THE UNIVERSITY OF CHICAGO

CORRUPTION AND DECENTRALIZATION: DOES COUNTRY SIZE MATTER FOR INTERJURISDICTIONAL COMPETITION?

A DISSERTATION SUBMITTED TO
THE FACULTY OF THE DIVISION OF SOCIAL SCIENCES
IN CANDIDACY FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

DEPARTMENT OF ECONOMICS

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CHICAGO, ILLINOIS
JUNE 2017

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1 Introduction

The scandals in Brazil and Malaysia and the shockwave from the leak of the Panama papers have made the world aware of corruption. This awareness has even prompted the United Nations to add the alleviation of corruption to its newly minted Sustainable Development Goals and to estimate that: "Corruption, bribery, theft and tax evasion cost some US $1.26 trillion for developing countries per year."[1] These estimates come from their observations of illicit financial flows. Even more worrisome, Transparency International claims that this problem seems to be getting worse in certain regions of the world. Its latest report points out that 58% of Africans say that corruption has increased in the last year.

Classical Economics regards corruption either as a way around over-bearing regulatory hurdles or as a different form of taxation. However, Mauro (1995)[20] observes that corruption decreases investment and economic growth in developing countries. Further, many cross-country studies and theoretical papers conclude that instead of greasing the system, corruption often adds sand to it. This field of research has recently seen a revival due to the increased availability of large and detailed data sets. This new literature, such as Fisman and Svensson (2007)[16], and Djankov and Sequeira (2010)[12], uses disaggregated or micro data to confirm that corruption is very costly for firms.

Many theoretical papers have heralded the decentralization of public administration as a potential tool to achieve alleviate corruption. Decentralization allegedly brings public officials closer to the people to increase accountability and fosters horizontal competition that limit the officials' capacity to extract bribes. However, there is still an ongoing controversy in the empirical literature on whether that theory is valid or not. Some papers show positive effects, some negative, and many are inconclusive.

This paper proposes the following thesis to solve the disparity between theory and empirical observation: the ability of decentralization to rein in corruption depends on the intensity of the competition at the regional level. In other words, it matters for the horizontal compe-

[1] http://www.un.org/sustainabledevelopment/peace-justice/

tition mechanism whether 2 or 100 regions are competing to attract firms and capital. If the country is too small, then decentralization only serves to increase the size of the bureaucracy that does not lead to a reduction in corruption.

The paper unfolds in three parts. In section 2, I use the World Bank Enterprise survey and instrumental variables to show that decentralization is beneficial in larger countries. These surveys contain 80,000 firms in 124 low to middle income countries and were recorded between the years 2009 and 2016. Of the firms in the surveys, about half of them report that interacting with corrupt public officials has a moderate to very severe effect on their operations. This is understandable since the surveys estimate that these firms lose on average 6.5% of their total output to bribes.

In this empirical analysis, I use the share of sub-national public employment as the decentralization measure. I show that decentralization by itself has an ambiguous effect on corruption. However, when interacted with the countries' size then administrative decentralization in large countries strongly and significantly reduces the corruption that firms face. For example, a country on the 66th percentile in terms of size could reduce the bribes paid by its firms by as much as 2.38% of their sales. However, decentralization does not seem to impact much the likelihood that firms face corruption. This indicate that different factors affect the intensive and the extensive margins of corruption.

To test for a causal relation, I also use an instrumental variable (IV) strategy. The key challenge is to isolate the exogenous variation in the interaction term between decentralization and country size. The variables proposed as instruments are the widely used measure of ethnic fractionalization from Alesina et al. (2003)[5] and a variable that indicates whether the country originated from the union of previous states or by breaking off from another state. The IV regressions show that exogenous variation in the independent variables are indeed associated with variations in corruption consistent with the results from the OLS regressions. The empirical analysis concludes by showing the robustness of the results.

In section 3, I build a political economy model to provide a structural framework to test

the proposed mechanism through which decentralization could affect corruption. Although this model is like others featuring inter-jurisdictional competition, it features three key distinctions. First, the intensity of the competition among regional public officials increases with the number of regions. This is represented by the firms' location decision and the greater number of options in larger countries. Second, the intensive and extensive margins of corruption are introduced separately such that the bribes that can be extracted from firms depend on the market structure while the public official's decision of whether to be corrupt or not depends on the potential gain and cost of that decision. Third, the model features both a regional government tier and a central one when most models of horizontal competition only feature the lower tier. Therefore, the corruption faced by firms depends both on the endogenous decisions of the two types of public officials but also on the decentralization level.

The solution of the model shows that it generates the desired facts from the empirical analysis. Furthermore, the model also provides unobvious theoretical implications from the mechanism that are testable. The main prediction concerns the standard predictor of how the bribes firms have to pay: their moving cost. Many papers have established that firms with a higher moving cost pay more bribes. If this paper's hypothesis is correct and horizontal competition is more important in larger or more decentralized countries, then the difference between the bribes paid by firms with a high moving cost versus those with a low moving cost should increase with the country's size and decentralization levels.

In section 4, I show that the data confirm this conjecture. Then, to further confirm the hypothesis, I also look at corruption within the Nigerian economy. Nigeria is an interesting case study because its public administration is highly centralized given its size. This centralization raises the question of how much corruption could be reduced by decentralizing the country. To answer this counterfactual, I calibrate the model to the Nigerian data. The calibrated model leads to the estimate that decentralizing to the levels of similar sized countries could reduce the average bribes paid by a firm in Nigeria by 17% that leads to a 4.7%

increase in its production.

While the empirical tests confirm the hypothesis that it is the increased intensity of horizontal competition that leads to the benefits of decentralization in large countries, it is not the only possible mechanism. Thus, I examine why this mechanism fares better in explaining the observed behavior than other potential candidates, such as an increased benefit from accountability in larger countries or a higher quality of regional governance. There are two key identifying factors that differentiate the theory proposed in this paper from its competitors. The competing explanations fail to explain the responsiveness of bribes to the firms observed mobility and to account for the apparent negative effect of decentralization in smaller countries.

The remainder of the paper is organized as follows. In section 2, I define more thoroughly the core concepts, describe the data, and performs the empirical analysis. Section 3 presents the model, solves it and presents the theoretical implications. In section 4 I test a few predictions of the model, I also present the case study of Nigeria and the calibration of the model, and I consider alternative theories. Section 5 concludes the paper and discusses additional questions as well as ways the model could be extended to answer these questions.

2 Concepts, Data and Empirical Analysis

2.1 Defining Corruption

The literature on corruption most commonly defines it as the misuse of public power or office for private gain. Corruption can be classified many ways. A common distinction is between petty and grand corruption, which refers to the level of government at which it occurs. Petty corruption involves low level public officials and small bribes during the application of rules and legislation. It usually takes the form of tollbooth corruption, kickbacks, or embezzlement. Grand corruption on the other hand targets the legislative process itself with the intention of deviating the design of laws and legislation toward a group's interests. It

therefore usually involves high level officials and takes the form of political or regulatory capture.

Corruption can also be classified by whether it is coercive or collusive. Collusive corruption involves the agent paying a bribe to a public official to avoid a hurdle or to get preferential treatment that leads to them sharing the rents generated by the illicit transaction. Coercive corruption takes place when the public official threatens to retaliate if no bribes are paid. A good illustration of this dichotomy can be found in Djankov and Sequeira's (2010)[12] study of corruption in the ports of Southern Africa. They discuss how custom officials accept bribes to overlook regulation, a clear form of collusive corruption, while port operators extort bribes under the threat of mishandling the cargo, which is coercive corruption.

Shleifer and Vishny (1993) distinguish between corruption *with theft* and *without theft*. For the case of corruption with theft, the final cost of accessing the service is equal to the bribe, while in the case of corruption without theft the total cost adds the bribe to the official cost. One can see how collusive corruption is thus like corruption with theft. In the port example, agents end up paying a bribe instead of the port fees. On the other hand, having to pay port operators to make sure the cargo does not get lost is coercive and without theft.

There are two main schools of thought regarding the real cost of corruption; the "greasers" and the "sanders." The greasers posit that corruption can be beneficial to the economy because at best it allows the more efficient firms to circumvent bureaucratic hurdles and, at worst, it is nothing more than an alternative form of taxation. For the sanders, corruption creates undesirable distortions in the economy by preventing relevant regulations to fulfill their purpose by diverting resources away from the more efficient firms toward those that are better connected, or by creating excessive regulations in order to extract more bribes.

For a very long time, Classical Economics leaned on the side of the greasers but the consensus started shifting to the side of the sanders with the seminal study of Mauro (1995). In that study, the author observes a negative correlation between aggregate investment and measures of corruption in a cross-section of countries. A wave of cross-section regressions

studies followed the publication of Mauro's paper and most of them confirm its findings as well as extending them to other areas of the economy. Looking at one possible mechanism for this effect, Djankov, La Porta, Lopez de Silanes and Shleifer (2002)[11] show that through their quest for rents, corrupt officials deter entry for new firms and reduce growth.

A good review of this literature can be found in Svensson (2005)[29] and Lambsdorff (2006)[17] who conclude that most of the evidence indicates that corruption severely slows down development. Further, in the literature review, Lambsdorff lists the main causes that have been consistently associated with higher corruption. This list includes lower income, lower openness to trade, less economic competition, lack of a tradition of democracy, absence of freedom of the press, and a higher share of income from natural resources.

In parallel to these empirical works, many theoretical papers make a case for seeing corruption as costly for the economy. For example, Shleifer and Vishny (1993)[27] mention the added cost of secrecy due to the illegal nature of corruption and build a theoretical foundation for market-based models of corruption at the level of the distribution of public goods. Murphy, Shleifer and Vishny (1991)[21] describe how rent extraction can divert talent from more productive endeavors. And, Bardhan and Mookherjee (2000)[8] lay down theoretical foundations for political capture at the local and central levels in which lobbying influences policies away from their social optimum.

Recently, interest in corruption research has resurged due to the increased availability of data at the firm and individual levels. These data sets make the study of bribery and its effect on firms and through them, the economy, possible. For example, in their 2010 paper, Djankov and Sequeira report the large cost and effort firms undergo to avoid the more extractive ports. Another study by Fisman and Svensson (2007) looks at 300 firms in Uganda and finds that a 1% increase in bribes is three times more hurtful to the firm's growth than a 1% increase in taxes. The data set used in that study is the precursor to the one used in this paper.

Following these two previous studies, I focus on the bribes firms pay during their inter-

actions with public officials. Most of these interactions occur during the process of accessing government goods such as public roads, permits and licenses, utilities, and ports. The appellation "government goods" is to avoid the confusion with public goods, defined as non-rival and non-exclusive goods, while government goods are simply means the goods and services provided by the government. Based on Djankov and Sequiera's as well as Fisman and Svensson's research this type of corruption appears to have a direct effect on the firms' dynamics. This fact is further confirmed by the World Bank Surveys in which 39,484 out of 77,397 firms surveyed in the data set used in this paper report this type of corruption as a moderate to very severe obstacle to their operations.

To crystalize the concept of corruption I use the following example. Firms need an intermediate input from the government, like a road, to produce. To get access to that road, the firm must stop at a tollbooth where a public official collects a fee that is used to maintain the road. In my setting, the supply of roads is fixed and perfectly elastic. The firm can use these public goods but it can also substitute them with labor; for example, by making the deliveries through small secondary roads. The public official has monopoly power on the distribution of that good. And the official can decide to misuse that power and ask for a price higher than the official toll. The difference between the effective price and the official price is what is defined as a bribe. One assumption here is that the firms that access these tollbooths are aware of what the official toll should be and can therefore tell what the bribe is. This is a standard assumption even in empirical studies such as Olken and Barron (2009) in which the truck drivers are aware of what the toll is and what the bribe is. Following the previous definitions, the corruption studied in this paper therefore classifies as coercive and without theft.

