinate. Over 65 percent of respondents in the domestic survey 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 sample has been in business for four years and has between 10 and 49 employees.[8] Figure 6 shows the relationship between the bribe rate and firm size in our sample. Larger firms pay 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 theoretical prediction in the model we present – is the bribe rate.)

In addition to corruption activities, the PCI also has variables related to the firm's property rights status that we can use as measures of 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 (LURC). We will discuss these variables in more detail when we discuss the empirical results. The second proxy for mobility we have in the data is how many provinces the firm operates in. While the majority of firms are wholly located in one province, multi-province firms are reasonably common, with 30.6 percent having operations in provinces besides their main location.

Table 1 also summarizes several control variables we use, including the proportion of registration documents the firm has (a proxy for formality), whether the firm was formerly a household firm, whether it is a former state-owned enterprise, whether the owner is a

[8]We use the GSO fine-grained data on employment to impute the mean and median employment level within the PCI ranges. The median size of firms in the GSO that are between 10 and 49 employees is 19 employees.

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 as a predictor of the firm's size. Since the PCI is a sample, not a census, to measure the total employment in an industry in each year, we use the annual GSO census of firms in Vietnam to construct industry size. The GSO data include all formal sector firms in Vietnam, both private and state-owned. We restrict our sample to private firms in order to match with the PCI, and then merge the aggregate industry-province-year GSO measures to the PCI firms, at the industry-province-year level. We use the ISIC alphabetical industry codes in both data sets for our analysis. In the final merged data set, we have 18 distinct industry categories (see Appendix Table 1 for a description of the industries). Mean employment among firms in the GSO data is 24, similar to the level in the PCI. The main GSO variable we use in the analysis is the log of aggregate employment in the industry-province-year, which is also summarized in Table 1. We also use the GSO data to construct the rest-of-Vietnam IV.

To construct our China IV, 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 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.

3 Empirical strategy

The hypothesis we aim to test is that an increase in firm productivity, A, has a negative effect on bribes, or more specifically, bribes as a percentage of the firm's revenues ($Bribes$). Note than an increase in the price of a firm's products has the same impact as an increase in A; empirically, we will use demand shocks, which change the price that firms are paid for their goods or services, as the source of variation in A.

With data on firms indexed by i in province p, industry j, and time t, one could in principle test the hypothesis 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 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 firm employment (*Employ*) as a proxy.[9] 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 section 5), 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.

A second issue is that employment levels are potentially endogenous to the bribe level b. Thus, we estimate Equation (1) via two IV strategies, as described below.

3.1 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). The 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 above.

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 different average levels

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

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.

3.2 China IV

One potential 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 changes 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 section 5), 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 industries 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:

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

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

3.3 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 is 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.

4 Results

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

4.1 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).[10] Each observation in the first-stage regressions we present is a pjt combination.

The GSO data is a census of all firms in Vietnam in a given year. We can either run the first stage for all firms, or we can restrict our sample to only private firms. Since the PCI data only contains private firms, the most appropriate aggregate measures of firm productivity to predict outcomes in the PCI are based on only using private firms, so we make this sample restriction in the GSO.

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 percent level using the within-Vietnam IV; the F-statistic is 37.9. The coefficient on $\log(Employ_{p^-jt})$ is 0.724. This means that for a 10 percent increase in total employment in other provinces for industry j in year t, there is a 7.24 percent 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 0.724 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 0.723. The coefficient is significant at the 1 percent 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 different (e.g., it comprises only urban firms). The F-statistic is 7.05. Because of this relatively low (for an instrument) F-statistic (i.e. slightly below the usual critical value of 10), we focus more on the multiple-IV variant when using the China IV strategy.

We obtain a stronger first stage for China IV using multiple IVs. The multiple-IV first stages for both Vietnam and China are reported in Appendix Table 2. The F-statistics for the set of instruments are 21.1 using Vietnam and 18.5 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

[10] 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.

and multiple-IV China results.

4.2 Validation of matching between PCI and GSO data sets

Before turning to the second stage results, we investigate 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.[11] 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:

$$\log(Employ_{pjt}^{\text{PCI}}) = \alpha + \beta \log(Employ_{pjt}^{\text{GSO}}) + \nu_{pj} + \mu_t + \epsilon_{pjt} \tag{6}$$

[11] Even if average firm size falls because of entry, an increase in A will generally lead to growth on both the intensive and extensive margin. However, predicted employment would be a weak proxy for an existing firm's employment growth if shocks to A only affect the extensive margin. In our setting, there is correlated growth along both margins: Predicted total employment is highly correlated with both average firm size in 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 $\log(Employ_{p^-jt})$, controlling for province-industry and year fixed effects, the coefficients are 0.397 and 0.328 respectively; both are significant at the 1 percent 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 the two coefficients to their sum tells us how much a shock to $\log(Employ_{p^-jt})$ affects the intensive versus extensive margin. Reassuringly, about 55 percent (=0.397/0.725) is on the intensive margin.

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 Appendix Table 3. We can see that the changes in mean employment in PCI and mean employment in GSO are positively correlated: β is about 0.531 and significant at the 1% level. Similarly, the median employment in PCI and median employment in GSO are positively correlated and the coefficient is 0.478 and highly significant. 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.

4.3 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 -2.288, which is significant at the 5 percent level. Growth in firm employment leads to a drop in the rate of bribe extraction from firms. The coefficient magnitude suggests that a 10 percent increase in a firm's employment level leads to a 0.23 percentage point decline in the bribe rate. Column 2 uses multiple IVs (one per industry) and finds a similar coefficient, also significant at the 5 percent level.

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 linearize by using the middle of each category. We estimate two versions of the reduced form estimate, one using the linearized 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 -1.71, and significant at the 5 percent level. Column 4 reports the results from an ordered probit specification. The coefficient is again negative and significant at the 5 percent 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 1.6 percentage point reduction in informal payments, or about 47 percent 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 -0.68. 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 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 percent 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 percent 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 we develop below.

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 -1.91, similar in magnitude to the within-Vietnam analogue, which was -2.29, though the coefficient is not statistically significant. Column 2 of Panel B uses multiple IVs, and the coefficient is -2.01 and significant at the 5 percent level. Both the point estimate and precision are remarkably similar across the Vietnam and China specifications.

The point estimate for China of -2.01 in column 2 implies that a 10 percent increase in employment leads to -0.2 percentage point decline in bribe rate, or a doubling of employment leads to 1.4 percentage point decrease in the bribe rate, which is 41 percent of the mean level. The implied elasticity of the informal payment rate with respect to predicted firm size is -0.59, similar though slightly smaller than the elasticity of -0.68 we estimate using the single within-Vietnam IV. The reduced form OLS result reported in column 3 is negative but insignificant, while the ordered probit gives a negative reduced form effect that is statistically significant.

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 economic growth has a negative effect on the degree of government officials' bribe extraction from firms.

5 Model

In this section, we consider a model in which governments choose how much to extract from firms to maximize their bribe revenue. The model generates the prediction that bribes as a fraction of revenues should decrease with firm growth. This model is not the only explanation for the empirical fact that we presented in the previous section, but is one possible explanation for it. Moreover, the model has other testable predictions which we will investigate empirically in the next section.

In the model, 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. 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 basic idea that underlies most of the papers in the tax competition literature is that mobile factors can adjust their location to any inter-regional differentials in taxation or benefits. Local governments thus need to take into account such potential reaction when designing redistributive policies. Each local government chooses its tax parameters strategically trying to influence migration or capital movement. Models either assume that each region is a small economy among many, or that two regions (usually perfectly symmetric) play a Nash game, though the implications are generally robust to the choice of modeling approach. Cremer and Fourgeaud (1995) provide a comprehensive survey of this literature. In this paper, we adopt the second approach and consider a two-region Nash equilibrium.

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 economic development 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. In this section, we will set up the problem and state the key propositions. Details of the mathematical derivations and proofs can be found in the Appendix.

