Corruption and Competition*

Franklin Allen†
Imperial College London
f.allen@imperial.ac.uk and
University of Pennsylvania
allenf@wharton.upenn.edu

Jun “QJ” Qian
Shanghai Advanced Institute of
Finance
Shanghai Jiao Tong University
jqian@saif.sjtu.edu.cn

Lin Shen
Finance Department
The Wharton School
University of Pennsylvania
shenlin@wharton.upenn.edu

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Abstract

An interesting aspect of corruption is that its damaging effects on economic growth seem to differ significantly across countries. In large and regionally diverse countries such as China and India, rampant corruption has not slowed down growth; in many African and South American countries it seems that corrupt officials severely retard growth. We examine corruption associated with the provision of government services and goods. Local officials can charge a fee to cover the cost of provision. Due to an agency problem, corruption occurs, and local officials set higher than social optimal fees as bribes. Central government can mitigate the agency problem by paying for performance financed by tax revenues. However, budget-constrained central governments have limited power in controlling corruption with such payment schemes. One possibility is to use the law to try to rule out corruption. However, such attempts often fail. We argue that a different approach is to combat corruption by introducing competition between officials. With multiple officials providing the same service or good, the fee is determined competitively, and the pernicious effects of corruption are minimized. Moreover, the cost of implementing the optimal payment scheme by the central government is also minimized. This theory is consistent with some countries growing at fast rates despite corruption while others are severely damaged by it.

Keywords: Corruption, institutions, competition, taxes, user fee.

JEL Classifications: O0; H0; P5.

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† Corresponding author: Franklin Allen, Imperial College Business School, Tanaka Building, South Kensington Campus, London SW7 2AZ, UK. E-mail: f.allen@imperial.ac.uk.
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Abstract

An interesting aspect of corruption is that its damaging effects on economic growth seem to differ significantly across countries. In large and regionally diverse countries such as China and India, rampant corruption has not slowed down growth; in many African and South American countries it seems that corrupt officials severely retard growth. We examine corruption associated with the provision of government services and goods. Local officials can charge a fee to cover the cost of provision. Due to an agency problem, corruption occurs, and local officials set higher than social optimal fees as bribes. Central government can mitigate the agency problem by paying for performance financed by tax revenues. However, budget-constrained central governments have limited power in controlling corruption with such payment schemes. One possibility is to use the law to try to rule out corruption. However, such attempts often fail. We argue that a different approach is to combat corruption by introducing competition between officials. With multiple officials providing the same service or good, the fee is determined competitively, and the pernicious effects of corruption are minimized. Moreover, the cost of implementing the optimal payment scheme by the central government is also minimized. This theory is consistent with some countries growing at fast rates despite corruption while others are severely damaged by it.

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I. Introduction

Corruption has many damaging effects in any economy, including the distortion of incentives and misallocation of resources, and it occurs in various forms in almost all industries (e.g., Shleifer and Vishny 1993, Khwaja and Mian 2005). In its worst form, corruption is essentially outright theft and robbery done on a massive scale by high-ranking government officials. Corruption is also a pervasive and persistent problem, and takes on many different forms.\footnote{Extrapolating from firm and household survey data, the World Bank estimates that total bribes paid to officials around the world are about US$1 trillion per year, or 3% of world GDP (Rose-Ackerman 2004). For descriptions on the severity of corruption in individual countries, see reports from IMF, World Bank and Transparency International.} It occurs in many countries, including some of the most developed ones, and seems very difficult to eradicate.

Despite ample evidence at the micro-level on the prevalence, scale and damaging effects of corruption, researchers generally do not find a negative and significant relation between corruption, measured by a number of indexes provided by international organizations (most notably the Corruption Perception Index, or the CPI, published by the Transparency International), and economic growth in cross-country studies (e.g., Mauro 1995; Svensson 2005). One reason for this interesting and perhaps puzzling fact is that these indexes are imperfect measures for the multiple facets of corruption (e.g., Olken 2009; Gutmann et al. 2015). Another reason is that the negative effects of corruption on growth differ significantly across countries (e.g., Olken and Pande 2012). For example, in countries like China and India, rampant corruption has not slowed down growth (e.g., Allen et al. 2005, 2006); but in many African and South American countries, its effects seem far more damaging (e.g., Fisman and Svensson 2007).