In the past, the literature has proposed many solutions to alleviate corruption. Becker and Stigler (1974)[9] were the first to describe incentive-based measures to fight corruption. One of their main contributions was to suggest increasing the wages of public officials to make the possibility of losing the job more costly. Ades and Di Tella (1999)[4] suggest that high

economic rents from natural resources or a lack of competition in a product market lead to more corruption and thus reducing these rents could help. Other authors look into improving governance, state capacity (Rothstein and Uslaner (2016)[31]), or institutions (Fisman and Gatti (2006)[15]). The theorists have also proposed decentralization as another potential tool available for governments interested in reducing corruption. Despite good theoretical backing this option has had mixed results in empirical studies.

2.2 Defining Decentralization

Another main concept used throughout the paper is the decentralization of public power. The literature broadly defines the concept as the transfer of public powers or responsibilities from the central government to the regional or local ones. There are generally three types of decentralization: 1) administrative decentralization refers to whether the local or central authority employs the public officials, 2) fiscal decentralization refers to whether local governments have the power to tax citizens and firms and to decide how to spend their revenues, and 3) political decentralization refers to the presence of an elected legislative or executive officials at the sub-national levels of the government.

Many authors argue that decentralization could be a valuable tool to fight corruption. Most of their arguments fall into two categories: increased accountability and horizontal competition. In her book, Ostrom (1990)[25] examines the vital importance of organizations with locally accountable leadership for the efficient management of common-pool resources. More recently, Myerson (2015)[23] discuss how decentralization is beneficial for the citizens by giving them the power to punish local governments who serves them badly while still serving the central government well.

Horizontal competition or the idea that public officials across different jurisdiction compete against each other to attract populations or capital was first introduced by Tiebout in 1956[30]. Tiebout discusses this competition in the context of the provision of public goods. Rose-Ackerman (1978)[26] transfers this mechanism to the study of corruption, and more

recently Bai, Jayachandran, Malesky and Olken (2015) do the same. The latter paper is the closest in terms of theory and approach to my paper.

Despite strong theoretical support, the empirical evidence that decentralization reduces corruption has been ambiguous so far. Some papers such as Arikan (2004)[6] and Fisman and Gatti (2002)[14] find that decentralization reduces corruption. Others such as Fan, Lin and Treisman (2009)[13] and Lessman and Markwardt (2010)[18] find that decentralization reduces corruption only in certain cases, and finally, a few papers find no relation at all. In his literature review, Lambsdorff states: "Decentralization could be a means of reducing corruption by bringing government closer to the people." But "Empirical results on decentralization's effect on corruption are mixed."

I argue that this controversy arises from the fact that decentralization is not intrinsically beneficial in all situations. Decentralization usually increases bureaucracy and makes it harder to keep track of every sub-national agency, therefore to be beneficial, it must be accompanied by a significant increase in competition across regions. Thus, the main thesis of this paper is that the effect of decentralization on corruption depends on the intensity of the horizontal competition that in turn depends on the number of regions trying to attract more firms and capital. This thesis is a refinement of the pre-existing theory for which it does not matter whether two regions or an arbitrarily large number of regions compete.

One issue with testing the hypothesis empirically is that the concept of region is not well defined. The definition used in this paper is the territory under the jurisdiction of a governmental agency. However, this definition is not very useful when trying to compare the number of regions across countries. In the best situation, every country has the same number of government tiers, with each tier defined similarly. In reality, things are far more complex. For instance, Slovenia and Slovakia are two relatively similar countries. Slovenia has a population of 2 million habitants and a land area of 20 $000 km^2$. Slovenia's government is composed of two tiers: 1 central government and 250 local administrative units. Slovakia has a population of 5 million habitants, a land area of 49 $000 km^2$, and 4 tiers of government:

1 central government, 38 administrative districts, 121 sub-districts, and 2,821 municipalities. There is no direct number that directly compares the number of regions within these two countries.

To solve this obstacle, the empirical analysis uses the land area of a country as a proxy for the number of regions. This solution is supported by the fact that the number of regions in equivalent tiers given that there is a lower tier is strongly and positively correlated with land area. In the appendix, the two scatter plots in Figure 2 show this correlation. Many explanations can be provided for this correlation. One is that there might be an optimal region size and thus larger countries naturally have more regions. This concept is present in other works in the literature, such as Alesina and Spolaore (2003)[5]. Another possible reason why larger countries have more regions is because they also usually have more ethnic fractionalization. Further, larger countries might also contain more geographical features, such as rivers, mountains, and deserts, that naturally provide separation between regions. A good example of this feature is the Outaouais river in Canada that serves as a border between the provinces of Quebec and Ontario.

In this paper, decentralization is defined as transferring the provision of the public goods from central agencies to regional ones. Going back to the toll road example can again help to illustrate this concept. Everywhere around the world, roads are a government responsibility that is commonly managed by more than one tier of government. For example, the United States has the National Highway System that is managed by the national government and a state system that is managed by the states. Furthermore, one can imagine that a firm might only need one of these toll roads for its operations, either to get its production to the market or to get access to some input factors.

In the model, the roads' tollbooth can be managed either by a central public official or a regional one. Decentralization then refers to the fraction of tollbooths in a region that are manned by public officials employed at regional agencies. Based on this conceptualization of decentralization, administrative decentralization is the most appropriate concept for the

empirical analysis because it is directly measuring that ratio.

This distinction between regional and central agencies is also related to another claim that I make: that horizontal competition is a feature of regional agencies but not of the central agency. Two arguments support his claim. First, Barron and Olken (2009)[24] conclude from their study of the bribes paid by truckers in Indonesia that low level bribery rarely involves negotiations. Firms know the level of bribes required for access to each good. In that sense, firms should pay the same bribe for a good if it comes from the same governmental agency. For example, the bribe on a highway crossing the country would be similar at different locations on that highway, but there is much more product differentiation possible between the Region X's Transportation Agency and Region Y's. Second, it is a standard assumption in the literature, such as in Bai, Jayachandran, Malesky and Olken (2015) or Schleifer and Vishny (1993), that corruption is decided more at the agency level than at the individual level. This idea of agency culture or collective action explaining corruption is a very interesting and active area of research.

There is no denying that taxation and corruption are two closely related activities. As previously mentioned, the main mechanism of inter-jurisdiction competition was originally designed for the public policy and fiscal policy literature. Why then is this paper about corruption and not taxation in general? As mentioned earlier, Fisman and Svensson (2005) find that corruption is much more harmful to firms' growth than taxation. Schleifer and Vishny (1993) explain that there are many costs associated to the secrecy and illegality of corruption. Other papers such as Acemoglu and Verdier (1998[2], 2000[3]) also provide theories of corruption that introduce distortions above and beyond the implicit tax that corruption imposes. Moreover, the rents captured by the corrupt public official raise his or her income higher than equivalent individuals in the private sector. This diversion of resources away from governments as well as the efforts of public officials to generate them, such as generating more entry barriers that Djankov, La Porta, Lopez de Silanes and Shleifer (2002)[11] find, can lead to very high costs to the economy that makes alleviating corruption

an important objective.

Further, the fact that the Tiebout-style mechanisms work well to explain fiscal levels does not necessarily mean that they do in the case of corruption. Showing that horizontal competition is indeed a powerful tool to study corruption behaviors is by itself an interesting result. Moreover, there are reasons to believe that these types of mechanisms can be even more appropriate to study corruption than taxation. Although there are important levels of regional taxation, most countries also have fiscal systems where taxes are collected by a central government and then redistributed to regional levels. This type of system can be observed in Plot 3 in the appendix that interacts a measure of administrative decentralization (share of regional public official in the public administration) with a measure of fiscal decentralization (share of taxes collected by regional governments).

2.3 Data Presentation

Studying corruption is challenging for many reasons. A major reason is the difficulty in measuring corruption due to its illegal status as well as the stigma and secrecy surrounding it. To overcome this challenge, I use two different empirical measures. The Corruption Perceptions Index from Transparency International and the World Bank's Enterprise Surveys. The Corruption Perceptions Index is based on analyses by 30 different experts from across the world and has more of a macro view of corruption. This Perception Index ranges from a no corruption score of 100 to the maximum corruption level of 0. For consistency with the other measures in my data set where higher score means more corruption, I reverse the Perception Index by taking the actual score and subtract it from a maximum score of 100 such that a higher score means more corruption. In the World Bank's Enterprise Surveys, interviewers ask 80,500 firms a myriad of question that are related to their experience with corruption as well as more general information about the firm itself (age, industry, size, sales, etc.). To maximize the honesty of the answers, the interviewers are not affiliated with the government.

Both the experts-based and the self-reported approaches have their pros and cons but Charron (2015)[10] finds they provide similar accuracy. Experts can be influenced by ex-post biases, and the macro approach means that a lot of information is lost in the process. As previously discussed, corruption can take many forms and the Perceptions Index does not differentiate between them. On the other hand, self-reported surveys are often criticized for being riddled with misreporting. Even though the World Bank takes many measures to prevent misreporting, the fear of reprisals from reporting an illegal activity can still lead to underreporting. Despite this downside, the percentage of sales paid in informal payments remains the main measure of corruption used in this survey due to its more precise nature and its focus on one type of corruption: the bribes firms pay public officials.

To make these two approaches more comparable, the firm-level observation of corruption is aggregated at the country level three different ways. First, I compute the average level of annual bribes in percentage of sales that the firms report. The World Bank uses stratified sampling and therefore the firms' values need re-weighting to make the sample representative of the country's economy. The World Bank provides the weights. The second measure is the ratio of positive bribes reporting firms to the total number of firms that provide an answer to the question on how many bribes they pay. This measure indicates the pervasiveness of corruption in the country. The third measure is the country's weighted average reported bribes conditional on having paid one. This measure is more indicative of the scale of the bribes firms need to pay, which assumes that firms need to pay a similar number of bribes.

Figure 4 in the appendix shows a strong, positive correlation between the Corruption Perceptions Index and the measures of pervasiveness and scale derived from the World Bank's surveys. This correlation indicates that either both approaches (perception and self-reporting) are unbiased or that both are subject to a similar bias. This last explanation seems unlikely given that one is from an individual, usually managing a small firm, and the other, from an international expert. Further, that association appears to break down as the level of corruption increases such that a high Corruption Perceptions index is not necessarily

associated with a higher probability of a bribe or a bigger bribe. This is consistent with the idea that corruption is a very broad concept and that bribes are only one of the possible ways a country can be corrupt.

The decentralization measure is the share of employment measured by wage expenditures from a combination of the IMF's Government Finance Statistics and the World Bank's Wage Bill and Pay Compression data set. Due to data limitation, I am not always able to match the years of the decentralization measure and the World Bank Enterprise Surveys, but all data are for the years between 2010 and 2015. Corruption measures and decentralization are persistent enough over such a short period that it is unlikely to affect the results. The aggregate variables such as Population, GDP (in PPP), and most of the other controls come from the World Bank's data sets. Overall, the data set contains 124 middle to low income countries although the number of countries in each regression varies depending on the available measures for each. Table 1 presents the main summary statistics.

Table 1: Summary Statistics

Var Name	Mean	SD	Quartiles		
			25th	Median	75th
# of firms per country	649.1	1020.9	239.5	360.5	600.75
Prop. of Firms Reporting a Bribe (% of firms, weighted average)	15.3	15.1	4.5	10	21.1
Conditional Avg. of the Bribe (% of sales, weighted average)	6.5	4.2	3.4	5.8	8.3
Corruption Perceptions Index	63.2	13.6	56.5	65	73
Local and Regional Share of Public Employment (% of total)	29	22.7	10	23.1	44.6
Land Area (in 100 000 Km^2)	6.9	18.8	0.39	1.7	6.5

2.4 Empirical Analysis

Table 2 shows the weighted average values for the different measures of corruption. Countries are divided into three size bins, small, medium, and large, as well as two bins for decentralization: decentralized and centralized. Countries identified as decentralized countries have a share of sub-national public employment higher than the median of the sample. In this table, the effect of decentralization on corruption depends on the size of the country. Larger countries seem to benefit the most from it while it is detrimental to smaller ones.