We assume that there are two provinces, denoted 1 and 2.[12] Each province is endowed with a unit mass of incumbent firms. Note that this assumption of no entry, which we adopt

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

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 percent of a firm's revenues that it must pay in bribes.[13] 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 characterize 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. 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

$$\max_{K\geq 0, L\geq 0}(1-b_1)AK^{\alpha}L^{\beta} - wL - rK \tag{7}$$

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 following familiar results:

$$\begin{aligned} \frac{L^*}{K^*} &= \frac{r}{w}\frac{\beta}{\alpha} && (8) \\ K^* &= \left(\frac{r}{(1-b_1)A\alpha}\left(\frac{r}{w}\frac{\beta}{\alpha}\right)^{-\beta}\right)^{\frac{1}{\alpha+\beta-1}} && (9) \\ \pi^* &= (1-b_1)AK^{*\alpha}L^{*\beta} - wL^* - rK^* && (10) \end{aligned}$$

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

[13] We focus on bribes as a percent of revenues because this is the variable we observe in our empirical analysis. All of the results shown here go through if we instead use bribes as a proportion of the firm's capital stock K. Details for the alternative model are available upon request.

moving costs. To proceed, we need to impose some structure on the moving costs m. We specify the moving costs for firm i as

$$m_i = \theta A^{\eta} \epsilon_i. \tag{11}$$

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.[14] The exponent $\eta \geq 0$ 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

$$\begin{aligned} \pi_1^* &\geq \pi_2^* - \theta A^{\eta} \epsilon, \quad \text{or} \\ \epsilon &\geq \frac{\pi_2^* - \pi_1^*}{\theta A^{\eta}} \end{aligned} \tag{12}$$

To simplify the algebra, we further assume that ϵ is uniformly distributed over $[0, 1]$.[15] The equilibrium number of firms for a given θ in province 1 is therefore simply $1 - \frac{\pi_2^* - \pi_1^*}{\theta A^{\eta}}$.[16] Since

[14] Note that all of our key results are robust to instead parameterizing 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. To do so, one could parameterize moving costs as $\theta K^{*\eta} \epsilon_i$, where K^* refers to the equilibrium level of capital that is chosen in province 1. The idea is that if you move, you must move your existing capital stock to province 2, and then readjust. Details for this alternative model are available upon request.

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

[16] Even though we have in mind a world of many firms with heterogenous θ, we are solving the model for a particular θ. (This would correspond to firms with the same property right status or same status of single or multi-province operations in our empirical section.) 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. It is important to bear in mind that by doing so, we are assuming there is no interaction, either through factor markets or

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 takes b_2 as given and solves,

$$\max_{b_1 \geq 0} b_1 A K^{*\alpha} L^{*\beta} \left(1 - \frac{\pi_2^* - \pi_1^*}{\theta A^\eta}\right) \tag{13}$$

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

$$K^* + b_1^*(\alpha+\beta)\frac{dK^*}{db_1} + \frac{b_1^* K^*}{\theta A^\eta}\frac{d\pi_1^*}{db_1} = 0 \tag{14}$$

After some algebra, we get:

$$\left(\frac{1}{\theta} A^{1-\eta} \left(\frac{r\beta}{w\alpha}\right)^{\beta} K^{*\alpha+\beta} + \frac{\alpha+\beta}{1-\alpha-\beta}\frac{1}{1-b^*}\right) b^* = 1 \tag{15}$$

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

Several aspects of the equilibrium condition in Equation (15) 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 Burgess et al. (2012).

Next, we examine how the equilibrium bribe rate responds to increases in the profitability of firms, i.e. increases in A. Taking the derivative with respect to $\log A$ on both sides of Equation (15) and re-arranging terms, we get our first result:

products market, among different types of firms. This is a non-trivial simplifying assumption, but it makes the problem tractable.

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* $\eta > \frac{1}{1-\alpha-\beta}$.

The critical factor that determines the sign of $db^*/d\log A$ is η, which characterizes 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 $\eta = \frac{1}{1-\alpha-\beta}$.[17] 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 fulfill 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.

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. This prediction also holds in the data, as discussed in the previous section.

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 percent of GDP, whereas for rich countries (with per-capita GDP above \$9,200), corporate income taxes represent only 4.5 percent 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

[17] 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.

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. *If* $0 \leq \eta < \frac{1}{1-\alpha-\beta}$*, the elasticity* $-\frac{d \log b^*}{d \log A}$ *is monotonically decreasing in* θ*, that is,* $\frac{d^2 \log b^*}{d \log A d\theta} > 0$.

Intuitively, Proposition 1 implies 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.[18]

6 Results: Heterogeneous effects by firms' moving costs

We presented evidence in section 4 that economic growth (specifically, an increase in firm employment) reduces the rate of bribe extraction. While this evidence is consistent with the model (Proposition 1), the specific inter-jurisdictional competition idea outlined in our model 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 our model, as opposed to potential alternative explanations, is that the effect of an increase in A on the bribe rate b should be greater in magnitude when firms are more mobile. [19]

Thus, in this section, we test Proposition 2. The prediction is that a positive shock to aggregate productivity leads to a bigger decrease in unofficial payments for firms that are more mobile.

The estimating equation is as follows:

$$Bribes_{ipjt} = \alpha + \beta A_{ipjt} + \gamma A_{ipjt} \times MovingCost_{ipjt} + \delta MovingCost_{ipjt} + \nu_{pj} + \mu_t + \epsilon_{ipjt} \quad (16)$$

[18]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.

[19]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.

The prediction is that γ in Equation (16) is positive, so that the reduction in bribes as A 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 characteristics of firms. 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.

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.[20] 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 Office (LURRO). The LURRO does not evaluate the application, but simply checks the completeness of the application and supporting documents. It is required to inform the firm whether additional information is needed within three days of the application. After the LURRO inspection, the application is sent to the Provincial People's Committee (the local executive office) for evaluation and verification. While the People's Committee is legally obligated to respond within 50 days, in practice, waiting periods are substantially longer – often over a year or more. These waiting periods pose the largest obstacle to LURC acquisition.[21]

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.[22] However, if a firm purchased the land it occupies but does not have a land use rights certificate, it is difficult for the firm to move for two reasons. First, it is costly and difficult to obtain land in a new province for business operations. More importantly, firms without LURCs will have difficulty obtaining the true commercial value of their land when they try to sell. Land without LURCs is known to be less valuable, as it can easily be expropriated by local authorities (Kim, 2004; Do and Iyer, 2003). Consequently, they will

[20] 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.

[21] Decree No. 88/2009/ND-CP dated 19 October 2009 on grant of certificates of land use rights and house and land-attached asset ownership; 2003 Land Law, amended and supplemented in 2009.

[22] Even though LURC trading was possible since 1993, it only became widespread with the 2003 Land Law. The overtime variation we see in the data comes from firms learning about the process and whether it benefits them.

find it more difficult to relocate.

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.[23] 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 ownership 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 -0.30 and significant at the 1 percent 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 -2.29. The results in column 1 suggest that the impact is about 13 (=0.30/2.29) percent 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 firm size interacted with $\log(Employ_{pjt})$, suggesting that the land ownership

[23]Unfortunately, we do not know the year the firm purchased its land, so we cannot do the analogous exercise for land ownership. In Appendix Table 4 , we show the results using contemporaneous LURC.

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 $\log(Employ_{pjt})$. The coefficient on the interaction of the firm owning land and having an LURC and $\log(Employ_{p^{-}jt})$ 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 because it is most clear-cut that firms with an LURC have stronger property rights. This interaction coefficient of -0.22 is negative and significant at the 5 percent level.[24] This is consistent with the prediction of Proposition 2.

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. The preferred specification using multiple IVs, and comparing firms with an LURC to those that own land without an LURC (column 7) gives a coefficient of -0.205, significant at the 5 percent level and very similar to the point estimate using the within-Vietnam 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. Appendix Table 5 shows that possessing an LURC is indeed correlated with a variety of other firm characteristics. To examine whether the heterogeneity in impacts we observed in Table 4 is really attributable to the LURC rather than these other correlated characteristics, Table 5 and 6 present several additional robustness checks, 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 $\log(Employ_{pjt})$.