Why does corruption occur and why is it so difficult to eradicate? How to explain the cross-country variations on the impact of corruption? In this paper, we address these questions by focusing on corruption associated with the provision of government services and goods to the public such as banking licenses, initial public offering approval for firms that want to go public, and many
other services such as provision of driver’s licenses. We first argue that corruption arises due to an agency problem. Officials can charge fees to cover the cost of provision. However, the fees charged cannot be perfectly monitored by the central government, therefore officials have incentive to take advantage of their market power and charge higher than social optimal user fees. In this regard, we define bribes as fees paid in excess of the cost of provision and corruption as officials receiving bribes over and above the costs of supplying the socially optimal level of services and goods. The central government can reduce corruption by paying bonuses to officials who increase the provision of services and goods to firms and the public. However, the central government might not have sufficient tax revenues to implement such costly salary schemes. Even if the government is not budget-constrained, it would optimally tolerate moderate levels of corruption to save the cost of such conditional salary payments. This is related to the idea of capitulation wages (e.g. Besley and McLaren 1993, Gorodnichenko and Peter 2007), which basically means wages are so low that only corrupt citizens would accept employment as government officials, and this is sometimes more efficient than paying incentive compatible wages to achieve the social optimum. In the long run, one way to curtail corruption is to raise more revenues directly through taxes and raise the sensitivity of payment to performance for officials.

With insufficient tax revenues in the short run, however, can anything be done to minimize the damaging effects of corruption? Using the legal system to make corruption illegal is one way to try to prevent corruption. However, the rampant corruption in many countries shows the limitations of this kind of approach. We argue that if services and goods are provided in a competitive environment, so that multiple officials compete to provide the same service or good (e.g., issuing licenses for banks), then the pernicious effects of corruption can be significantly reduced. In this case, the bribe an official charges is similar to a fee that is competitively determined (e.g., through Bertrand competition) and substitutes for taxes. As a result, the level of services and goods
provision can approach the first best (socially optimal) level. On the other hand, when a
government official is the monopolist in the provision of public goods or services, a much higher
user fee will be charged, leading to a lower level of provision of the goods or services and slower
economic growth.

To ensure that there is competition among officials, economic agents demanding the good or
services must be able to move from one provider to another (or credibly signal that they can do so)
and have the information regarding the user fees in other regions to exploit the differences in user
fees. In a more general and realistic setting with transaction costs (for switching), we show that an
imperfect Bertrand competition yields an output level that is below the first best level (with perfect
competition) but higher than that of monopoly, and that the cost of implementing the optimal salary
scheme is lower. Thus, the central government is less likely to be constrained by insufficient tax
revenues. An implication of this result is that economic agents can alleviate the damaging effects of
corruption through reducing their own transaction costs. For example, small firms are easier to
relocate than large firms; firms operate in industries that require small scales of investment in fixed
assets can also relocate at low costs. Therefore, the size and choice of assets makes it more difficult
for corrupt officials in any region to extract rents from firms.