Table 2: Corruption, Country Size, and Decentralization

	Small (0th-33th perc.)		Median (33th-66th perc.)		Large (66th-100th perc.)	
	Centralized	Decentralized	Centralized	Decentralized	Centralized	Decentralized
Avg Bribe (% of sales)	0.42	0.48	1.49	0.87	1.88	1.29
Cond Avg Bribe (% of sales)	5.77	6.72	6.90	5.60	8.99	5.81
Prop. of Firms Reporting a Bribe	6.61	8.64	15.32	16.41	20.75	19.95
Perc. Index	52.72	51.43	69.09	59.57	70.58	64.56

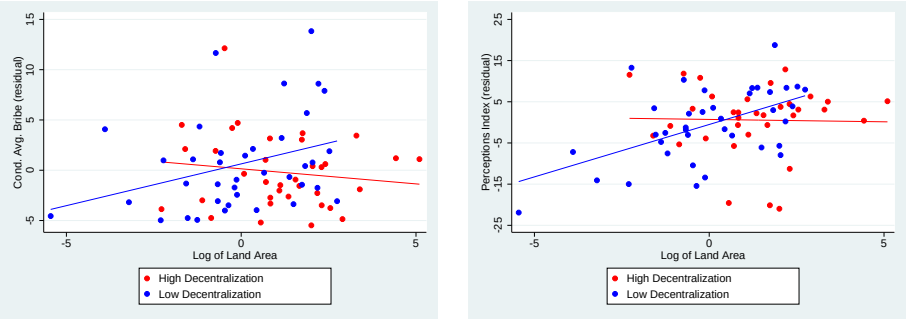
The first row of Table 2 shows that for smaller countries, decentralization increases the average proportion of sales paid in bribes. However, in large decentralized countries this proportion is 33% smaller than in the large centralized countries. The average bribe paid by firms depends on two things, the proportion of firms paying bribes and the scale of those bribes. Looking at the proportion of firms paying bribes, the table shows that it increases with the country's size and that decentralization does not make much of a difference for large countries. In small countries decentralization even increases the proportion of firms paying bribes. On the other hand, the conditional average of bribes, the measure of scale, undergoes a significant reduction when a large country goes from centralized to decentralized. The bottom row of the table also shows these results apply to the Corruption Perceptions Index from the Transparency International institute. However, these results do not control for anything and their purpose is more indicative.

This table also shows that larger countries are on average more corrupt. Many explanations are possible for this fact. One reasoning is that monitoring public officials is harder in

larger countries where they are more often out of sight of monitoring agencies. Another explanation is that as countries get larger, the public officials get further and further from the people they are serving and this distance leads to a decrease in their accountability. Further, it is possible that because of economies of scale in public administration, public officials in larger countries have a higher concentration of power and therefore more incentives to be corrupt.

As a first test of the robustness of these findings, Figure 1 plots the residuals from a regression of the two country-level measures of corruption on the three most common explanatory variables for corruption: GDP per capita, freedom of the press, and the size of the government. The residuals are plotted over the size of the country on the X-axis and the countries are again divided into two categories: decentralized and centralized. The first graph shows the residuals from the country's weighted scale of the bribes and the second graph uses the Perception Corruption Index.

Figure 1: Corruption and Country Size



(a) Scale of Bribes (b) Corruption Perceptions Index

A striking feature of these graphs is that the relation between size and corruption goes the opposite direction for the two categories of country. The red dots in the graph represent countries that have a regional share of public employment higher than the median while blue dots are the countries with a lower share. The graphs show that decentralization is a liability for smaller countries but a boon for larger ones. This realization potentially sheds some light on the mixed results for decentralization and corruption and the lack of consensus

Table 3: Country Level Regressions

	(1) Cond. Avg. Bribe (weighted)	(2) Cond. Avg. Bribe (weighted)	(3) Perc. Index	(4) Perc. Index
Decentralized	-1.194	-0.488	-0.194	1.654
(Ind. Var.)	(1.122)	(1.150)	(2.019)	(2.075)
Log of Land Area x Decentralized		**-1.164**** **(0.581)**		**-2.609**** **(1.037)**
LogLandArea	0.402	0.888**	1.430**	2.438***
	(0.310)	(0.421)	(0.674)	(0.695)
GDP per cap.	-0.247	-0.0647	-5.627***	-5.313***
(PPP 2011 units)	(0.716)	(0.754)	(1.431)	(1.508)
Freedom of the Press	0.0254	0.0245	-0.393***	-0.398***
	(0.0260)	(0.0260)	(0.0602)	(0.0624)
Size of Gov.	-0.0786	-0.0940	-0.00117	-0.0341
(Expenditure Share)	(0.0748)	(0.0774)	(0.126)	(0.120)
constant	8.067***	8.330***	85.86***	86.66***
	(1.749)	(1.770)	(3.509)	(3.412)
N	73	73	72	72
adj. R^2	0.007	0.053	0.657	0.677

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

in the literature. For the case of the proportion of firms paying bribes, decentralization also reduces corruption but only in the largest countries. This indicates that decentralization begins to reduce the size of the bribe for much smaller countries than the ones for which it reduces the pervasiveness of corruption.

Table 3 presents the regressions at the country level featured in the previous plots. The non-significance of the coefficient in Columns 1 and 3 is consistent with the ambiguous effect of decentralization on in the literature. In these regressions, the decentralized variable is an indicator variable that takes a value of one if the country has a decentralization value higher than the median and zero otherwise. The robust standard errors are reported in parentheses. The interaction term between decentralization and a country's size is strongly significant and negative in columns 2 and 5, which is consistent with my thesis.

Table 4 uses the full depth of the World Bank Enterprise Surveys and reproduces the cross-country regressions in Table 3 but at the firm level. The dependent variables are now the reported bribes paid, the reported bribes paid conditional on paying one and an

Table 4: Firm-Level Regressions

	(1) Bribe	(2) Bribe	(3) Bribe (Cond.)	(4) Bribe (Cond.)	(5) Bribe>0 (Probit)	(6) Bribe>0 (Probit)
Decentralized	-0.284	0.199	-2.426*	-0.608	0.0777	0.373***
(Ind. Var.)	(0.285)	(0.217)	(1.235)	(1.240)	(0.138)	(0.127)
Log of Land Area x Decentralized		**-0.429*** (0.124)**		**-1.207** (0.543)**		**-0.232*** (0.0573)**
Log of Land Area	0.00917	0.281***	-0.118	0.771*	0.0216	0.181***
(100 000 Km^2)	(0.0543)	(0.0968)	(0.241)	(0.452)	(0.0344)	(0.0495)
GDP per cap.	-0.0663	-0.0159	0.656	0.680	-0.145	-0.120
(PPP 2011 units)	(0.200)	(0.184)	(0.794)	(0.731)	(0.0978)	(0.0913)
Size of Gov.	-0.0269	-0.0273	-0.0954	-0.0877	-0.00515	-0.00489
(Share of GDP)	(0.0257)	(0.0217)	(0.0723)	(0.0652)	(0.00929)	(0.00780)
Freedom of the Press	-0.0130**	-0.0105**	-0.0484*	-0.0445*	-0.00583	-0.00497
	(0.00612)	(0.00484)	(0.0258)	(0.0235)	(0.00391)	(0.00350)
Log of #	-0.0908***	-0.0789***	-0.570***	-0.557***	-0.0148	-0.00915
of Employees	(0.0244)	(0.0238)	(0.121)	(0.126)	(0.0170)	(0.0166)
Log of Age	0.00789	-0.0124	-0.331	-0.329	0.0325	0.0248
	(0.0390)	(0.0377)	(0.202)	(0.199)	(0.0225)	(0.0231)
constant	2.345***	1.882***	7.206***	5.747***	-0.759***	-0.980***
	(0.470)	(0.393)	(1.783)	(1.838)	(0.281)	(0.228)
Year FE	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes
Clustered SE	yes	yes	yes	yes	yes	yes
N	45991	45991	6002	6002	45862	45862
ll	-122344.0	-122195.0	-20715.3	-20694.3	-17101.1	-16933.5
r2_p					0.0384	0.0479
r2_a	0.0188	0.0251	0.0890	0.0952		

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

indicator variable that takes the value of one if the firm reports paying a bribe and zero otherwise. This last dependent variable can be studied by using a Probit specification. The disaggregated data provides further firm specific controls such as the firm's size, its age, and its industries. Columns 1 and 2 regress the level of the bribe reported by the firms as the dependent variable, columns 3 and 4 only look at firms that report paying a bribe bigger than zero, and columns 5 and 6 perform the Probit on the binary dependent variable. All standard errors are clustered at the country level.

Confirming the findings for the cross-country regressions, decentralization by itself is very weakly linked to corruption and only when looking at the conditional expectation of bribes in

column 3 is it statistically significant, although only at the 10% level. When the interaction between decentralization and land area is introduced in columns 2, 4, and 6, it is always statistically significant and negative. The main difference between this table and the previous one is that in column 6, the positive coefficient for the decentralized indicator variable is now significant. This significance illustrates the previous observation that decentralization seems to be associated with an initial increase in corruption, which only disappears in very large countries. Multiple explanations are possible but the one I propose that decentralized public officials are harder to keep track of and thus can become corrupt more easily. In contrast, the reduction in the magnitude of the bribe associated with decentralization starts with the smaller countries and grows with the size of the country. This is consistent with the explanation advanced by this paper that the magnitude of bribes or their intensive margin is determined by market incentives while the pervasiveness or the extensive margin of bribes is more dependent on accountability.

Table 5 summarizes the effects of decentralization in two different country sizes; a small country in the 33th percentile of land area, close to the size of Sri Lanka, and a large country in the 66th percentile, similar in size with Paraguay. The numbers look at the difference between the corruption values of these two types of countries by using the coefficients from Table 4. The results are very similar in magnitude to the ones implied by Table 2. According to the values in the previous regressions, a small decentralizing country could expect its firms to pay on average an additional 0.018% of their sales in informal payments per year while in a large country those same firms would their share of sales paid in bribes reduced by 2.38%. These numbers represent a significant part of the operating profit of these firms.

Table 5: Difference between centralized and decentralized corruption in a small vs large country

	33th perc. (≈ size of Sri Lanka)	66th perc. (≈ size of Paraguay)
Avg. Bribe (% sales)	0.36	-0.48
Cond. Avg. Bribe (% sales)	**0.018**	**-2.38**
Prob. of Paying a Bribe	0.46	0.022

2.5 Identification Strategy

To establish a causal relation between decentralization and corruption, I need to rule out the possibility of reverse causality. The possibility exists that in more corrupt countries, the central government has higher incentives to centralize power to keep the rents for themselves. Furthermore, with more rents being available in larger countries, this incentive is stronger. An instrumental strategy is most appropriate to attain this objective.

The key challenge is to isolate exogenous variations in decentralization and in the interaction term between decentralization and a country's size. The two variables that fulfill this task are a measure of ethnic fractionalization and an indicator variable for whether the country, in its most recent iteration, originated from the union of independent states or if it broke off from another state. The literature has used the first variable as an instrumental variable before. The second one is new but is similar to another commonly used instrument for decentralization: an indicator for federalism. All federated countries receive a value of one for the new union variable, but some countries can still be unions without having a federal constitution. For example, until it was united in 1950, Indonesia was a federation with 16 states that followed the administrative divisions of the Dutch East Indies. Although not officially a federation, Indonesia still gets a value of 1 for the union variable.