Specifically, each column of Table 5 takes the specification from column 4 of Table 4 (single IV) and adds as controls the variable shown in the column heading as well as the interaction of that variable with $\log(Employ_{pjt})$ to tease out the role of LURCs from other things it may be correlated with. For example, one concern is that property rights over land are really measuring overall formality rather than land rights per se. Column 1 of Table 5, Panel A, controls for a proxy for a firm's degree of formality—the share of registration

[24] We have also estimated ordered probit reduced form specifications for the three categories of firms: firms that rent the land they operate on, firms that own their land but do not have an LURC, and firms that own their land and have an LURC. Results are presented in Appendix Table 6. The coefficient estimates are consistent with the findings for the linear model in that the most negative impact of economic shocks on the bribe rate is observed for firms that own their land and have an LURC. We run separate ordered probit models on the subsamples because the interacted model is computationally infeasible.

documents it has—and its interaction with $\log(Employ_{pjt})$. The estimated interactions between $\log(Employ_{pjt})$ and LURC and LURC conditional on landownership are similar to main estimates in Table 4, though the LURC interaction estimate is significant only at 10 percent significance level in the latter case. To the extent that firms that have LURCs have a higher willingness to pay bribes to obtain permits in general, controlling for the number of other permits they have should control for this.

Columns 2 to 7 control for other potentially confounding factors that may be correlated with possessing an LURC, such as whether the firm is a former household firm, whether it is a former state-owned enterprise, whether it is managed by a former government official, whether the government has an ownership stake, premise size, and years of establishment; again, in each case, the variable and its interaction with $\log(Employ_{pjt})$ are added to the regression. Across the board, the estimated interactions remain broadly similar, with statistical significance changing slightly from specification to specification but the point estimates remaining stable.

In Column 8 of Table 5, we aggregate all of these control variables into an index by estimating two propensity scores, one for owning land and one for having an LURC based on the seven variables used in columns 1 to 7.[25] We then control for the propensity scores to own land and have an LURC and their interactions with $\log(Employ_{pjt})$. Reassuringly, the finding that the effect of growth on bribes is stronger for firms with an LURC (better property rights) is robust to this alternative specification as well.

Panel B of Table 5 presents the robustness checks for the China instrument and we also find a stable point estimate for the LURC interaction term. Table 6 presents the same set of robustness checks except using multiple IVs. Again, we find that the interaction coefficients are robust to controlling for several potential confounders.

In sum, the analysis in Tables 5 and 6 suggests that while certain firms are more likely to have LURC permits than others, none of these observable covariates substantially changes the impact of having an LURC on the relationship between $\log(Employ_{pjt})$ and bribe rates.

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, 30 percent have operations in at least two provinces. Of the firms with operations in multiple provinces, the majority have operations in one other province besides its headquarters location. These

[25] Appendix Table 5 shows the coefficients of the propensity score regressions.

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.

Table 7 examines heterogeneity based on multi-province operations. Columns 1 and 2 use as the proxy for $MovingCost$ the number of provinces other than where the firm is headquartered that it operates in. In Panel A, which uses the rest-of-Vietnam IV, the interaction is negative and significant at the 5 percent level, both with and without controlling for the industry's average firm size. Columns 3 and 4 use instead a dummy variable for operating in at least one other province. The interaction coefficient is -0.28 in column 3 (significant at the 10 percent level) and -0.29 in column 4 (significant at the 5 percent level). The main effect of $\log(Employ_{pjt})$ in column 3 is -2.045, so the interaction coefficient implies that having multi-province operations increases the negative effect of growth on the bribe rate by 14 percent.

Columns 5 to 8 present the multiple-IV results using the rest of Vietnam. Using the number of other provinces, the point estimates on the interaction effect becomes smaller and insignificant, while the coefficient using a dummy for multi-province operations, shown in columns 7 and 8, remains similar in magnitude and significance to the single-IV counterpart in columns 3 and 4.

We find similar results, reported in Panel B, using the Chinese IV. Focusing on the multiple-IV results in column 5 to 8, the effect of growth on bribery is stronger for mobile firms when mobility is measured either as the number of provinces the firm operates in (columns 5-6, marginally significant) or as an indicator for operating in more than one province (columns 7-8, significant at the 1 percent level).

Tables 8 and 9 present the battery of robustness checks for the result that growth decreases the bribe rate for firms with multi-province operations for the single and multiple IV strategies, respectively. When including the seven distinct control variables or the propensity score to own land and have an LURC that aggregates the control variables, the coefficient of interest remains stable in magnitude and, for the most part, statistically significant. In particular, for the preferred specifications of the single-IV Vietnam approach and the multiple-IV China approach, the interaction with a dummy for operating in multiple provinces remains significant at the 5 percent level in 15 of 16 cases, and significant at the 10 percent level in one other specification.

To summarize our main empirical results, first, we showed in section 4 that positive economic shocks reduce corruption. Second, in this section we presented evidence that corruption falls more in response to positive economic 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.

6.1 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.

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 analyze 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 10, column 1).[26]

[26]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 percent of firms report a profit margin

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.

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 2.1 is such that bribery is decentralized 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, a crackdown in the construction industry in 2008. Table 10, 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.

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

of less than 1 percent of revenues, with 23 percent of firms reporting 0 profits. Given these reporting issues, the PCI dataset does not ask about profits.

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 10 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:

$$w_{pj} = \frac{1}{T}\sum_t \frac{Employ_{pjt}}{Employ_{pt}}. \tag{17}$$

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

$$predicted\,\log(Employ_{pt}) = \log\left(\sum_j w_{pj}\frac{Employ_{p-jt}}{\left(\frac{1}{T}\sum_t Employ_{p-jt}\right)}\right) \tag{18}$$

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 actually positive, 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.

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 10 suggest that this is not the entire explanation for our results.

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.

7 Conclusion

This paper examines the relationship between higher growth and lower corruption, using firm level data from Vietnam, and establishes two empirical facts. The first is that economic growth (as measured by higher employment for a firm or industry) reduces the proportion of firm revenues extracted by government officials as bribes. The second is that the reduction in corruption caused by economic growth is larger in magnitude for firms that can more easily relocate due to stronger property rights over their land. We also find similar evidence of heterogeneous effects using a second measure of the ability to relocate, namely having operations in more than one province.

These two facts map to the two main contributions of the paper. The first is an important empirical contribution: We provide causal evidence on the effect of economic growth on the amount of corruption in an economy. Despite much interest in the relationship between corruption and development, there exists very little credible evidence of a causal relationship. The challenge is finding a way to separate causation from just correlation. We provide rigorous evidence by using subnational variation and an often-used identification strategy based on aggregate-level shocks outside of a subnational region (either in other regions, or in a neighboring country) as a source of plausibly exogenous variation in the region.

To do so, we make use of a unique data set that collects data from firms on their bribe payments to government officials and is available for several years, samples firms from several industries, and is representative at the province level. We take advantage of the fact that political science showing that corruption is decentralized 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 a lot of the corruption activities are highly localized, such as China.

Our second contribution is to lay out a mechanism through which economic growth reduces corruption. We model provincial governments' decisions about bribe extraction. Competition among provinces to retain or attract firms is the mechanism that keeps corruption in check. Not surprisingly, then, 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. There are offsetting forces. As a firm grows, a given increase in the bribe rate would translate into a larger increase in bribe revenues extracted from the firm. On the other hand, the larger a firm is, the more it would benefit from moving to a different region with a lower bribe rate. We show that under the plausible assumption that a firm's moving costs scale up less than one-for-one with its size, economic growth leads to a decline in the rate of bribe extraction. We also derive the prediction that this effect of economic growth on bribe extraction is larger in magnitude for firms with lower moving costs. Our second empirical fact described above—that the effect of growth on corruption is larger for firms with transferable rights to their land—is consistent with this prediction, suggesting that the mechanism of inter-provincial competition is indeed important in determining the degree of corruption in an economy.

Our results have several implications for understanding the determinants of corruption in developing countries. The finding that growth reduces corruption suggests that corruption might decline naturally as a country grows even without explicit anti-corruption efforts. While the effects we describe here might naturally operate via within-country competition in relatively large, decentralized countries such as Vietnam, one could imagine similar factors might also be at play for small countries, where the competition might be between countries rather than between regions of a given country.

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), with the idea being that competitive pressure of the type discussed here 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. The results also highlight a complex interplay between growth and institutions. The fact that economic growth is most successful in reducing corruption when coupled with strong property rights implies a complementarity between policies to strengthen institutions and to promote growth, and a mechanism through which strengthening institutions can be self-reinforcing.