The main policy implication from our analysis is that setting up the provision of government
services and goods in a competitive environment reduces the damaging effects of corruption and
promotes growth. In practice, anti-corruption legislations and strong punishment on corruption
have been proved to be inefficient in combating corruption in some countries/organizations (e.g.,
Olken and Pande 2012, Ogus 2004). One of the reasons is that corruption also occurs in law
enforcement and monitoring system, and corrupt officials can get away with it by bribing the
inspectors (e.g., Damania 2004). What we are proposing, introducing competition in the
organizational structure, is more effective in controlling corruption in the sense that it is incentive
compatible and therefore is immune from corruption in the enforcement system. One way to implement this would be to decentralize the provision of services and goods to local government officials or agencies. A potential problem with the delegation of the provision to local officials or agencies is quality control (e.g., banking licenses to incompetent firms), and thus monitoring may be necessary to ensure that quality is not compromised under decentralization. In large and diversified countries, a competitive environment can also be created by encouraging inter-regional economic activities and lowering the costs (and bureaucracy) of relocation across regions, while in small and homogeneous countries this can be done by encouraging international trade and lowering the costs of relocation across countries. Another policy implication to introduce competition and reduce friction is through facilitating information revelation, specifically the fee charged by other officials. For example, the central government can reward officials whose regions have shown the fastest economic growth and attracted the largest amount of economic activities (and investment) from non-local sources as in China. These policies encourage inter-regional competition among officials and induce more government services and goods to be supplied. It may in circumstances be better not to heavily penalize corruption to facilitate the provision of price information.

Our results are broadly consistent with evidence on corruption and growth and provide new predictions. First, corruption is more likely to occur in countries whose governments have low taxing ability and tax income – most of these countries are poor and developing countries. Second, in large and regionally diverse countries such as China and India, there is a limited amount of bribes officials can extort because of regional competition (e.g., Burgess et al 2012). In some African and South American countries with homogeneity across regions (in part due to historical reasons from colonial eras), corrupt officials effectively have monopoly power and this allows them to extract much larger amounts of rents, which in turn significantly reduces the level of economic activities. Third, consistent with the implications of our model, there is cross-country evidence on the negative
relation between “openness” of an economy (e.g., exports/GDP) and corruption, and a positive relation between corruption and excessive regulation of entry of new firms (e.g., Djankov et al. 2002; Svensson 2005).

Fourth, our model shows that corruption has less damaging effects on industries and firms that can be easily relocated. Consistent with this prediction, in both China and India, the sectors that have witnessed the fastest growth are small- and medium-sized firms from services and labor- and technology-intensive industries (e.g., Allen et al. 2005, 2006), while in Russia, an economy dominated by large corporations in heavy manufacturing industries, firm-growth in a large number of industries has lagged behind other countries. Further empirical studies can systematically examine the impact of corruption on different industries across countries or different regions within the same country.² Finally, in China, one of the key yardsticks in measuring the performance of local officials is economic growth and the amount of investment from non-local sources (e.g., Li 1998; Li and Zhou 2005); in other countries the most corrupt government officials hold the highest positions in the government, making it impossible to implement incentive-aligning policies for lower level officials.

Our paper contributes to the related strands of literature on political economy, institutions and economic growth. Proponents of institutional development argue that a country’s institutions restraining the government and powerful elites, determine the country’s long-run economic growth (e.g., Rajan and Zingales 2003a, b; Acemoglu and Johnson 2005). Unlike this line of research and most of the literature on corruption that focuses on its negative impact on growth, we show that, because of competition among officials, lack of corruption is not a necessary condition for economic growth. We also propose different degrees of competition (among officials) as the new rationale to explain cross-country (and regional) differences of corruption and growth. In addition,

² With survey data on firms from Uganda, Svensson (2003) finds that firms with less sunk costs (of capital stock) pay smaller amount of bribes, consistent with our model prediction.
our model shows reducing corruption can be expensive and therefore depends on the budget of the central government. As a result, during early phrases of economic development, policies aiming at eliminating corruption by raising salaries of officials are not likely to succeed, while policies to increase the degree of competition among officials in providing the same services and goods can be much more effective in reducing the damaging effects of corruption.

The rest of the paper is organized as follows. In Section II, we review related work and present empirical evidence on corruption, governments’ taxing ability and economic growth. Section III presents a model of corruption based on standard models of industrial organization and market power. Section IV provides model extensions and discussions, and Section V concludes.