The idea behind the union variable is that before these states were created, the original units each had a government infrastructure. Therefore, at the creation of the union, it is less

costly for the new country to be decentralized as the regions already have administrative infrastructures and know-how. On the other hand, a country breaking from another entity, such as Croatia, Macedonia, and Slovenia in 1974, needs to rapidly create new institutions to manage the country. In this situation, creating one powerful central administration might be easier than creating a multitude of regional administrations.

The argument behind ethnic fractionalization is that different ethnic groups probably have different preferences for public goods and services. If the ethnic groups are concentrated in different locations, then their fight for self-determination could push the country towards more decentralization. Both the ethnic fractionalization and the union variables are also amplified by the size of the country. For example, governing a union of states is easier with a central government if each of these states are relatively small. Similarly, the larger the region occupied by an ethnic group, the more resources this group has to fight for its self-determination and the greater the threat of secession, which makes bargaining for a decentralized administration easier to do.

Another advantage of the IV regression is that it can extend the study to more countries where the value for administrative decentralization is missing but all other variables available. Table 6 shows the two first-stage regressions, the second-stage regression, and the out of sample regression using the predicted values from the two first stages.

Table 6: IV Regressions

	(1) Decentralized	(2) Decentralized x Log Land Area	(3) Bribe (Cond.)	(4) Bribe (Cond.)
Union	0.117	0.925***		
	(0.155)	(0.343)		
Ethnic	0.284	-1.319**		
Fractionalization	(0.309)	(0.550)		
Decentralized			8.985	8.178
			(8.370)	(5.999)
Log of Land Area			-4.069**	-3.235***
x Decentralized			(1.864)	(1.120)
Log of Land Area	0.0920***	0.407***	1.312	1.007
	(0.0326)	(0.0945)	(1.164)	(0.712)
GDP per cap.	0.260***	0.187	-1.415	-0.922
	(0.0810)	(0.196)	(2.164)	(1.573)
Freedom of the Press	0.000941	-0.000461	0.0150	0.000723
	(0.00340)	(0.00679)	(0.0434)	(0.0208)
Size of the Gov.	0.00201	-0.0184	-0.126	-0.103
	(0.00649)	(0.0129)	(0.100)	(0.0637)
Specification	First Stage	First Stage	Second Stage	Out-of-Sample
N	71	71	71	95
r2_a	0.177	0.536	.	0.0535
F	6.784	7.999		2.174

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

For the first stage of decentralization, the instruments are weak. However, in the case of instrumenting for the interaction term, the instruments are very strong. These results are consistent with the story told above about the relationship between the variables and the country size. Also, because the second term is the one that is of main interest, the weakness of the instruments for the first endogenous term should not be an issue. In the second-stage and the out-of-sample regressions, the coefficients for the interaction terms are significant while decentralization by itself is not. These coefficients confirm the results from the previous analysis as well as providing good evidence of a causal relation.

2.6 Robustness

In the appendix, Table 13 presents two different robustness test for the different specifications in Table 4. The first test, presented in columns 1 to 3, adds more controls such as population size, openness to trade, and the square of the land area. The second test, presented in columns 4 to 6, is to replace the discretized decentralization variable with its continuous counterpart.

All specifications are robust to the addition of extra controls except for one: the conditional bribe. The significance of this specification decreases to between the 5 and 10% thresholds. This decrease is most probably due to the addition of the population variable, which is strongly correlated with decentralization when controlling for land area, and the fact that the sample size in this situation is much smaller. The results are also robust to using the continuous decentralization variable instead of the discrete one. I have performed other robustness tests for the IV specification and cross-country results, and they support the results. I omit them for brevity but they are available from the author on demand.

3 Model

3.1 Motivation

The findings of the empirical analysis show that decentralization in small countries increases the pervasiveness of bribes while still reducing their magnitude. This disparity between the effect of decentralization on the extensive and intensive margins of corruption indicates that decentralization changes the market structure for public goods in a way that reduces the ability of some public officials to extract high rents. In the model presented in this section, regional public officials are harder to monitor but they also face more competition that reduces the size of the bribes they can extract. This reduced efficiency of monitoring follows the line of the traditional arguments against decentralization that claim that the absence of a strong central bureaucracy reduces the state's capacity and the quality of its governance.

The claim that decentralization might reduce state capacity is supported by many academics including Acemoglu and Robinson[1]. However, the analysis in the previous section shows that this reduction of state capacity can be more than compensated in large countries where decentralization can be beneficial. My explanation for this phenomenon is that as countries get bigger, the regional competition increases and with it the elasticity of the demand for the public goods provided by the public officials. This demand leads to lower bribes and eventually to a point where it is no longer profitable for public officials to be corrupt, which reduces the pervasiveness of bribes but only in the largest countries.

The model that I construct is closest to Bai, Jayachandran, Malesky and Olken (2015)[7]. It is also strongly influenced by some ideas presented in the seminal paper by Schleifer and Vishny (1993), such as the importance of the government goods' market structure and the elasticity of demand in determining the level of bribes. There are a few differences between this model and the ones in the literature. Most models either assume that each region is a small economy among many, or that two regions (usually perfectly symmetric) play a Nash game. The key distinction between this paper's model and its peers is the departure from

these standard approaches with the addition of a dimension in which competition increases with the number of regions.

There are many reasons why the number of regions should matter for the intensity of the inter-jurisdictional competition. One is the added difficulty of coordinating many colluding public officials. Another is the larger potential gain from asking for lower bribes because firms can be attracted from a larger number of outside regions. Further, there is a higher potential cost from asking for higher bribes because firms also have many outside alternatives to move to. This last reason is very common in spatial economy models. The model presented below features the last two of these arguments.

The modification to the usual inter-jurisdiction competition mechanism is not the only difference between this model and the literature. Another difference is the presence in the same model of both horizontal and vertical dimensions with the presence of both horizontal interactions and a multi-tiered government. I could not discuss the country size dependent advantages and the costs of decentralizing the administration without the vertical dimension. Decentralization after all is a transfer of power and responsibilities on the vertical dimension.

Finally, the last innovation of this model is to have both an intensive and an extensive margin of corruption. This innovation means that the public officials' decision of how much to ask for a bribe is separate from the decision of whether to be corrupt or not. The distinction between these two margins is persistently observed in the empirical analysis which shows that the proportion of firms that pay bribes and the magnitude of those bribes cannot be explained by the same factors. Despite being separate, these decisions are not independent and of course in the model, the choice of being corrupt depends on the expected gains from corruption.

3.2 Description

I begin by assuming that a country is composed of n regions. This n is the proxy for the size of the country as well as the number of regions in the country. This is a strong but simplifying

assumption as it also implies that the economic activity is homogenously distributed inside countries and that region sizes are similar across countries. Further, I assume that the government only contains two tiers: regional and central.

In each region, there is a unit measure of firms who produce a homogenous consumption good. Two inputs are required for production: labor and a government produced intermediate good. The government good is provided to the firm by a public official. I assume that firms are paired with only one public official, which can be either central or regional. Going back to the toll road example, firms only use one type of road. In reality, firms use a combination of regional and central government intermediate goods for production. Adding more factors in the production function to generate that fact would not change the results as long as each one of these government factors have their independent markets. The decentralization level ϕ of the economy is the share of regional public employment, therefore it makes sense that the probability that a firm is paired to a regional official is equal to that share.

The government good is produced at a fixed marginal cost equal to η, which means that charging this price to customers covers all of the government's cost of maintaining and distributing the goods. By putting a public official in charge of the distribution of this good, the government is effectively giving him or her a monopoly on that market. This monopoly means that the public official could abuse his or her market power and charge a price higher than (η). Bribes in the model are therefore defined as the difference between the effective price demanded by the public official and the marginal cost. I assume that the firms are aware of the size of that bribe as in Olken and Barron (2009).

Corruption is most often illegal and socially stigmatized, although its level of acceptability varies from one country to another. In the model, if a public official decides to be corrupt, the risk of getting caught and the social stigma are represented by a fixed cost (Ψ_{jh}) that depends on the tier (j=C or R) of the public official and the type of firms he or she is associated with, such that $\Psi_{jh} = \psi_j + \omega_h$ where h identifies the firm with which the public

official is paired, ψ_j is the fixed cost for tier j and ω_h is the fixed cost for firm h.

The main difference between central and regional public officials is that the central public officials cannot price discriminate across regions, whereas the local public official chooses a price for the region he or she is in. Going back to the toll road example, this means that the bribes at tollbooths on federal roads is the same in every region while the bribes at tollbooths on regional roads are the same within a region but differ from region to region.

One concern about decentralization is the duplication of agencies and the increased size of the bureaucracy. To represent this concern in the model, I assume that each region has an administration size of measure one that is composed of central and regional public officials according to my decentralization ratio. However, the central public officials are shared across regions while the regional ones are not. This difference means that the total size of the public administration is $n\phi + (1 - \phi)$. This is a strong assumption on the economies of scale since I assume that the same number of central public officials are required to service a country with 1 region or with 100 regions. However, the theoretical results are not directly dependent on this assumption, and its only function is to make the rents that individual corrupt officials can earn independent of the decentralization measure. It also underscores that monitoring a decentralized bureaucracy is harder that leads to the assumption that the cost of being corrupt should be smaller for regional public officials: $\psi_R < \psi_C$.

A last assumption is that firms are mobile across regions, although doing so is costly. One important aspect of moving is that doing so does not change the type of public official that the firm interacts with. A firm that is matched with a regional public official will still be associated with a regional public official, consistent with the industry story. Finally, labor is also mobile across regions that leads to a single wage rate for the country.

The timing of the model is as follows:

1. Public officials observe the type of firm they are associated with, the cost of being corrupt, and decide to be corrupt or not.

2. The corrupt public officials pick a level of bribes.

3. Firms observe the prices and decide whether to move to another region or not.

4. Firms produce and pay to use the government goods.

The solution to this model is a Nash equilibrium where all regional public officials face a symmetric problem and end up asking for an identical price $p_{iR} = p_R^*$ such that no deviation is profitable. The equilibrium comes from backward induction and from finding a price level where no deviation is beneficial.

3.3 Solving the Model

Production of the consumption goods is determined by a Cobb-Douglas production function such that the profit maximization for firm h in region i is:

$$\max_{G_{ih}, L_{ih}} AG^{\alpha}L^{\beta} - p_{ij}G_{ih} - wL_{ih} \tag{1}$$

The G_{ih} is the demand for the government good, and p_{ij} denotes the price of that government good where j=C or R refers to the type of public official the firm is paired with. For the firms to make a profit, I assume that $\alpha + \beta < 1$. The solution of this problem determines the firm's demand for the government good as a function of its price as well as its profits:

$$G_{ih}^*(p_{ij}) = (A\beta^{\beta}\alpha^{1-\beta})^{\frac{1}{1-\alpha-\beta}}(\frac{1}{w})^{\frac{\beta}{1-\alpha-\beta}}(\frac{1}{p_{ij}})^{\frac{1-\beta}{1-\alpha-\beta}} \tag{2}$$

$$L_{ih}^*(p_{ij}) = G_{ih}^*(p_j)\frac{p_j}{w}\frac{\beta}{\alpha} \tag{3}$$

$$\pi_{ih}^*(p_{ij}) = (1-\alpha-\beta)(G_{ih}^*(p))^{\alpha}(L_{ih}^*)^{\beta} \tag{4}$$

Going back one step in the timing schedule, the firm can choose whether to move or not. This decision depends on whether the difference between the profit after and before the move

is larger than the cost of moving. Following Bai et al (2015), firm h's cost of moving from region i to region k (m_{ikh}) is composed of two elements:

$$m_{ih} = \theta \pi^*_{ih} \epsilon_{kh} \tag{5}$$

The moving cost is thus proportional to the profits of the firm in its original region. The θ is the component of the moving cost that is observable to the government while ϵ_{kh} is idiosyncratic to firm h and is drawn from a uniform distribution U[0,1]. The reason for the idiosyncrasy is that firms have spatial preferences or connections in different regions.