While the focus of this paper is government corruption, it is worth noting the implications for the parallel case of tax rates. Our model implies that economic growth should lead to a reduction in tax rates via the same mechanism of inter-jurisdictional competition, especially for firms that can credibly threaten to relocate. If most firm relocations are within a country, then the prediction is that sub-national (e.g., state) corporate tax rates should decline with economic growth. While we do not have explicit data on sub-national corporate tax rates across countries, it is worth noting that total corporate taxes are indeed lower as a share of GDP in rich countries than poor countries (Gordon and Li, 2009).

Finally, it is important to note that while we have implemented the idea of economic growth and firm mobility as forces for reducing corruption within a single country, similar ideas could work across countries as well. 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, and as long as that cost is concave in firm size, this will lead countries to reduce bribe rates in an attempt to prevent too many firms from switching. 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.

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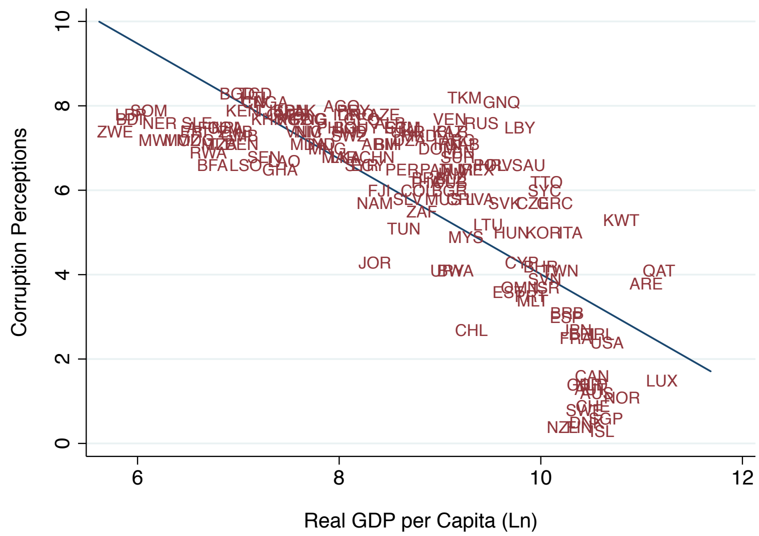
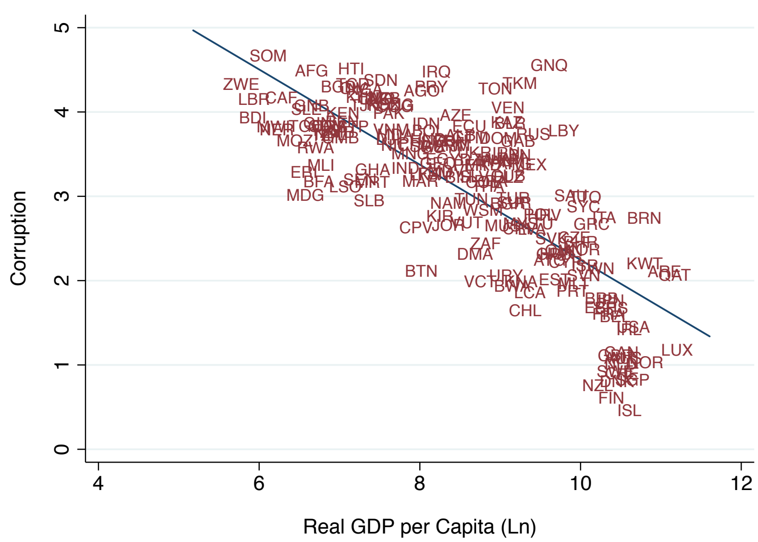
Figure 1: Cross-Country Relationship Between GDP and Corruption

Panel A. Transparency International Corruption Index (2005)

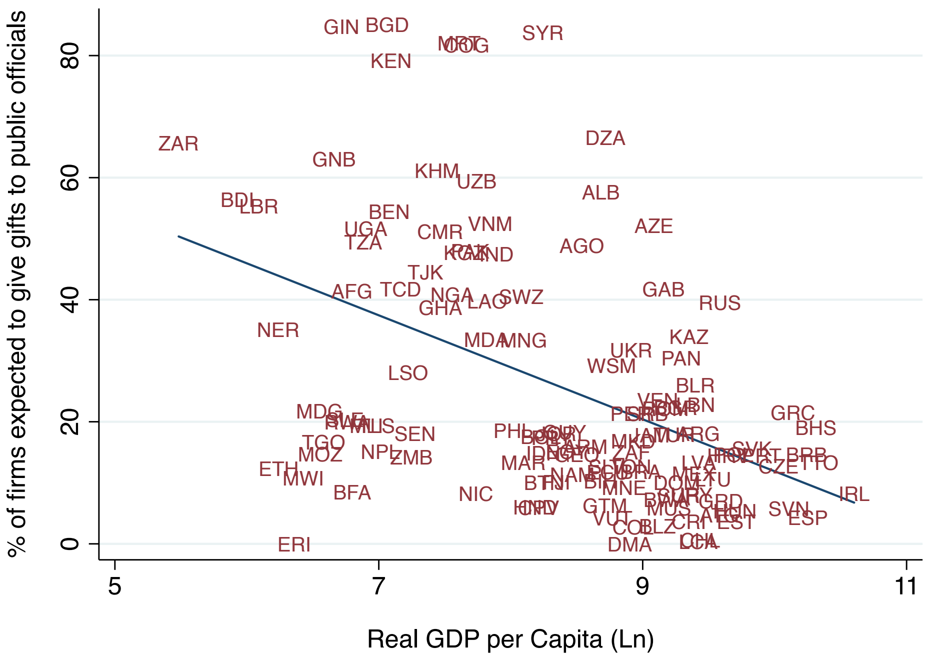


Panel B. World Bank Control of Corruption (2005)



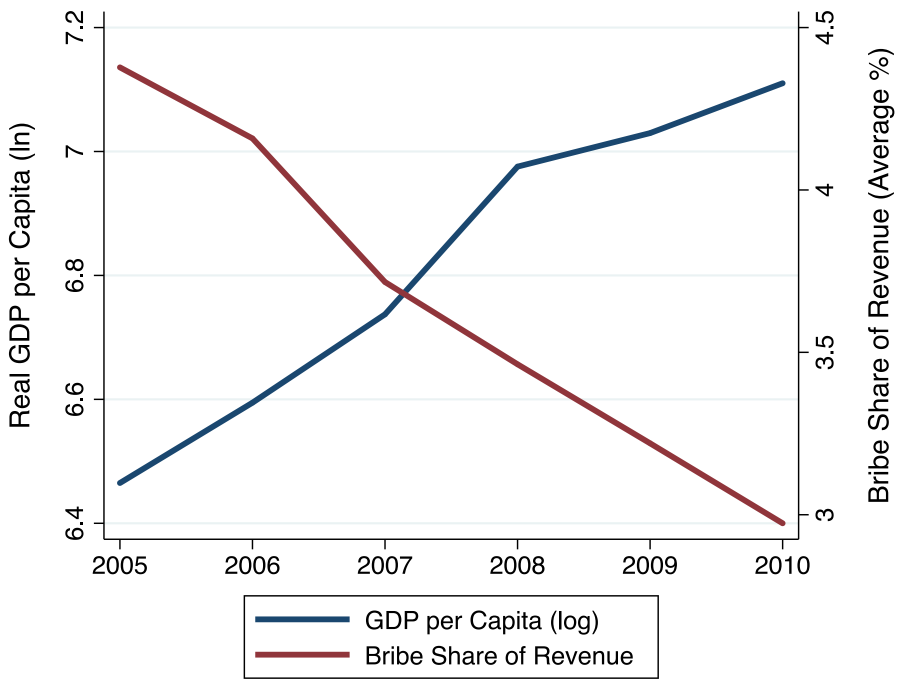
In Panel A, the Corruption Perception Index (CPI) defines corruption as the abuse of public office for private gain. The CPI Score measures perceptions of the degree of corruption as seen by business people, risk analysts, and the general public and ranges between 10 (highly corrupt) and 0 (highly clean). In Panel B, Control of Corruption measures perceptions of corruption, conventionally defined as the exercise of public power for private gain. It ranges between 5 (highly corrupt) and 0 (highly clean). In both panels, the x-axis is the log of PPP Converted GDP Per Capita (Chain Series), at 2005 constant prices.