II. Related Work and Facts about Corruption

The ideas that corruption does not necessarily slow down economic growth, and conceivably certain forms of “efficient corruption” can actually promote growth, can be traced back to at least Leff (1964) and Huntington (1968). These authors argue that corruption is more likely to occur during periods of rapid economic and social development and modernization. They also argue that through bribing corrupt officials economic agents can bypass bureaucracy and bad, rigid laws and regulations and expedite activities that lead to faster economic growth. Subsequently, researchers formalized these ideas by modeling competition among economic agents (e.g., banks applying for licenses) in submitting bribes to officials (e.g., Lui 1985; Bliss and Di Tella 1997; Ades and Di Tella 1999). However, this type of competition may not be enough to reduce the damaging effects of corruption, because corrupt officials may favor more distortions and secrecy than granting the license to the most efficient agent as argued by Shleifer and Vishny (1993).³ In our model, we take the competition among agents as given and focus on competition among officials in providing the

³ Most of the literature focuses on the negative impact of corruption on economic development. See, for example, Svensson (2005) for a review of the literature.
same service or good, and show that this latter form of competition is more important in terms of reducing the damaging effects of corruption.

While Shleifer and Vishny (1993) focus on reasons why corruption can have a significantly negative impact on economic development, we focus on how competition among officials can minimize these damaging effects. Like their paper, we show that the ‘industrial organization’ of the provision of government goods and services is an important determinant of the effects of corruption. Unlike their paper, we argue that the fundamental reason for the occurrence of corruption is an agency problem, while the government’s inability to collect sufficient taxes to compensate the officials adequately leads to the prevalence of corruption. Competition among officials can yield the same outcome as the first best situation when the government has sufficient tax income. We also argue that competition among officials is a robust mechanism in dealing with corruption, even if the central government cannot monitor the process through which the services or goods are provided by local officials (e.g., officials can lie about the quantity of services sold or the amount of money they have collected).

There is a strand of literature examining how the central government can control corrupt officials at local levels providing goods and services. Following Becker and Stigler (1974), most of the literature regards the relation between central and local government officials in the framework of a principal-agent relationship, and study ways to motivate the ‘agent’ (local officials) to carry out their tasks congruent with the goals of the ‘principal’ (central government) that is to promote economic growth. We also have the principal-agent problem in our model. In addition, we focus on what policies and performance evaluation measures the central government can come up with to motivate competition among officials. We argue that these policies and salary contract paid by central government to local officials are both of first order importance, and they substitute each
other in the sense that when competition among officials is high the optimal payment made by the central government is low.

Our work is also closely related to the literature on the structure of the bureaucracy. Tiebout (1961) argues that decentralization enhances efficiency because of the informational advantage and tailored regulation by local officials. Albornoz and Cabrales (2013) argued and provided empirical evidence that decentralization reduces (aggravates) corruption for sufficiently high (low) levels of political competition. Our model predicts that increasing competition at the same level always reduce corruption. Djankov et al (2010) and Banerjee et al (2011) showed that transparency helps curtail corruptions by allowing the public to monitor government officials. Our model also features the positive effect of transparency in controlling corruption, however through facilitating the comparison of user fees and thus mobility across regions.

Finally, there is also a literature on institutions and long-run economic growth. For example, Rajan and Zingales (2003a, b) and Acemoglu and Johnson (2005) argue that institutions restraining the government and the powerful elites promote economic growth. In this regard, the evidence in China and India provides important counterexamples to this literature, in that despite powerful elites and corruption these countries have achieved impressive growth records. In this regard, our model provides a new rationale on why lack of corruption is not a necessary condition for economic growth among emerging economies.

Insert Tables 1 and 2 here.