Firm h in region i will move to region k if:

$$\pi^*_{kh}(p_{kj}) - \pi^*_{ih}(p_{ij}) > m_{ikh} \tag{6}$$

that can be rewritten as:

$$\epsilon_{kh} < \frac{\pi^*_{kh}(p_{kj})}{\pi^*_{ih}(p_{ij})} - 1 \tag{7}$$

Further, only firms paired with regional public officials have an incentive to move, given that there cannot be price variations for central public officials.

In equilibrium, there is no point in moving since all regional public officials are asking for the same price. But what if one of them deviates from this equilibrium? The consequences of this deviation depend on whether the deviation is above or below the equilibrium bribe level. If it is above, then the public official extracts more from the firm it is paired with, but the firm might move out. If the deviation is below the equilibrium bribe level, then firms from other regions might move in. These movements affect the total demand for a region's public official.

The core innovation of this model is that the size of the country matters for the size of the effect of a deviation. This innovation is already built into the mode. In the case of a firm trying to move out, it has (n-1) potential regions to move to, giving it (n-1) independent draws for the idiosyncratic component of the moving cost. For the case of firms trying to

move in, they can come from (n-1) outside regions, but since there is only one destination each of these firms can only draw one ϵ_{ih}.

Lemma 1 Assuming that every other regional public officials are asking for the equilibrium price p_R, then the expected change in the number of firms that demand goods from a regional public official in region i who deviates from the equilibrium is given by:

$$\begin{cases} h(p_i, p_R) = 1 + \frac{n-1}{\theta}((\frac{p_R}{p_i})^{\frac{\alpha}{1-\alpha-\beta}} - 1) & if \;\; p_i < p_R \\ g(p_i, p_R) = [1 - \frac{1}{\theta}((\frac{p_i}{p_R})^{\frac{\alpha}{1-\alpha-\beta}} - 1)]^{n-1} & if \;\; p_i > p_R \end{cases}$$

(See proof in appendix.)

The next step is the public officials' decision on their optimal prices. The central public official who provides the public good j cannot discriminate among regions and must thus offer $p_{iC} = p_C$ for all i. However, to capture the previously discussed idea that a central agency in a larger country has more to gain from being corrupt, I assume that the central public official is servicing all regions at once. In the toll road example, this is similar to the idea that there is one inter-regional highway across the country and the public official (or the agency in charge of maintaining that road) charges any firm using it, no matter which region it comes from. The central public official problem is therefore:

$$\max_{p_C} \sum_{i=1}^{n} (p_C - \eta) G_{iC}(p_C) \tag{8}$$

The form of this equation results from the assumption that the quantity of central public officials is independent of the number of regions. Having $(1 - \phi)$ central public officials per region removes the summation from this problem but does not change the optimal size of the bribe demanded by central public officials. The only purpose of this assumption is to create the effect of a concentration of power in the economy that leads the central administration to become more corrupt in terms of the proportion of public officials asking for bribes, not

the magnitude of those bribes, as the country becomes larger. The concentration of power is only one possible way to introduce this result to the model. If instead one wanted to model the reduced accountability to the population of the central administration in large countries, then it would only be necessary to make ψ_C decrease when n increases. This alternative specification has the exact same implications for the solution of the model.

For the case of the regional public official, the equilibrium level of bribe is going to be one where no deviations are beneficial. To find that level, I define a function representing the gains from this deviation:

$$\Gamma(p_i, p_R) = \begin{cases} (p_i - \eta) G^*_{ih}(p_i) h(p_i, p_R) & if \;\; p_i \geq p_R \\ (p_i - \eta) G^*_{ih}(p_i) g(p_i, p_R) & if \;\; p_i > p_R \end{cases}$$

where $(p_i - \eta)$ is the profit made by the public official per unit of goods provided to firms, $G^*_{ih}(p_i)$ is the demand per firm, and h(.) and g(.) are the expected number of firms after the official's deviation p_i. At the point where $p_i = p_R$, both h(.) and g(.) are equal to one because no firms move. The Nash equilibrium is thus a p_R such that:

$$\left. \frac{\partial \Gamma(p_i, p_R)}{\partial p_i} \right|_{p_i = p_R} = 0 \tag{9}$$

The solution to this equation gives a local stationary point. The following lemma establishes its existence and its uniqueness.

Lemma 2 The public officials' equilibrium price levels are:

$$p_C = \eta \frac{1 - \beta}{\alpha} \tag{10}$$

$$p_R = \eta \frac{\frac{1-\beta}{\alpha} + \frac{n-1}{\theta}}{1 + \frac{n-1}{\theta}} \tag{11}$$

The equilibrium is unique. *(See proof in appendix.)*

Lemma 2 discloses a few things worthy of being pointed out. As expected with a monop-

olistic competition setting, the prices demanded by the public officials are the marginal cost times a markup >1 ($1-\alpha-\beta>0$ then $\frac{1-\beta}{\alpha}>1$). The size of that markup depends on two things, the elasticity of substitution between labor and the government good given by $\frac{1-\beta}{1-\alpha-\beta}$ and the elasticity of the demand faced by the public official. More substitutability given by a smaller α leads to a smaller markup. Additionally, as n increases, the Tiebout competition among regions increases, which leads to a more elastic demand. As n becomes very large, the regional price converges to the no corruption price $p_R^* \to \eta$. On the other hand, if n=1 then the price for the regional public good is the same as the price for a central public good.

The only remaining problem to solve is the public officials' decision to be corrupt or not. This cost is specific to the type of public official and the types of firms he or she is associated with. In equilibrium, no firm moves and therefore, a public official of type j that is associated with a firm h decides to be corrupt if:

$$\Psi_{Rh} < (p_R - \eta)G^*(p_R) \tag{12}$$

$$\Psi_{Ch} < n(p_C - \eta)G^*(p_C) \tag{13}$$

And the share of the public official who is corrupt is given by the distribution of ω_h. This way of determining the pervasiveness of paying bribes assumes that the decision on being corrupt or not incurs a one-time fixed cost independent of the scale of that corruption. The randomization of that cost over the public officials expresses the idea that some industries are more amenable to corruption than others.

3.4 Results and Implications

I now establish that this model does reproduce the facts from the empirical analysis section. Those facts were that decentralization reduces corruption in large countries and that this reduction occurs through the reduction in the magnitude of bribes, i.e. at the intensive margin.

Proposition 1 The conditional expected bribe, $\phi(p_R - \eta) + (1 - \phi)(p_C - \eta)$, always decreases with decentralization. Moreover, the magnitude of that reduction increases with the country's size n. In mathematical terms:

$$\frac{\partial(\phi(p_R - \eta) + (1 - \phi)(p_C - \eta))}{\partial \phi} \leq 0 \tag{14}$$

$$\frac{\partial^2(\phi(p_R - \eta) + (1 - \phi)(p_C - \eta))}{\partial \phi \partial n} < 0 \tag{15}$$

The inequality on the first line is strict if n>1.

Proof: $\frac{\partial(\phi(p_R-\eta)+(1-\phi)(p_C^*-\eta))}{\partial \phi} = p_R^* - p_C^*$, *if n=1* $p_R^* = p_C^*$ *as n becomes larger, then* p_R^* *decreases more and more toward* η *and thus* $p_R < p_C$ *with the difference increasing with n.*

This proposition establishes that the model can reproduce the first part of the empirical facts. In column 4 of Table 4, the interaction between decentralization and size is negative and significant; even decentralization alone, in column 3, is negative although not significant at the 5% threshold.

Proposition 2 If $\psi_R < \psi_C$, then there exist a $\bar{n}$ such that if $n > \bar{n}$, then the probability of paying a bribe, $\phi P(\Psi_{Rh} < (p_R - \eta)G^*(p_R)) + (1 - \phi)P(\Psi_{Ch} < n(p_C - \eta)G^*(p_C))$, is decreasing decreases with ϕ.
See proof in the appendix

According to this proposition, decentralization in smaller countries increases the pervasiveness of bribes while only in larger countries is that effect reversed. In column 6 of Table 4, both coefficients for the interaction term and the decentralization level are significant but these coefficients have opposite signs. Decentralization initially has an increasing effect on decentralization. The only assumption necessary to get this result is that $\psi_R > psi_C$ states

that monitoring more public officials is harder.

Proposition 3 If $\psi_R < \psi_C$, then there exist a $\tilde{n}$ such that if $n > \tilde{n}$, then the expected bribe paid by firms decreases with ϕ, that is:

$$\frac{\partial(\phi P[\Psi_{Rh} < (p_R - \eta)G^*(p_R)](p_R^* - \eta) + (1-\phi)P[\Psi_{Ch} < n(p_C - \eta)G^*(p_C)](p_C - \eta))}{\partial \phi} \leq 0 \tag{16}$$

The inequality is strict if n>1. Moreover, this effect increases with the country's size:

$$\frac{\partial^2(\phi P(\Psi_{Rh} < (p_R - \eta)G^*(p_R))(p_R^* - \eta) + (1-\phi)P(\Psi_{Ch} < n(p_C - \eta)G^*(p_C))(p_C^* - \eta))}{\partial \phi \partial n} < 0 \tag{17}$$

See proof in the appendix

This is the main theoretical result of this section and generates the main fact from column 2 in Table 4 that decentralization can reduce the average bribes paid by firms in large countries. The country also does not need to be as big as it needs to be for the pervasiveness of bribes to decrease with decentralization. It is easy to show that $\bar{n} > \tilde{n}$, because the average bribe also decreases with the size of the bribes that always decrease with decentralization as per proposition 1.

Propositions 1 through 3 show how a refined version of the horizontal competition mechanism can reproduce the facts from the empirical analysis. To further validate this hypothesis, it is important to see if some testable predictions can be extracted from this model and then verified in the data. This additional step would help confirm that among all the alternative explanations to why decentralization alleviates corruption in large countries, horizontal competition is the most likely one.

Lemma 3 In larger countries, the bribe level associated with a central government good

should be much higher relative to the one associated with a regional government good:

$$\frac{\partial \frac{p_C}{p_R}}{\partial n} > 0 \tag{18}$$

Proof: I have established that p_R^*s decreases with n while p_C^* does not.

The most direct implication of my mechanism is that larger countries have more competition at the regional level than smaller ones. One caveat of the theory is that the prices demanded by the public officials are always proportional to the marginal cost η, which is not observable and most likely varies across countries. This problem can be overcome by comparing within countries the differences across tiers of government. Lemma 3 simply re-states this implication by saying that in large countries, the central government should be able to ask much higher bribes relatively to the regional government. Finding the opposite in the data would quickly invalidate my thesis.

Proposition 4 The bribes paid by firms with higher moving costs should be higher. Moreover, the difference in bribes paid by those firms with a higher relative to a lower moving cost should be higher in a decentralized country. In mathematical terms:

$$\frac{\partial(\phi(p_R^* - \eta) + (1-\phi)(p_C^* - \eta))}{\partial \theta} > 0 \tag{19}$$

$$\frac{\partial^2(\phi(p_R^* - \eta) + (1-\phi)(p_C^* - \eta))}{\partial \theta \partial \phi} > 0 \tag{20}$$

Proof: $\frac{\partial^2(\phi(p_R^*-\eta)+(1-\phi)(p_C^*-\eta))}{\partial\theta\partial\phi} = \frac{1}{\Psi_R}\frac{\partial P_R^*}{\partial\theta} > 0$

This is the main prediction of the model. The first part of this proposition is a well-known fact in the corruption literature, that is, the firms with a higher observable moving cost end up paying more bribes. Fisman and Svensson (2007) as well as Bai et al. (2015) have both verified it in their respective empirical observations. The innovation of this proposition is in the second part in which the reasoning is that according to the Tiebout explanation, a country

where regional public officials are more important or where inter-jurisdictional competition is more intense should also see a bigger difference in the bribes paid by non-mobile firms versus mobile ones.