Figure 2: Relationship Between GDP and Corruption Using Survey Data from Firms



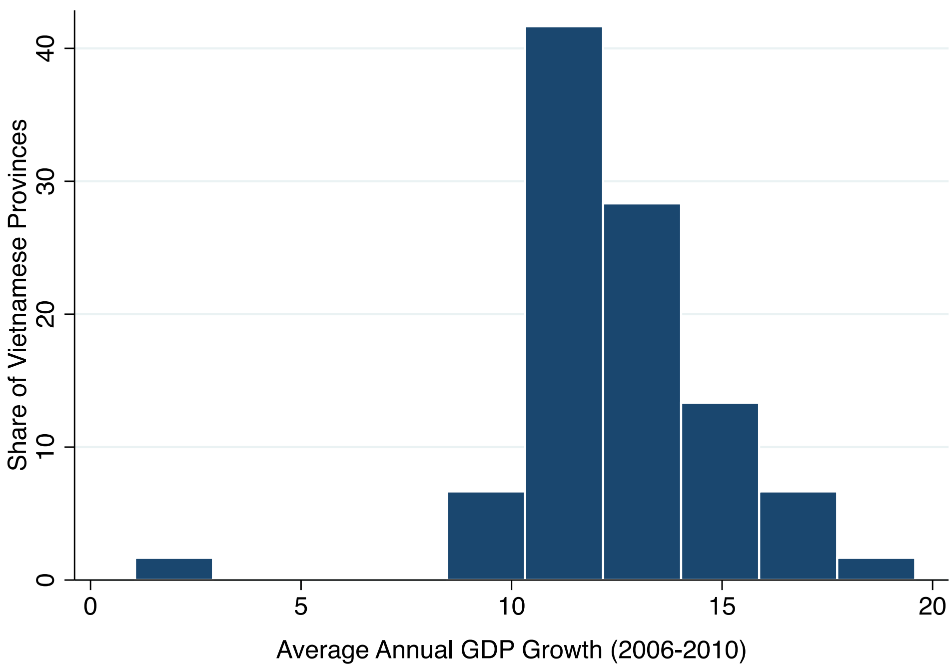
This figure plots the percentage of firms who expect to give gifts to public officials to get things done for 122 countries in the World Bank Enterprise Survey. For each country, we use the year that the country is most recently surveyed. The x-axis is the log of PPP-adjusted GDP per capita (Chain Series),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

Figure 3: Time Trend in Bribes and GDP in Vietnam



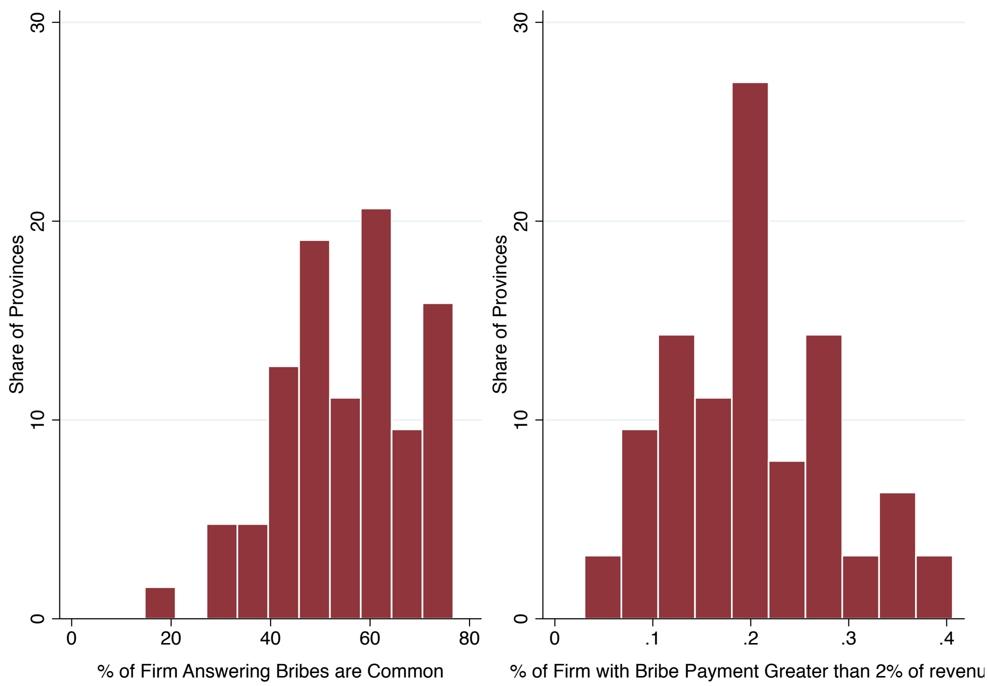
This figure plots real GDP per capita and the average amount of bribe as a share of revenue paid by firms in Vietnam from 2005 to 2010. The bribe share variable is averaged across all firms surveyed in the PCI for the corresponding year.

Figure 4: Average Annual GDP Growth by Province in Vietnam (2006-2010)



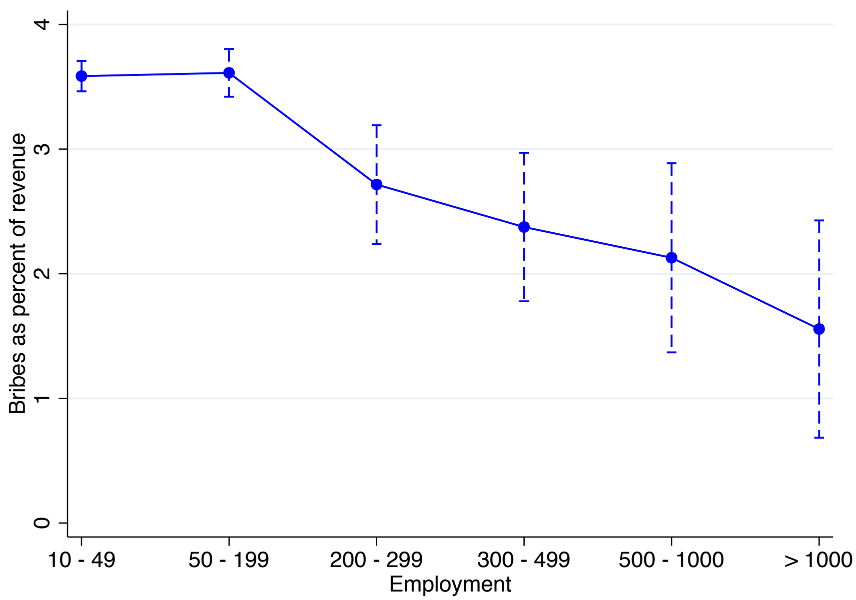
This figure plots the distribution of average annual GDP growth across provinces in Vietnam from 2006 to 2010. We have excluded provinces that reported implausibly high growth rate over this period (over 20 percent) as these numbers are very much likely overstated.

Figure 5: Variation in Corruption across Provinces in Vietnam



This figure plots the distribution of corruption across provinces in Vietnam, using data from the 2010 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 10 percent of revenues as bribes to public officials.

Figure 6: Cross-Sectional Relationship Between Bribe Rate and Firm Employment



This figure plots the mean bribe rate as a percent of revenue for each employment size category in the PCI data, as well as the 95 percent confidence interval.

Table 1: Summary Statistics of Firms

	Observations	Median	Mean	Std Dev
Bribes as percentage of revenue (%)	13160	1.5	3.44	5.468
Years since establishment	12846	4	5.505	6.317
Number of employees (PCI)	12011	19	93.886	249.325
Mean employment (GSO, mean for industry-year-province level)	13160	23.776	36.753	33.868
Log employment (GSO, aggregate for industry-year-province)	13160	9.091	9.01	1.866
Log of business premise size (hectare)	6397	6.879	7.073	2.204
Land ownership (dummy)	13160	1	.726	.446
Land use right certificate (dummy)	12632	1	.575	.494
Land ownership without land use right certificate (dummy)	12632	0	.139	.346
Number of other provinces in which firm operates	13160	0	.528	1.058
Firm currently operates in more than one province (dummy)	13160	0	.306	.461
Share of registration documents held	10411	.167	.248	.286
Former household firm (dummy)	13158	1	.579	.494
Former SOE (dummy)	13158	0	.09	.286
Owner is a government official (dummy)	13158	0	.133	.34
Government holds positive share (dummy)	13158	0	.04	.196

Note: Each observation is a firm, and we pool the sample of firms over all years from 2006 to 2010. The PCI firms in our sample are those with valid industry and bribe payment data and whose province-industry-year is represented in the GSO data. The summary statistics reported in this table are for the 13,160 firms that meet this sample inclusion criterion. 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?" Variable defined as the number of registration documents held by the firm divided by the 95% 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 privatized 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.