Table 1 lists the largest twenty economies in the world as of 2014 using both (unadjusted) simple exchange rates and those that are based on purchasing power parity (PPP); the table also lists the top twenty economies that have the highest growth rates (GDP and per capita GDP) during the period 1990-2014. As shown in Table 3-B, some of the most corrupt countries (measured by the CPI and highlighted in bold) are also among the largest and fast growing economies, led by China.
and India. These facts reinforce our research goal that understanding how corruption affects economic growth differently across countries is an important question for the world economy and development. Table 2 presents the results of Bribe Payers’ Index (BPI) in 2011 and 2008, published by the Transparency International. The BPI is based on the responses of 3,016 in 2011 (2,742 in 2008) business executives worldwide to questions about the propensity of foreign firms that do the most business in their country to pay bribes or to make undocumented extra payments. The answers are converted to a score between 0 (bribes most frequent) to 10 (bribes never occur), and the ranking of 28 in 2011 (22 in 2008) of the leading countries, including all G20 countries, listed shows the average score of a country. Consistent with the rankings of CPI, firms from the three largest emerging countries (using PPP), China, India, and Russia, have the lowest BPI rankings or the highest propensity of paying bribes.

Tables 3-A and 3-B compare government’s taxing ability, measured by total taxes collected over GDP, economic growth and income level, measured by both GDP growth and per capita GDP, across three subgroups of countries ranked by corruption. As mentioned above, the corruption measure we adopted is the CPIs of Transparency International, which provides the most comprehensive (both in terms of number of countries covered and time horizon; using other corruption measures produced very similar results; see, e.g., Svensson 2005). We divided all countries into two groups according to their average CPIs from 1995 to 2014. The more (less) corrupt countries have CPIs above (below) the sample median. Consistent with prior research, these results motivate our model assumptions that the reason corruption alleviates is because the

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4 There is a strand of literature documenting the scale of shadow economies around the world (e.g., Friedman et al. 2000; Schneider and Enste 2000, 2002). Researchers find that the size of the shadow economy is larger (relative to GDP) in poor countries, especially where the tax rates are high, and that there is a positive correlation between size of shadow economy and corruption.
government can raise enough tax revenues to pay the government officials for providing goods and services at socially desirable levels.

Tables 3-A and 3-B also show that while the average GDP growth rate (during the 1981-2014 period) for the more corrupt group is higher than that of the less corrupt group, this difference is small; perhaps not surprisingly, the standard deviation of growth rates is also higher in the most corrupt group than for the least corrupt group. In most of the regression analysis (e.g., Mauro 1995; Svensson 2005), researchers generally do not find a statistically significant relation between corruption and GDP growth after controlling for other standard growth factors (such as human capital, initial growth conditions, etc). While this puzzling fact may be explained by measurement errors of corruption, we interpret it as evidence showing that the forms and damaging effects of corruption vary significantly across countries. The main purpose of our model is to provide a rationale for this interpretation and draw policy implications.

Table 3-B furthers our interpretation of the lack of significant relation between corruption and growth. Panel A compares government’s taxing ability and economic growth (measured by both GDP growth and per capita GDP) across the largest more corrupt countries in the world, while Panel B lists the largest less corrupt countries in the world. There are significant variations in terms of economic growth among the countries with lowest scores on corruption in Panel A. China appears to be the most significant ‘outlier’ in the group: While its corruption index/score (based on Transparency International’s CPI index, ranges from 1 to 10 with 1 being the most corrupt) had improved from 2.2 in 1995 to 3.6 in 2014, its annual GDP growth rates (using PPP measures) of almost 13% during the period 1981-2014 is the highest in the world; in PPP terms it currently has the largest economy in the world; and per capita GDP increased from US$343 in 1981 by 37 fold to almost $12,880 in 2014. Similar (but less spectacular) cases are other large and regionally diversified countries such as India and Indonesia, in that despite rampant corruption, these countries
have done quite well in terms of economic growth. At the other extreme, many countries in Africa and South America with similar scores on corruption have basically stagnated and there is nearly no growth in sight. Finally, a large and regionally diversified country with rampant government corruption, Russia, has done poorly in terms of economic growth during the same time period. Our model is consistent with these facts about corruption and economic growth across countries.