4 Tests and Applications of the Model

This section attempts to validate the model and its mechanism by testing the predictions empirically. This is done both at the cross-country level and within a country by doing a case study on Nigeria. Nigeria's public administration is highly centralized given the size of the country which could potentially lead to a significant reduction in corruption from decentralization. To perform this counterfactual exercise and estimate that reduction, I calibrate the model to the Nigerian economy.

4.1 Testing the Predictions

The general idea behind the mechanism of this paper is that decentralization can reduce corruption in large countries because as countries grow, the regional public officials become less and less corrupt compared to the central ones. Although this fact is intrinsic to the mechanism, it has not yet been established empirically. To do so, I make use of the richness of the World Bank's Enterprise Surveys. Among the questions asked in these surveys, some refer to whether the firm has recently interacted with different public officials such as tax inspectors, utilities officials, and permits and licensing officials. Although most of these government charges can be associated with different tiers in different countries, two of them are of interest because they are associated with associated to the same tier of government in every country. These interactions are the application for a construction permit, which is always at the local level, and the application for an import license, which is always at the central level.

In an ideal scenario, the World Bank would ask the firms how much bribes they paid

	(1) Bribe	(2) Bribe
Application for a Construction Permit	0.286***	0.230***
	(0.0742)	(0.0832)
Applicaiton for an Importation License	0.298***	0.213***
	(0.105)	(0.0812)
App. Constr. Permi. x Log of Land Area		0.0363
		(0.0236)
App. Imp. License x Log of Land Area		0.0658*
		(0.0390)
Log of Land Area	0.0585*	0.0451
	(0.0342)	(0.0351)
GDP per cap.	-0.275***	-0.275***
	(0.0973)	(0.0972)
Log of # of Employees	-0.137***	-0.137***
	(0.0270)	(0.0271)
Log of Age	-0.0679	-0.0680
	(0.0440)	(0.0438)
constant	0.949*	1.265**
	(0.512)	(0.539)
YearFE	yes	yes
IndustryFE	yes	yes
Clustered	yes	yes
N	62380	62380
ll	-165444.2	-165437.1
r2_p		
r2_a	0.0135	0.0137

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Central and Local Bribes

to each of these specific officials. However, this question is not asked as it could implicate the firm too much. As a second best, I estimate the treatment effect of these interaction by regressing the percentage of sales reported by firms against an indicator variable that takes the value one if the firm interacts with a public official and zero otherwise. The results of these regressions are plotted in Table 7.

Column 1 shows that both treatment effects of applying to these permits are associated with higher bribes when controlling for some confounding factors. In column 2, only the interaction between central government application and the size of the country is significant. Even without looking at the significance level, the coefficient for the central interaction term is still twice as big as the coefficient for the local interaction term. This is consistent with the

fact that central governments seem to get more corrupt as countries grow larger compared to regional public officials.

Testing proposition 4 requires a measure of the moving cost of the firms. Such a measure has been used before in the literature. For example, Svensson in his (2003)[28] paper shows that the level of bribes a firm pays is explained by its cost of divesting and reallocating its production to another sector or location, or investing the divested funds abroad. To measure this cost, the author uses the firm's capital stock per employee. In their paper Bai et al. (2015) use two measures for the moving cost: the firm's property rights and whether or not they have operations in multiple provinces. Their idea is that if a firm has a well-defined property right or is renting a property, then relocating is easier than if it does not have official land own rights and cannot easily sell the property. The authors also posit that firms with some of their operations elsewhere in the country 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.

In this paper, the measure of the cost of moving is the firm's reported cost of repurchasing all of its land and capital, normalized by the firm's sales. This measure is closely related to the one in Svensson (2003) and is directly available from the World Bank's surveys. One issue with measures inspired by Bai, Jayachandran, Malesky, and Olken is their interaction with decentralization. For example, a firm that operates in many regions might have a smaller moving cost but could also pay bribes in each region if the country is decentralized, muddying the direction of the effect. In Table 8, I regress the percentage of sales paid by firms, conditional on them reporting positive bribes, on the proxy for the moving costs and controls. The coefficient for the moving cost is positive and statistically significant, which is consistent with the first part of proposition 4.

Table 8: Moving Cost, Decentralization and Bribes

	(1) Bribe (Conditional)	(2) Bribe (Conditional)	(3) Bribe (Conditional)	(4) Bribe (Conditional)	(5) Bribe (Conditional)
Repurchase Cost of Capital	0.00691***	0.00664***	0.00676***	-0.145***	-0.135***
(over sales)	(0.00165)	(0.00157)	(0.00156)	(0.0394)	(0.0446)
Repurchase Cost		**0.119*** **	**0.110*** **		
x Decentralized		**(0.0246)**	**(0.0290)**		
Repurchase Cost				**0.0603*** **	**0.0560*** **
x Log of Land Area				**(0.0154)**	**(0.0175)**
Time on Reguation			0.0449***		0.0449***
(% of top manager's time)			(0.0131)		(0.0131)
Decentralized	-2.621**	-2.625**	-2.376**	-2.625**	-2.376**
(Ind. Var.)	(1.173)	(1.173)	(1.146)	(1.174)	(1.147)
Log of Land Area	-0.00525	-0.00621	-0.0596	-0.00622	-0.0596
	(0.202)	(0.202)	(0.193)	(0.202)	(0.193)
GDP per cap.	0.00711	0.00560	-0.220	0.00506	-0.221
	(0.487)	(0.488)	(0.484)	(0.488)	(0.484)
Log of #	-0.668***	-0.668***	-0.676***	-0.668***	-0.676***
of Employee	(0.152)	(0.152)	(0.162)	(0.152)	(0.162)
Log of Age	0.210	0.208	0.207	0.209	0.208
	(0.244)	(0.244)	(0.254)	(0.244)	(0.254)
YearFE	yes	yes	yes	yes	yes
IndustryFE	yes	yes	yes	yes	yes
Clustered	yes	yes	yes	yes	yes
N	2636	2636	2572	2636	2572
r2_a	0.0688	0.0685	0.0836	0.0685	0.0835

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The first column of Table 8 reproduces the standard fact from the literature that a higher moving cost should be associated with higher bribes. The second column shows that this moving cost is especially important in decentralized countries, and column 4 establishes that it is also the case for larger countries. Columns 3 and 5 control for the fact that firms with a higher capital intensity might face more regulation, which controls for the percentage of time that the top manager spends on regulation. These regressions provide strong support to this paper's hypothesis that horizontal competition is greater in larger countries.

These regressions provide strong support to this paper's hypothesis that horizontal competition is increased in in larger countries. The predictions from the theory have held against the empirical tests performed so far. Before comparing this hypothesis with competing ones, let's take a deeper look at corruption within a country as some of the facts gathered from this exercise will be useful to discuss the alternative theories.

4.2 Calibration and Counterfactual

Nigeria is one of the largest countries in land area in the sample and is highly centralized. The country has been a democracy since 1999 and its government is composed of three tiers: central, provincial, and local. It is also a federal nation containing 36 states and a federal capital territory. The central capital was previously situated in the traditionally Christian southern city of Lagos, which is still the country's main economic center. The present capital, Abuja, was built from the ground up in the mid-1990s to move the capital to a more neutral and geographically central location.

One of the advantage of looking at one specific country is the possibility to identify under which tier more of the previously mentioned responsibilities fall. For example, Table 9 recreates Table 7's results but adds one more interaction: the application for a water connection. In Nigeria this function is managed by the provinces.

Table 9: Central, Regional and Local Bribes

	(1) Bribe	(2) Bribe	(3) Bribe	(4) Bribe
Application for a Construction Permit (Local)	0.758 (0.734)			0.0405 (0.786)
Application for a Water Connection (State)		2.033** (0.869)		1.600* (0.897)
Application for an Importation License (Central)			4.420*** (1.108)	4.099*** (1.169)
log of # of Employees	0.476** (0.217)	0.462** (0.211)	0.308 (0.206)	0.308 (0.208)
Log of Age	0.417 (0.309)	0.472 (0.306)	0.477 (0.307)	0.533* (0.308)
constant	0.358 (2.273)	0.0246 (2.254)	0.846 (2.246)	0.418 (2.250)
Year FE	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes
Region FE	yes	yes	yes	yes
r2_a	0.108	0.113	0.125	0.126
N	1672	1686	1672	1659

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The effect on bribe levels from these government interactions are consistent with what the theory predicts for a large country. The local tier, which faces the most competition, is associated with the lowest bribe level while the highest tier of government is associated with the highest bribe level. The state government sits in between these two extremes. Focusing on a single country, also makes it possible to extract moments that can then be used to calibrate the models. Table 10 presents the moments used in the calibration as well as their sources.

Table 10: Calibration Moments

Moment	Value	Description	Source
ϕ	0.2	Level of administrative decentralization	World Bank's wage bill and pay compression data
n	37	Number of regions	Nigerian government official's website
$\frac{\Pi^C}{\Psi_C}$	0.318	Pervasiveness of corruption in central tier of government)	World Bank Enterprise Surveys (Ratio of firms reporting paying a bribe when applying for an importation license over the number of firms applying for the license)
$\frac{\Pi^R}{\Psi_R}$	0.313	Pervasiveness of corruption in regional tier of government)	World Bank Enterprise Surveys (Ratio of firms reporting paying a bribe when applying for a water connection over the number of firms applying for a water connection)
L^*	23.66	Average number of employees in the firm	World Bank Enterprise Surveys
Y^*	996 887 360	Average sales of the firm (in local currency)	World Bank Enterprise Surveys
$(p_C - \eta)\frac{\Pi^C}{\Psi_C}$	0.207	Average increase in bribe from using a central government good)	Table 7
$(p_R - \eta)\frac{\Pi^R}{\Psi_R}$	0.0421	Average increase in bribe from using a central government good)	Table 7
$\frac{G^*(p-\eta)}{Y^*}$	0.0324	Average percentage of sales paid in informal payments)	World Bank Enterprise Surveys
β	0.4	Labor share	Penn World Table 2015

Three parameters of the model cannot be directly inferred from the empirical moments and must be calibrated: the factor share of government goods α, the marginal cost of producing the government goods η, and the average moving cost θ. The calibration of the model yields that $\alpha = 0.48$, $\eta = 0.52$, and $\theta = 36$. A government good's share of 0.48 means that the firm's government cost is as big as its labor cost. This number seems somewhat large and this calibration could probably use some refinement such as considering the capital factor of production and other intermediate input costs. On the other hand, this calibration does a good job at recreating the kind of relation between decentralization and corruption that the reduced form analysis in Section 2 indicates.

In the counterfactual exercise I assume that the Nigerian economy decentralizes its public administration from a regional share of 20% to a share of 50%. This ratio of regional public employment is typical in countries of a similar size. According to the parameters from the data and the calibrated ones, this reform leads to a 17% decrease in the average bribes paid by firms. This is in the same range as the reduced form estimation that indicates an 11% reduction from a similar change in the decentralization level. According to the calibrated parameters, this 17% reduction in corruption leads to a 4.7% increase in the

firm's production, assuming that the labor market is perfectly elastic.

4.3 Alternative Explanations

This paper's thesis is that the benefits of decentralization increase with the size of the country due to the increased intensity of the horizontal competition. This idea is supported by tests of the model's predictions. However, this mechanism is not the only one that could lead to the observation that decentralization is more beneficial in larger countries. These alternative theories mainly fall into two categories: better accountability and a higher quality of governance.