Table 2: First Stage Results

	Dep. var.: Log Vietnamese employment in industry-year (in own province)	
Log Vietnamese employment in industry-year	0.724***	
(excluding own province)	(0.118)	
Log Chinese employment in industry-year		0.723***
		(0.272)
Observations	3873	3873
F-stats	37.86	7.050
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	Multiple IV	RF: OLS	RF: Ordered Probit
	(1)	(2)	(3)	(4)
Panel A. Rest-of-Vietnam IV				
Log Vietnamese	-2.288**	-2.008**		
employment in industry-year (in own province)	(0.960)	(0.990)		
Log Vietnamese			-1.713**	-0.275***
employment in industry-year (excluding own province)			(0.740)	(0.075)
Observations	13160	13160	13160	13160
Panel B. China IV				
Log Vietnamese	-1.907	-2.011**		
employment in industry-year (in own province)	(1.229)	(0.907)		
Log Chinese			-1.350	-0.297**
employment in industry-year			(0.876)	(0.121)
Observations	13160	13160	13160	13160
Province–industry and year fixed effects	✓	✓	✓	✓

Note: The dependent variable is the firm's bribe payment as percentage of revenue. This is coded as a categorical variable in the data: 0%, 0.5%, 1.5%, 6%, 15%, 25%, 35%. 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)	-2.268**	5.473	-2.310**	5.331	-1.875**	2.091	-2.035**	2.043
	(1.122)	(3.796)	(1.137)	(3.855)	(0.944)	(2.711)	(0.948)	(2.715)
Firm owns its land			-0.136	-0.125			-0.172	-0.160
X log Vietnamese employment in industry year (in own province)			(0.145)	(0.152)			(0.126)	(0.130)
Firm owns land and has LURC	-0.301***	-0.329***	-0.219**	-0.253**	-0.257***	-0.262***	-0.170*	-0.181*
X log Vietnamese employment in industry year (in own province)	(0.117)	(0.123)	(0.108)	(0.111)	(0.0802)	(0.0804)	(0.102)	(0.103)
Observations	11,486	11,486	11,486	11,486	11,486	11,486	11,486	11,486
Panel B. China IV								
Log Vietnamese employment in industry-year (in own province)	-1.511	10.97	-1.283	8.824	-1.892**	3.089	-2.055**	3.124
	(1.489)	(25.64)	(1.469)	(21.58)	(0.914)	(2.512)	(0.931)	(2.502)
Firm owns its land			-0.341**	-0.357**			-0.0992	-0.0897
X log Vietnamese employment in industry year (in own province)			(0.146)	(0.160)			(0.117)	(0.120)
Firm owns land and has LURC	-0.398***	-0.436**	-0.210	-0.231	-0.261***	-0.273***	-0.205**	-0.222**
X log Vietnamese employment in industry year (in own province)	(0.113)	(0.170)	(0.132)	(0.155)	(0.0946)	(0.0955)	(0.0989)	(0.100)
Observations	11,486	11,486	11,486	11,486	11,486	11,486	11,486	11,486
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. 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: 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	3.084	5.251	5.112	5.358	5.421	3.952	6.172	5.397
(in own province)	(4.247)	(3.815)	(3.858)	(3.847)	(3.917)	(4.134)	(4.062)	(3.875)
Firm owns land and has LURC X log Vietnamese	-0.257*	-0.256**	-0.263**	-0.251**	-0.251**	-0.334**	-0.234**	-0.317*
employment in industry year (in own province)	(0.138)	(0.103)	(0.114)	(0.110)	(0.110)	(0.139)	(0.111)	(0.173)
Firm owns its land X log Vietnamese	-0.245	-0.125	-0.125	-0.126	-0.131	-0.0573	-0.162	-0.181
employment in industry year (in own province)	(0.156)	(0.153)	(0.149)	(0.152)	(0.155)	(0.156)	(0.153)	(0.162)
Observations	9,262	11,484	11,484	11,484	11,484	10,611	11,222	8,456
Panel B. China IV								
Log Vietnamese employment in industry-year	3.293	8.734	8.683	9.380	9.483	5.536	7.784	8.117
(in own province)	(5.763)	(21.47)	(21.43)	(22.51)	(23.51)	(4.685)	(15.09)	(6.986)
Firm owns land and has LURC X log Vietnamese	-0.222	-0.215	-0.225	-0.221	-0.229	-0.284*	-0.188	-0.281
employment in industry year (in own province)	(0.172)	(0.146)	(0.161)	(0.161)	(0.155)	(0.165)	(0.132)	(0.203)
Firm owns its land X log Vietnamese	-0.448***	-0.391**	-0.361**	-0.356**	-0.365**	-0.313*	-0.384**	-0.437**
employment in industry year (in own province)	(0.172)	(0.162)	(0.161)	(0.161)	(0.167)	(0.171)	(0.152)	(0.186)
Observations	9,262	11,484	11,484	11,484	11,484	10,611	11,222	8,456
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' 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. 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 6: 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	1.598	1.986	1.116	1.606	1.756	-0.713	2.201	2.344
(in own province)	(3.123)	(2.552)	(2.749)	(2.712)	(2.760)	(3.409)	(2.870)	(2.727)
Firm owns land and has LURC X log Vietnamese	-0.171	-0.188*	-0.180*	-0.167	-0.178*	-0.228*	-0.176*	-0.228
employment in industry year (in own province)	(0.129)	(0.0994)	(0.107)	(0.105)	(0.103)	(0.121)	(0.103)	(0.150)
Firm owns its land X log Vietnamese	-0.277**	-0.147	-0.179	-0.155	-0.171	-0.119	-0.195	-0.233*
employment in industry year (in own province)	(0.123)	(0.129)	(0.131)	(0.126)	(0.129)	(0.139)	(0.127)	(0.136)
Observations	9,262	11,484	11,484	11,484	11,484	10,611	11,222	8,456
Panel B. China IV								
Log Vietnamese employment in industry-year	3.106	3.060	2.329	2.731	2.896	0.943	3.421	3.266
(in own province)	(3.082)	(2.345)	(2.545)	(2.429)	(2.537)	(2.514)	(2.580)	(2.493)
Firm owns land and has LURC X log Vietnamese	-0.225*	-0.218**	-0.228**	-0.201**	-0.219**	-0.290***	-0.201**	-0.258*
employment in industry year (in own province)	(0.125)	(0.0990)	(0.103)	(0.0989)	(0.100)	(0.111)	(0.0986)	(0.145)
Firm owns its land X log Vietnamese	-0.201*	-0.0886	-0.0938	-0.0978	-0.0938	-0.0174	-0.126	-0.109
employment in industry year (in own province)	(0.116)	(0.124)	(0.117)	(0.120)	(0.120)	(0.113)	(0.117)	(0.117)
Observations	9,262	11,484	11,484	11,484	11,484	10,611	11,222	8,456
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' property rights after controlling for other firm characteristics. Column (1) to (8) controls for the following explanatory variables and their interactions with log 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. 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 7: 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)	(5)	(6)	(7)	(8)
Panel A. Rest-of-Vietnam IV								
Log Vietnamese employment in industry-year	-2.293**	4.455	-2.045**	5.024	-1.940**	1.327	-1.786*	1.995
(in own province)	(0.965)	(3.180)	(0.969)	(3.332)	(0.943)	(2.112)	(0.966)	(2.138)
Number of other provinces in which firm operates	-0.0779**	-0.0799**			-0.0460	-0.0481		
X log Vietnamese employment in industry-year (in own province)	(0.0370)	(0.0367)			(0.0376)	(0.0382)		
Firm currently operates in more than one province			-0.283***	-0.292***			-0.254**	-0.266**
X log Vietnamese employment in industry-year (in own province)			(0.110)	(0.113)			(0.108)	(0.112)
Observations	13,160	13,160	13,160	13,160	13,160	13,160	13,160	13,160
Panel B. China IV								
Log Vietnamese employment in industry-year (in own province)	-1.697	7.934	-1.605	9.695	-1.839**	1.942	-1.689*	2.556