III. A Simple Model of Government Goods and Services Provision and Corruption

We develop the simplest possible model for conveying our main message that competition among officials reduces the damaging effects of corruption. We consider a central government’s problem of providing a service (or good) to the public when there is an agency problem. We analyze how this can be done with different structures of supplying the good and the efficiency of different structures. We first examine the first best case without an agency problem. Next, we analyze different cases where the government uses tax revenue as a resource of payment to local official(s) to motivate the provision of the government service.

III.1 Elements of the Model and First Best Solution

We assume that the government service is homogeneous, in that there is no difference in quality provided by different officials in different regions (of the same country or different countries). We also assume that the demand for this good among economic agents from different regions can be characterized by a downward sloping demand function. For simplicity, we assume this function to be linear, and takes the form

\[ P(Q) = W - aQ, \]

where \( Q \) is the equilibrium level of the good supplied in the economy, \( W \) indicates highest possible consumer surplus (agent obtaining the good with price 0), and the parameter \( a ( > 0 ) \), indicates the
sensitivity of quantity demanded when price changes.\textsuperscript{5} We further assume that the provision of the government service is costly, and the cost is linear in the quantity supplied, i.e.

\[ C(Q) = cQ, \]

where the constant \( c \) is the marginal cost for producing and supplying each additional unit. Local government officials can charge fees to cover the cost of provision. The First Best case is achieved when the fees charged by local government officials are observable.

With our model setup, it is straightforward to derive the First Best level of this government service, \( Q^* \). This is achieved by increasing the supply of the service until the marginal cost of supplying the last unit equals the marginal benefit of the buyer of the final unit, or

\[ MC(Q) = c = P(Q). \quad (1) \]

Solving for \( Q \) in (1) above gives

\[ Q^{FB} = \frac{W - c}{a}, \]

and the associated user fee charged is

\[ P^{FB} = c. \]

From standard demand theory we know that at this output level there is no deadweight loss and social welfare is maximized. The First Best case is summarized in the following result.

**Proposition 1** Without an agency problem, the government official(s) will charge \( P^{FB} \) to supply \( Q^{FB} \) units of the service in the economy.

\textsuperscript{5} Our assumptions on the demand function for the government service can be restrictive for two reasons. First, the consumption or use of some services by one agent can have a positive (or negative) externality on other agents. This is not captured by the above demand function. Second, one agent may need to purchase multiple government services and goods in order to undertake her own activity, in which case the joint determination of the provision of all the services and goods becomes important.
III.2 Agency Problem: Monopoly vs. Perfect Bertrand Competition

Now suppose that there is an agency problem, and the local officials can potentially charge higher than socially optimal fees to maximize their own payoffs. We assume that the monitoring of officials’ fundraising and the provision of the good is imprecise, so that the supervisor of the officials providing the service cannot differentiate the reasons why the total quantity supplied in the economy is below $Q^{FB}$: This can be induced by officials charging excessive fees and thus reducing demand, or because the officials lie about the amount that can be raised in the economy to cover the production/supply costs (this can be due to the fact that there is some uncertainty in the economy about how much funds can be raised for different purposes). In other words, the central government cannot observe or derive the fee charged from the demand function. The lack of effective monitoring implies the officials providing the service have the discretion to restrict the quantity that is supplied so as to maximize their own benefits. This is our definition of corruption, with the user fees charged in excess of $P^{FB}$ by officials corresponding to bribes. Although the central government cannot monitor the local official(s), it may be able to mitigate the problem through a salary contract as a function of the quantity of government good (or service) provided. For simplicity, we restrict attention to the linear contract

$$T(Q) = tQ + s.$$  

We believe this linear payment contract captures the basic idea of pay for performance with the simplest form. In practice, government officials may not directly receive pecuniary rewards for good performance; however, performance is usually rewarded indirectly via promotion. For example, in China the likelihood of promotion of local officials increases in their performance including local economic growth and the amount of investment from non-local sources (e.g., Li

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6 Holmstrom and Milgrom (1987) showed that linear contracts are more robust to agent manipulation.
1998; Li and Zhou 2005). As long as the reward scheme increases in performance, the general result that the central government can mitigate corruption by adopting such a reward scheme goes through.