The main argument behind accountability is that as a country grows larger, the central public officials become more and more removed from the population they serve and therefore are less accountable to their actions. In this case, decentralization has the benefit of bringing the officials closer to the population and thus making them more accountable. In the case of the quality of governance, one idea, such as in Myerson (2006)[22], is that public officials begin their careers as regional public officials and the best of them go on to be promoted in the central administration. Another idea could be that in larger countries, the regional administrations learn from the experimentations of one another and are therefore better at knowing which policies work or do not work.

The primary way to differentiate between these alternative theories and the one proposed in this paper is through the interaction between corruption and the moving cost. Only the inter-jurisdiction mechanism can account for the fact that the moving cost matters, and that it matters more the more decentralized or larger the countries are. Furthermore, in Section 2, both Tables 2 and 5 show that decentralization could be detrimental to smaller countries. However, all of the alternative theories imply that decentralization is always beneficial, no matter the size of the country.

One implication of the increased quality of governance theories is that the benefits of decentralization accrue both at the regional level where public officials are incentivized to

not be corrupt to get access to higher ranking offices and at the central level that can vet the regional public officials and only hire the most honest and highest quality ones. However, Table 7 shows that central agencies seem to be getting more corrupt in larger countries, not less corrupt.

The argument behind accountability says that making regional governments more accountable to the population should lead to lower corruption in large countries. One way to directly test this hypothesis is to find a measure of administrative decentralization. Such a variable measuring the accountability of regional governments to the local population exists in the form of the Regional Authority Index from the work of Marks, Hooghe and Schakel (2008)[19] and in the World Bank measures of political decentralization.

The Regional Authority Index measures ten dimensions: institutional depth, policy scope, fiscal autonomy, borrowing autonomy, representation, law making, executive control, fiscal control, borrowing control, and constitutional reform. The World Bank's political decentralization takes a value of two if the executive and legislative representatives of the regional units are elected, a value of one if the executive representative is elected, and zero if there are no regional elections. Table 11 shows the regressions of the bribes paid by firms but replaces the measures of administrative decentralization with the new measures of accountability. These measures do not seem to reduce corruption when interacted with size.

Table 11: Accountability of Regional Government

	(1) Bribe	(2) Bribe>0 (Probit)	(3) Bribe Bribe	(4) Bribe (Conditional)
Regional Authority	-0.00839	-0.00988		
	(0.0101)	(0.00859)		
Log of Land Area x Regional Authority		0.00126 (0.00496)		
Political Decentralization			0.246	0.349**
			(0.160)	(0.166)
Log of Land Area x Policital Decentralization				-0.0816 (0.0741)
Log of Land Area	0.0591*	0.0465	-0.109	-0.0449
	(0.0331)	(0.0667)	(0.0834)	(0.102)
GDP per cap.	-0.199**	-0.209*	-0.242	-0.221
	(0.0879)	(0.107)	(0.167)	(0.163)
Size of Gov	0.00141	0.00128	-0.0242	-0.0266
	(0.00653)	(0.00638)	(0.0236)	(0.0234)
Log of # of Employees	-0.0866*** (0.0310)	-0.0864*** (0.0309)	-0.0805*** (0.0230)	-0.0804*** (0.0230)
Log of Age	-0.0110	-0.00930	-0.0339	-0.0306
	(0.0359)	(0.0358)	(0.0423)	(0.0412)
constant	0.637**	0.619**	1.772***	1.711***
	(0.294)	(0.295)	(0.327)	(0.336)
YearFE	yes	yes	yes	yes
IndustryFE	yes	yes	yes	yes
Clustered	yes	yes	yes	yes
N	23661	23661	43329	43329
r2_a	0.0112	0.0112	0.0195	0.0200

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Another implication from the idea that corruption should increase as the government becomes more remote from the population is that regions farther from the central capital should see more corruption. I test this prediction for the case of Nigeria. Table 12 shows regressions on the bribe levels on distance from the central capital Abuja by using the firm's region as its location. Distance in this case is negatively correlated with corruption.

Table 12: Distance and Bribes in Nigeria

	(1) Bribe Bribe	(2) Bribe>0 (Probit)	(3) Bribe (Conditional)
Distance from Capital (Km)	-0.00361*** (0.000726)	-0.000890*** (0.000158)	-0.00147 (0.00140)
log of # of Employees	0.420*** (0.0837)	0.0775*** (0.0197)	0.560*** (0.156)
log of age	-0.0615 (0.106)	0.0410 (0.0260)	-0.492* (0.191)
constant	3.415*** (0.562)	0.203 (0.132)	3.916*** (1.072)
YearFE	yes	yes	yes
IndustryFE	yes	yes	yes
ClusterFE	yes	yes	yes
N	5870	5855	2472
ll	-18441.2	-3669.6	-8219.7
r2_p		0.0794	
r2_a	0.0306		0.163

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5 Discussion

This paper uses data from the World Bank's Enterprise Surveys to shed some light on the interaction between decentralization and corruption. Despite previous mixed results, I find strong evidence that decentralization can reduce the bribes that firms in countries with low to middle income must pay during their interactions with public officials. Specifically, the empirical analysis establishes that decentralization in large countries limits the magnitude of the bribes extracted from. To establish causality in this relation, this paper proposes a new instrument for decentralization and shows that exogenous variations in the formative origin of the country lead to variations in the size of the bribes.

To explain this phenomenon, I propose a refinement in the standard horizontal competition mechanism. This theoretical contribution makes the intensity of the competition among regional public officials increase with the number of regions and the size of the country. More intense competition means a more elastic demand for the goods provided by the public officials and therefore a lower mark up from their market power. When the bribes to regional public officials fall below a certain threshold, decentralization becomes a powerful tool to reduce corruption. This proposed mechanism also predicts that a firm's moving cost matters

more as a predictor of corruption when it faces larger or more decentralized countries. This prediction is verified in the data and cannot be reproduced using alternative explanations.

These results have policy implications broader than merely suggesting that larger countries such as Nigeria could benefit from decentralization. They also offer guidelines on how best to design a decentralization effort by making sure that these efforts do not create barriers to the movement of firms across regions or indicate that as far as alleviating corruption is concerned, it is not as much the decision making that must be decentralized but the provision and delivery of the goods and services. This paper also shows how governance can be improved by introducing market based frameworks that can be potentially less expensive than compensation or monitoring based interventions.

Finally, this paper raises many questions and future research directions. During the empirical analysis, I observe that the extensive margin of corruption is positively correlated with a country's size; to the best of my knowledge, the literature has not yet addressed this fact. Although a few potential explanations have been proposed such as the concentration of power due to economies of scale in governance or the increased cost of monitoring, this paper does not provide a satisfying explanation for this fact nor for the factors influencing the extensive margin of corruption. More research is needed to confirm the fact and explain it. Furthermore, in their book, Alesina and Spolaore discuss the endogeneity of the size of nations. This paper raises the crucial question on the optimal size and quantity of subnational entities that are potentially easier to tweak and optimize.

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6 Appendix

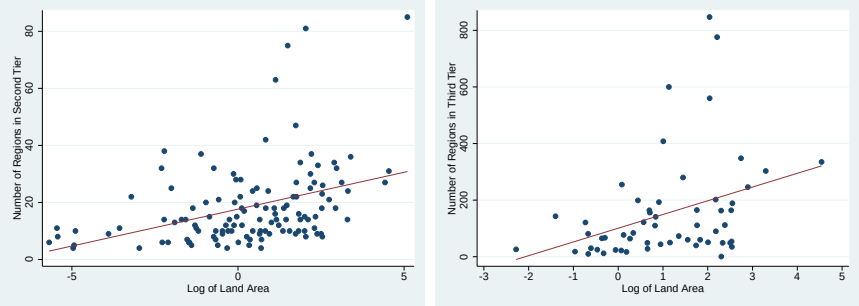

Figure 2: Number of Regions and Country Size

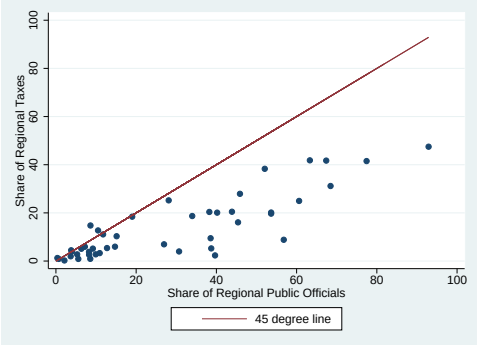

Figure 3: Administrative vs Fiscal Decentralization

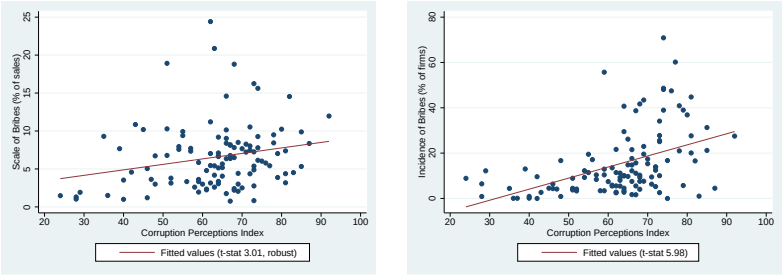

Figure 4: Perceived and Reported Corruption

Table 13: Country Level Regressions

	(1) Bribe	(2) Bribe	(3) PayBribe	(4) Bribe	(5) Bribe	(6) PayBribe
Log of Land Area x Decentralized	**-0.573***** **(0.181)**	**-1.278*** **(0.669)**	**-0.301***** **(0.0629)**	**-0.00794***** **(0.00198)**	**-0.0192**** **(0.00920)**	**-0.00521***** **(0.00103)**
Log of Land Area	0.251*** (0.0925)	0.586 (0.493)	0.153*** (0.0485)	0.388*** (0.0963)	0.998** (0.468)	0.259*** (0.0497)
Decentralized	0.379 (0.253)	0.00607 (1.435)	0.397*** (0.116)	0.000136 (0.00523)	-0.0305 (0.0237)	0.00740** (0.00327)
GDP per cap	-0.0384 (0.182)	0.763 (0.776)	-0.133 (0.0999)	-0.118 (0.169)	0.396 (0.645)	-0.149* (0.0898)
Size of Gov	-0.0234 (0.0202)	-0.0892 (0.0598)	-0.00129 (0.00785)	-0.0317 (0.0213)	-0.104 (0.0634)	-0.00509 (0.00730)
Log of # of Employees	-0.0759*** (0.0241)	-0.577*** (0.131)	-0.00739 (0.0166)	-0.0760*** (0.0236)	-0.523*** (0.127)	-0.00660 (0.0165)
Log of Age	-0.0212 (0.0363)	-0.356* (0.193)	0.0142 (0.0204)	-0.0227 (0.0376)	-0.375* (0.193)	0.0238 (0.0231)
Freedom of the Press	-0.00968* (0.00546)	-0.0551** (0.0216)	-0.00367 (0.00366)			
Opennes to Trade	-0.00679 (0.00437)	-0.0324* (0.0175)	-0.00188 (0.00208)			
Log of Population	-0.00743 (0.104)	-0.101 (0.420)	0.0249 (0.0576)			
Log of Land Area Squared	0.0286 (0.0217)	-0.0147 (0.118)	0.0172* (0.0104)			
constant	2.785*** (0.822)	11.40*** (3.518)	-0.946*** (0.289)	1.470*** (0.296)	4.160*** (1.381)	-1.148*** (0.291)
Specification	Indicator	Indicator	Indicator	Continuous	Continuous	Continuous
YearFE	yes	yes	yes	yes	yes	yes
IndustryFE	yes	yes	yes	yes	yes	yes
Clustered	yes	yes	yes	yes	yes	yes
N	45701	5855	45573	45991	6002	45862
ll	-121325.8	-20197.5	-16633.0	-122149.1	-20687.1	-16902.4
r2_p			0.0476			0.0496
r2_a	0.0263	0.103		0.0271	0.0975	

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Proof of Lemma 1

First, I assume that the regional public official of region i decreases his or her price such that $p_i < p_R$. Because of this deviation from the equilibrium, firms from other regions are going to move to region i. The number of outside regions times the probability that a firm from those regions is going to move to region i is:

$$(n-1)P(\theta\pi_{kh}(p_R)\epsilon_{ih} < \pi_{ih}(p_i) - \pi_{kh}(p_R) = (n-1)P(\epsilon_{ih} < \frac{1}{\theta}((\frac{p_R}{p_i})^{\frac{\alpha}{1-\alpha-\beta}} - 1)) \tag{21}$$

$$= \frac{n-1}{(}\theta(\frac{p_R}{p_i})^{\frac{\alpha}{1-\alpha-\beta}} - 1) \tag{22}$$

The first equality substitutes the profits for the values from the solution of the firm problem.