	(1.175)	(15.17)	(1.194)	(17.44)	(0.865)	(1.934)	(0.880)	(1.983)
Number of other provinces in which firm operates	-0.0969**	-0.0998**			-0.0603	-0.0619*		
X log Vietnamese employment in industry-year (in own province)	(0.0386)	(0.0442)			(0.0372)	(0.0374)		
Firm currently operates in more than one province			-0.364***	-0.360**			-0.247***	-0.258***
X log Vietnamese employment in industry-year (in own province)			(0.136)	(0.141)			(0.0948)	(0.0984)
Observations	13,160	13,160	13,160	13,160	13,160	13,160	13,160	13,160
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' operation locations. 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 operation location 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. 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 8: 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								
Number of Other Provinces the Firm Operates In								
Log Vietnamese employment	2.644	4.384	4.224	4.499	4.483	3.846	5.103	4.118
in industry-year (in own province)	(3.631)	(3.130)	(3.165)	(3.185)	(3.221)	(3.475)	(3.527)	(2.987)
Number of other provinces in which firm operates	-0.0970*	-0.0802**	-0.0837**	-0.0791**	-0.0806**	-0.113**	-0.0864**	-0.134**
X log Vietnamese employment	(0.0507)	(0.0366)	(0.0372)	(0.0356)	(0.0364)	(0.0494)	(0.0384)	(0.0650)
in industry-year (in own province)								
Observations	10,411	13,158	13,158	13,158	13,158	12,027	12,846	9,418
Dummy for Operating in More than One Province								
Log Vietnamese employment	3.072	4.953	4.807	5.067	5.059	4.409	5.670	4.279
in industry-year (in own province)	(3.678)	(3.279)	(3.321)	(3.339)	(3.369)	(3.601)	(3.681)	(3.130)
Firm currently operates in more than one province	-0.361**	-0.291***	-0.292***	-0.291***	-0.292***	-0.297**	-0.312***	-0.366**
X log Vietnamese employment	(0.150)	(0.112)	(0.113)	(0.113)	(0.112)	(0.126)	(0.113)	(0.166)
in industry-year (in own province)								
Observations	10,411	13,158	13,158	13,158	13,158	12,027	12,846	9,418
Panel B. China IV								
Number of Other Provinces the Firm Operates In								
Log Vietnamese employment	2.488	7.780	7.619	8.506	8.197	4.838	8.614	8.438
in industry-year (in own province)	(4.886)	(15.12)	(15.07)	(15.87)	(15.89)	(3.347)	(13.98)	(8.076)
Number of other provinces in which firm operates	-0.0986**	-0.0977**	-0.0989**	-0.0958**	-0.0997**	-0.121**	-0.109**	-0.141
X log Vietnamese employment	(0.0495)	(0.0425)	(0.0421)	(0.0455)	(0.0426)	(0.0571)	(0.0459)	(0.0862)
in industry-year (in own province)								
Observations	10,411	13,158	13,158	13,158	13,158	12,027	12,846	9,418
Dummy for Operating in More than One Province								
Log Vietnamese employment	3.024	9.531	9.448	10.22	9.992	5.179	10.30	8.530
in industry-year (in own province)	(5.137)	(17.38)	(17.45)	(18.12)	(18.29)	(3.456)	(15.93)	(6.132)
Firm currently operates in more than one province	-0.395**	-0.355**	-0.356**	-0.350**	-0.356**	-0.366**	-0.379***	-0.413*
X log Vietnamese employment	(0.178)	(0.139)	(0.140)	(0.143)	(0.138)	(0.162)	(0.147)	(0.225)
in industry-year (in own province)								
Observations	10,411	13,158	13,158	13,158	13,158	12,027	12,846	9,418
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. 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 for having multiple locations. All regressions control for the main effects of the operation location 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 9: 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 having multiple locations
Panel A. Rest-of-Vietnam IV								
Number of Other Provinces the Firm Operates In								
Log Vietnamese employment	0.930	1.321	0.456	1.031	0.589	-1.146	1.568	2.026
in industry-year (in own province)	(2.760)	(1.956)	(2.115)	(2.128)	(2.127)	(2.915)	(2.226)	(2.215)
Number of other provinces in which firm operates	-0.0412	-0.0457	-0.0491	-0.0456	-0.0474	-0.0704	-0.0584	-0.0640
X log Vietnamese employment	(0.0475)	(0.0380)	(0.0377)	(0.0368)	(0.0374)	(0.0432)	(0.0390)	(0.0526)
in industry-year (in own province)								
Observations	10,411	13,158	13,158	13,158	13,158	12,027	12,846	9,418
Dummy for Operating in More than One Province								
Log Vietnamese employment	1.340	1.973	0.927	1.687	1.181	-0.766	2.282	3.600
in industry-year (in own province)	(2.700)	(1.961)	(2.185)	(2.149)	(2.180)	(2.899)	(2.309)	(2.504)
Firm currently operates in more than one province	-0.292**	-0.255**	-0.259**	-0.258**	-0.261**	-0.267**	-0.284**	-0.281**
X log Vietnamese employment	(0.128)	(0.110)	(0.112)	(0.111)	(0.110)	(0.122)	(0.113)	(0.142)
in industry-year (in own province)								
Observations	10,411	13,158	13,158	13,158	13,158	12,027	12,846	9,418
Panel B. China IV								
Number of Other Provinces the Firm Operates In								
Log Vietnamese employment	1.913	2.005	1.181	1.701	1.378	0.549	2.211	2.776
in industry-year (in own province)	(2.610)	(1.775)	(1.935)	(1.909)	(1.938)	(1.982)	(2.009)	(2.016)
Number of other provinces in which firm operates	-0.0619	-0.0593	-0.0676*	-0.0597*	-0.0636*	-0.0849**	-0.0720*	-0.0822*
X log Vietnamese employment	(0.0487)	(0.0365)	(0.0383)	(0.0358)	(0.0366)	(0.0375)	(0.0392)	(0.0481)
in industry-year (in own province)								
Observations	10,411	13,158	13,158	13,158	13,158	12,027	12,846	9,418
Dummy for Operating in More than One Province								
Log Vietnamese employment	2.376	2.634	1.624	2.300	1.963	0.979	2.882	3.796
in industry-year (in own province)	(2.601)	(1.809)	(2.024)	(1.942)	(1.994)	(2.030)	(2.111)	(2.311)
Firm currently operates in more than one province	-0.278**	-0.251***	-0.257***	-0.249**	-0.257***	-0.252**	-0.276***	-0.255*
X log Vietnamese employment	(0.124)	(0.0965)	(0.0984)	(0.0972)	(0.0971)	(0.107)	(0.0967)	(0.132)
in industry-year (in own province)								
Observations	10,411	13,158	13,158	13,158	13,158	12,027	12,846	9,418
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. Column (1) to (8) controls for the following explanatory variables and their interactions with log 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 for having multiple locations. All regressions control for the main effects of the operation location 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 10: 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	0.0994***	-2.332**	-2.312**
(in own province)	(0.0221)	(1.087)	(0.904)
Log Vietnamese province-year employment			0.409
			(2.759)
Observations	3,561	11,012	13,160
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 normalized 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, normalized 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. 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.

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Appendix Tables

Appendix Table 1: 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 analysis sample.