Next, we examine different structures of the government services market, focusing on the supply side while taking as given the demand for the service. We first examine the case where the provision of the service is carried out by one official so that he has monopoly power. This case can be associated with the scenario that in one region there is only one government branch/office that the service can be obtained. In countries with multiple regions where the same service is supplied, this case corresponds to the situation in which it is impossible for agents from one region to move to another, so that the official in each region is a monopolist in providing the service.

If the central government is budget constrained and cannot allocate any resource to pay the local officials, given the monopoly and assuming that the demand function is relatively inelastic \((a \gg 0)\), the official has an incentive to cut back the quantity supplied, raise the fee (assuming he cannot price discriminate between buyers of the service so he can only set one fee for all units) and maximize his total fees from providing the good. To do this, the monopolist official supplies the government service until the marginal cost of supplying the last unit equates that of his marginal revenue of selling the unit, which is below marginal benefit of the buyer of the final unit:

\[
MC(Q) = c = MR(Q) = \frac{dP(Q)}{dQ} Q = W - 2a Q. 
\]

(2)

Solving for \(Q\) in (2) yields

\[
Q^{M} = \frac{W - c}{2a},
\]

and the corresponding excess user fee for each unit of the government good charged by the monopolist official is given by:

\[
f^{M} = P(Q^{M}) - P^{FB} = \frac{W - c}{2}. 
\]

(3)
Again, from standard industrial organization and market structure models, we know that the output level under monopoly, $Q^M$, is strictly below the First Best level, $Q^{FB}$, derived in (1). The comparison of output levels under different structures are illustrated in Figure 1, which also depicts the profits earned by the monopolist official as well as the deadweight loss generated by the less-than-optimal level of provision of the government good.

**Insert Figure 1 here.**

The profits earned by the official, net of the costs of supplying $Q^M$ to the agents in the economy, is indicated by the shaded area in Figure 1, while the deadweight loss is indicated by the dark triangle. The size of the loss, indicated by the shaded area of the triangle, is proportional to the product of the differences in output levels ($Q^{FB} - Q^M$) and the profit margin ($P(Q^M) - c$):

$$DWLoss^M \equiv \frac{1}{2} \times (Q^{FB} - Q^M) \times [P(Q^M) - c] = \frac{(W - c)^2}{8a},$$

where the last equality is derived by plugging in the expressions for $Q^*$ and $Q^M$.

If the central government has enough tax revenues to pay the local official to increase the provision of government good, and the payment contract $(t, s)$ is

$$T(Q) = \begin{cases} tQ + s & \text{if } Q \geq Q^M \\ 0 & \text{if } Q < Q^M \end{cases},$$

The objective of the local official now is to maximize the profit from fees plus compensation:

$$\max_Q P(Q)Q - cQ + T(Q),$$

Solving for $Q$ in (5) yields $Q(s, t) = \max \left\{ \frac{W - c + t}{2a}, Q^M \right\}$. As long as $t > 0$, the monopolistic official is willing to increase the quantity of the service supplied, and therefore the government can successfully mitigate the agency problem by offering payment with high sensitivity to quantity.