Adding this measure of firms moving in region i to measure 1 of firms already present gives the final measure of firms in the region after the deviation:

$$h(p_i, p_R) = 1 + \frac{(n-1)}{\theta}\frac{\alpha}{1-\alpha-\beta}(1 - \frac{p_{iR}}{p_R^*}) \tag{23}$$

Second, I assume that the regional public official of region i increases his or her price such that $p_{ir} > p_r^*$. This increase leads to a move out of region i. Because each firm in the region draws an idiosyncratic component of the moving cost for every potential region, each can move.

The probability that a firm leaves is thus the probability that it draws at least one moving cost lower than the increase in profits from moving:

$$P(\bigcup_{k=1}^{n-1}(\theta\pi_{ih}(p_R)\epsilon_{kh} < \pi_{kh}(p_R) - \pi_{ih}(p_i))) = P(\bigcup_{k=1}^{n-1}[\epsilon_{kh} < \frac{1}{\theta}((\frac{p_i}{p_R})^{\frac{\alpha}{1-\alpha-\beta}} - 1)]) \tag{24}$$

This is equivalent to one minus the probability that all firm's moving costs are larger than

the savings:

$$P(\bigcup_{k=1}^{n-1}[\epsilon_{kh} < \frac{1}{\theta}((\frac{p_i}{p_R})^{\frac{\alpha}{1-\alpha-\beta}} - 1)]) = 1 - P(\bigcap_{k=1}^{n-1}[\epsilon_{kh} > \frac{1}{\theta}((\frac{p_i}{p_R})^{\frac{\alpha}{1-\alpha-\beta}} - 1)]) \tag{25}$$

$$= 1 - [P(\epsilon_{kh} > \frac{1}{\theta}((\frac{p_i}{p_R})^{\frac{\alpha}{1-\alpha-\beta}} - 1)]^{n-1} \tag{26}$$

$$= 1 - [1 - \frac{1}{\theta}((\frac{p_i}{p_R})^{\frac{\alpha}{1-\alpha-\beta}} - 1)]^{n-1} \tag{27}$$

Where the second equality follows from the independence of the draws. By subtracting the probability that a firm is leaving from the initial measure of firms in the region give the final size of the market after the deviation:

$$g(p_i, p_R) = [1 - \frac{1}{\theta}((\frac{p_i}{p_R})^{\frac{\alpha}{1-\alpha-\beta}} - 1)]^{n-1} \tag{28}$$

Proof of Lemma 2

To find the equilibrium level of bribes, I solve the decision problem of the two types of public official starting with the central one.

$$\max_{p_C} \sum_{i=1}^{n} (p_C - \eta) G_i(p_C) \tag{29}$$

I plug in the demand levels from the firm problem, summing them over all the regions, and remove the multiplying constants and get:

$$\max_{p_C} (p_C - \eta)(\frac{1}{p_C})^{\frac{1-\beta}{1-\alpha-\beta}} \tag{30}$$

The first order condition is:

$$(1 - \frac{1-\beta}{1-\alpha-\beta}) p_C^{-\frac{1-\beta}{1-\alpha-\beta}} + \frac{1-\beta}{1-\alpha-\beta} \eta p_C^{-\frac{1-\beta}{1-\alpha-\beta}-1} = 0 \tag{31}$$

$$\Rightarrow p_C^* = \eta \frac{1-\beta}{\alpha} \tag{32}$$

The previous assumption that the firm has decreasing returns to scale, i.e. $1-\alpha-\beta>0$, means that $\frac{1-\beta}{\alpha}>1$.

For the regional public officials, the potential gain from deviating from the equilibrium p_R^* is:

$$\Gamma(p_i,p_R)=\begin{cases} f(p_i)h(p_i,p_R) & if\ \ p_i\geq p_R \\ f(p_i)g(p_i,p_R) & if\ \ p_i>p_R \end{cases}$$

where $f(p_i)=(p_i-\eta)G_{ih}^*(p_i)$. The derivative of this function is thus:

$$\frac{\partial\Gamma(p_i,p_R)}{\partial p_i}=\begin{cases} f'(p_i)h(p_i,p_R)+f(p_i)h'(p_i,p_R) & if\ \ p_i\geq p_R \\ f'(p_i)g(p_i,p_R)+f(p_i)g'(p_i,p_R) & if\ \ p_i>p_R \end{cases}$$

For now whether $\Gamma(.)$ is continuously differentiable is not known. Therefore, I look at the derivatives of g(.) and h(.) with respect to p_i, that is, holding p_R fixed:

$$g'(p_i,p_R)=(n-1)[1-\frac{1}{\theta}((\frac{p_i}{p_R})^{\frac{\alpha}{1-\alpha-\beta}}-1)]^{n-2}(\frac{-1}{\theta}\frac{\alpha}{1-\alpha-\beta}p_R^{\frac{-\alpha}{1-\alpha-\beta}}p_i^{\frac{\alpha}{1-\alpha-\beta}-1} \tag{33}$$

$$h'(p_i,p_R)=\frac{n-1}{\theta}p_R^{\frac{\alpha}{1-\alpha-\beta}}(\frac{-\alpha}{1-\alpha-\beta})p_i^{\frac{-\alpha}{1-\alpha-\beta}-1} \tag{34}$$

The evaluation of these derivatives at the point where $p_i=p_R$ shows the following:

$$g'(p_R,p_R)=\frac{-(n-1)}{\theta}\frac{\alpha}{1-\alpha-\beta}p_R^{-1} \tag{35}$$

$$h'(p_R,p_R)=\frac{-(n-1)}{\theta}\frac{\alpha}{1-\alpha-\beta}p_R^{-1} \tag{36}$$

This result shows that $g'(p_R,p_R)=h'(p_R,p_R)$ for any value of p_R. Adding to this the fact that $h(p_R,p_R)=g(p_R,p_R)=1$ means that the derivative of $\Gamma(.)$ evaluated at $p_i=p_R$ can be rewritten as:

$$\left.\frac{\partial\Gamma(p_i,p_R)}{\partial p_i}\right|_{p_i=p_R}=f'(p_R)+f(p_R,p_R)g'(p_R,p_R) \tag{37}$$

Setting the left-hand part of this equality to zero and solving for p_R gives the Nash equilibrium

for the regional public officials:

$$(1-\frac{1-\beta}{1-\alpha-\beta})p_R^{-\frac{1-\beta}{1-\alpha-\beta}}+\frac{1-\beta}{1-\alpha-\beta}\eta p_R^{-\frac{1-\beta}{1-\alpha-\beta}-1}+\frac{(n-1)}{\theta}(-\frac{\alpha}{1-\alpha-\beta}p_R^{-1}(p_R-\eta)[_R^{-\frac{1-\beta}{1-\alpha-\beta}}=0 \tag{38}$$

$$\Rightarrow p_R=\eta\frac{\frac{1-\beta}{\alpha}+\frac{n-1}{\theta}}{1+\frac{n-1}{\theta}} \tag{39}$$

This result also shows that $p_R=\eta\frac{\frac{1-\beta}{\alpha}+\frac{n-1}{\theta}}{1+\frac{n-1}{\theta}}$ is the only point where

$$\left.\frac{\partial\Gamma(p_i,p_R)}{\partial p_i}\right|_{p_i=p_R}=0 \tag{40}$$

that establishes the uniqueness of this equilibrium..

Proof of Proposition 2

First, p_R is lower than or equal to the profit maximization price of a monopoly because of inter-jurisdictional competition. This fact implies that increasing p_R increases the rents from being corrupt. Second, I have shown that an increase in n decreases the price p_R^*. These two elements together mean that the rents of a regional public official decrease with n, which entails that the proportion of regional public officials for which corruption is a profitable choice decreases.

In centralized countries, the central public officials' return for being corrupt is:

$$\Pi_C=\sum_{i=1}^{n}(p_C^*-\eta)G(p_C^*) \tag{41}$$

Since the level of central bribes is independent of both the decentralization level and the size of the country, the equilibrium rents of central public officials is linearly proportional to n. Therefore as n increases, so does the proportion of central public officials who choose to be corrupt, up to the point where this proportion is equal to one.

Therefore, $P(\Psi_{Rh} < (p_R - \eta)G^*(p_R))$ decreases with n, and $P(\Psi_{Ch} < n(p_C - \eta)G^*(p_C))$ increases with n. Further, the assumption that $\psi_R < \psi_C$ makes sure that these equalities only cross one. The point $\bar{n}$ where $P(\Psi_{Rh} < (p_R - \eta)G^*(p_R)) = P(\Psi_{Ch} < n(p_C - \eta)G^*(p_C))$.

Proof of Proposition 3

The derivative of the average bribe is equal to:

$$\frac{\partial(\phi P(\Psi_{Rh} < (p_R - \eta)G^*(p_R))(p_R^* - \eta) + (1-\phi)P(\Psi_{Ch} < n(p_C - \eta)G^*(p_C))(p_C^* - \eta))}{\partial \phi}$$

$$= P(\Psi_{Rh} < (p_R - \eta)G^*(p_R))(p_R^* - \eta) - P(\Psi_{Ch} < n(p_C - \eta)G^*(p_C))(p_C^* - \eta) \quad (42)$$

I decompose it and rename each of the components:

$$K_1(n) = P(\Psi_{Rh} < (p_R - \eta)G^*(p_R))(p_R^* - \eta) \quad (43)$$

$$K_2(n) = P(\Psi_{Ch} < n(p_C - \eta)G^*(p_C))(p_C^* - \eta) \quad (44)$$

Combining propositions 1 and 2 shows that these quantities evolve as follows:

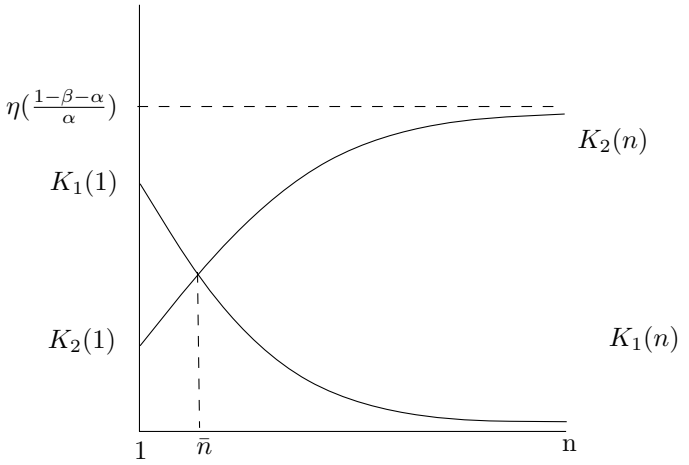

Figure 5: Perception vs Self-Reporting Indexes

If $\Psi_R < \Psi_C$, then $K_1(1) > K_2(1)$. These two equations cross at only one point $\tilde{n}$ such that:

$$K_1(\tilde{n}) = K_2(\tilde{n}) \tag{45}$$