Appendix Table 2: 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	-0.609	0.514
	(0.383)	(1.078)
Interaction coefficient for Mining and Quarrying	-1.377	-5.855*
	(0.848)	(3.456)
Interaction coefficient for Manufacturing	-1.053**	-1.760**
	(0.461)	(0.873)
Interaction coefficient for Electricity and Gas Supply	-0.427	-3.422
	(0.351)	(7.531)
Interaction coefficient for Water Supply	0.109	1.501
	(0.232)	(1.251)
Interaction coefficient for Construction	-0.134	-0.039
	(0.264)	(0.519)
Interaction coefficient for Wholesale and Retail Trade	-0.162	-0.118
	(0.224)	(0.392)
Interaction coefficient for Transportation and Storage	0.029	0.929
	(0.256)	(1.500)
Interaction coefficient for Accommodation and Food Service	-0.205	-0.222
	(0.217)	(0.460)
Interaction coefficient for Information and Communication	0.162	0.826
	(0.188)	(0.609)
Interaction coefficient for Financial and Insurance Activities	-0.012	0.174
	(0.173)	(0.772)
Interaction coefficient for Real Estate Activities	0.529***	2.346***
	(0.199)	(0.696)
Interaction coefficient for Professional and Scientific Activities	0.198	1.313*
	(0.172)	(0.746)
Interaction coefficient for Administration and Support Activities	0.503***	1.321***
	(0.182)	(0.408)
Interaction coefficient for Education	0.338*	9.107***
	(0.185)	(3.420)
Interaction coefficient for Human Health and Social Work	0.529***	3.926***
	(0.195)	(1.045)
Interaction coefficient for Arts, Entertainment and Recreation	0.117	2.712
	(0.208)	(2.766)
Interaction coefficient for Other Service Activities	0.339	0.874**
	(0.216)	(0.361)
Observations	3873	3873
F-stats	21.13	18.45
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.

Appendix Table 3: Cross-Validation of PCI and GSO Data

	Log Vietnamese mean employment in PCI data	Log Vietnamese median employment in PCI data
Log Vietnamese mean employment in GSO data	0.531***	
	(0.041)	
Log Vietnamese median employment in GSO data		0.478***
		(0.047)
Observations	4607	4607
Province–industry and year fixed effects	✓	✓

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 and year fixed effect. Industries refer to ISIC 2-digit industry code. Robust standard errors are clustered at the province level and reported. *** implies significance at 0.01 level, ** 0.5, * 0.1.

Appendix Table 4: 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	-2.210**	5.563	-2.268**	5.468	-1.950**	3.397	-2.069**	3.334
(in own province)	(1.101)	(3.792)	(1.115)	(3.862)	(0.947)	(2.442)	(0.960)	(2.448)
Firm owns its land X log Vietnamese employment			-0.111	-0.105			-0.107	-0.0965
in industry year (in own province)			(0.144)	(0.156)			(0.130)	(0.135)
Firm owns land and has LURC X log Vietnamese	-0.300**	-0.320**	-0.226	-0.250	-0.248**	-0.259**	-0.178	-0.195
employment in industry year (in own province)	(0.145)	(0.148)	(0.152)	(0.154)	(0.112)	(0.113)	(0.132)	(0.132)
Observations	11,486	11,486	11,486	11,486	11,486	11,486	11,486	11,486
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 using contemporaneous Measure of LURC.

Appendix Table 5: 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	0.784***	0.481***	0.457***
	(0.092)	(0.088)	(0.085)
Former HH firm (dummy)	0.453***	-0.071	-0.065
	(0.052)	(0.050)	(0.049)
Former SOE (dummy)	0.184**	0.253***	0.278***
	(0.090)	(0.085)	(0.082)
Owner is government official (dummy)	0.389**	0.450***	0.349***
	(0.151)	(0.142)	(0.133)
Government holds positive share (dummy)	-0.360***	0.164	0.153
	(0.121)	(0.112)	(0.108)
Log of business premise size (hectare)	0.274***	0.027*	0.029*
	(0.017)	(0.015)	(0.015)
Years since establishment	0.059***	0.006*	0.008**
	(0.005)	(0.004)	(0.004)
Observations	8456	9418	9418

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. *** implies significance at 0.01 level, ** 0.5, * 0.1.

Appendix Table 6: 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	-0.018		0.638*		-0.396	
(excluding own province)	(0.202)		(0.366)		(0.257)	
Log Chinese employment in industry-year		0.010		-0.009		-0.211
		(0.440)		(0.679)		(0.332)
Observations	3610	3610	1760	1760	5183	5183
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. 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: Mathematical Details of the Model

This Appendix proves Propositions 1 and 2. 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 thus have

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

which gives

$$\begin{aligned} K_1^* &= \alpha((1-b_1)A\alpha^\alpha\beta^\beta)^{\frac{1}{1-\alpha-\beta}} \\ L_1^* &= \beta((1-b_1)A\alpha^\alpha\beta^\beta)^{\frac{1}{1-\alpha-\beta}} \\ \pi_1^* &= (1-\alpha-\beta)((1-b_1)A\alpha^\alpha\beta^\beta)^{\frac{1}{1-\alpha-\beta}} \end{aligned}$$

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

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

where

$$\begin{aligned} R_1 &= (1-b_1)^{\frac{1}{1-\alpha-\beta}} && (2) \\ R_2 &= (1-b_2)^{\frac{1}{1-\alpha-\beta}} && (3) \\ \lambda &= \frac{A^{\frac{1}{1-\alpha-\beta}}}{\theta A^\eta}(1-\alpha-\beta)(\alpha^\alpha\beta^\beta)^{\frac{1}{1-\alpha-\beta}} && (4) \\ t &= (A\alpha^\alpha\beta^\beta)^{\frac{1}{1-\alpha-\beta}} && (5) \end{aligned}$$

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 (1) then yields

$$\lambda(R_1^{\alpha+\beta} - R_1) = (1-\lambda(R_2-R_1)) * (1-(\alpha+\beta)R_1^{\alpha+\beta-1}) \tag{6}$$

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

$$\lambda(R_1^{\alpha+\beta} - R_1) = 1-(\alpha+\beta)R_1^{\alpha+\beta-1} \tag{7}$$

This gives the equilibrium bribe rate b^* via (2).

Proposition 1. $\frac{db^*}{dlogA} < 0$ *if* $0 \leq \eta < \frac{1}{1-\alpha-\beta}$; $= 0$ *if* $\eta = \frac{1}{1-\alpha-\beta}$; > 0 *if* $\eta > \frac{1}{1-\alpha-\beta}$.

Proof. : Re-arrange (7) 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, (7) has a unique solution for fixed parameters (so fixed λ), and this solution is strictly increasing in λ. In other words,

$$\frac{dR^*}{d\lambda} > 0 \tag{8}$$

From (2), $b^* = 1 - (R^*)^{1-\alpha-\beta}$, and so $\frac{db^*}{dR^*} < 0$. Also from (4), $\frac{d\lambda}{dA}$ is positive when $\eta < \frac{1}{1-\alpha-\beta}$ and negative otherwise. Multiplying the three inequalities, we obtain

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

■

Proposition 2. *The elasticity* $-\frac{db^*}{dA}\frac{A}{b^*}$ *is monotonically decreasing in* θ *when* $0 \leq \eta < \frac{1}{1-\alpha-\beta}$.

Proof. : From (2),

$$\epsilon_{R^*} = \frac{1}{1-\alpha-\beta}\frac{b^*}{1-b^*}\epsilon_{b^*} \tag{9}$$

where $\epsilon_R = \frac{dR}{dA}\frac{A}{R}$ and $\epsilon_b = -\frac{db}{dA}\frac{A}{b}$. Taking the derivative of (7) with respect to A, we get (omitting stars)

$$\epsilon_\lambda := \frac{1}{1-\alpha-\beta} - \eta = \left(\frac{(\alpha+\beta)(1-\alpha-\beta)R^{\alpha+\beta-1}}{1-(\alpha+\beta)R^{\alpha+\beta-1}} + \frac{R-(\alpha+\beta)R^{\alpha+\beta}}{R^{\alpha+\beta}-R}\right)\epsilon_R \tag{10}$$

Substitute (9) and (2) into (10), we have

$$\frac{\epsilon_\lambda}{\epsilon_b} = \left((\alpha+\beta)R^{\alpha+\beta-2} + \frac{R^{\alpha+\beta-1}-1}{(1-\alpha-\beta)R}\right)\phi^{-1} \tag{11}$$

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

$$\frac{d\epsilon_{b^*}}{d\theta} < 0, \text{when } \epsilon_\lambda > 0 \Leftrightarrow \eta < \frac{1}{1-\alpha-\beta} \tag{12}$$

■