However, it is also costly for the central government to adopt such a payment scheme. To model the
cost, we assume that the total social welfare created consists two parts: that from supplying the specific government good (service) and that from other government activities. A central government can make use of its tax revenues of amount \( g \) to create social welfare \( v(g) \) through other government activities, where \( v'(g) > 0 \) and \( v''(g) < 0 \) for all \( g \geq 0 \). The cost of payment scheme can be interpreted as the opportunity cost of reducing welfare through other government activities. And a negative second order derivative of \( v(g) \) indicates that the marginal cost of implementing the payment scheme is lower for “wealthier” central government. The average welfare created per unit of the government good (service) is \( \frac{1}{2}(W - c + P(Q) - c) \), thus the total welfare created from supplying the government good (service) is \( \frac{1}{2}(W - c + P(Q) - c)Q \). If the central government allocates \( T(Q) \) for the payment scheme, the welfare created from other activities is then \( v(g-T(Q)) \). Therefore the optimal contract to offer for a government with total budget \( g \) can be calculated as follow,

\[
\max_{t,s} \frac{1}{2}(W - c + P(Q) - c)Q + v(g-T(Q)) \tag{6}
\]

subject to \( Q = \max \left\{ \frac{W - c + I}{2a}, Q^M \right\} \tag{7} \)

\[
T(Q^M) \geq 0 \tag{8}
\]

The solution (see proof in appendix A.1) to the central government’s problem \( \{ t^M, s^M \} \) is such that

\[
v' \left( g - \frac{I^{M^2}}{2a} \right) = \frac{W - c}{4t^M} - \frac{1}{4} \tag{9}
\]

\[
s^M = \frac{W - c}{2a} I^M. \tag{10}
\]

The corresponding quantity supplied and excess user fee charged are
\[ \hat{Q}^M = \frac{W - c + t^M}{2a} \in (Q^M, Q^{FB}) \]  

(11)

\[ \hat{f}^M = \frac{W - c - t^M}{2} \in (0, f^M). \]  

(12)

respectively. The central government needs to allocate

\[ T^M(\hat{Q}^M) = \frac{t^{M^2}}{2a} \]  

(13)

to pay the monopolistic local official, and the total social welfare loss compared to the first best case is

\[ DWLoss^M_r = \frac{(W - c - t^M)^2}{8a} + v(g) - v(g - \frac{t^{M^2}}{2a}) \in (0, DWLoss^M). \]  

(14)

Note that even if the government has enough resources, the quantity supplied under the payment scheme is strictly less than the first-best level. In other words, even if it is able to eliminate corruption completely the central government chooses not to. This is because the marginal cost of inducing the official to increase the supply of government good increases. It is simply too costly to eradicate corruption, and the central government is better off to live with moderate corruption and save the tax revenue for other purposes. This result may be qualitatively sensitive to the structure of payment scheme, but the general intuition of increasing marginal cost of combating corruption should hold as long as the limited liability constraint (8) is imposed. Proposition 2 (see proof in appendix A.2) below summarizes the results for the monopolist case.

**Proposition 2** With a monopolist official providing the government good, the central government optimally offers payment contract \{t^M, s^M\} as in equation (9) and (10), and the excess user fee charged for each unit is set at \( \hat{f}^M \in (0, f^M) \) as in equation (12), resulting in a total of

\( \hat{Q}^M \in (Q^M, Q^{FB}) \) units supplied in the economy as in equation (11). The total payment to the
monopolistic official \( T^M (\hat{Q}^M) \) as in equation (13) increases when: i) \( W \) increases; ii) \( c \) decreases; iii) \( a \) decreases and iv) \( g \) increases. The deadweight loss of the monopolist supplier \( DWLoss^M_t \) as in equation (14) increases when: i) \( W \) increases; ii) \( c \) decreases; iii) \( a \) decreases; and iv) \( g \) decreases.

The comparative statics on the total payment of the incentive scheme \( T^M (\hat{Q}^M) \) are intuitive. A higher \( W \) and (or) a lower \( c \) indicates higher consumer surplus from consuming the government good, and hence more incentive for the central government to reduce corruption and increase the quantity supplied. Therefore the central government would allocate more resource to the incentive scheme to control corruption when \( W \) increases and (or) \( c \) decreases. A lower \( a \), the slope of the demand curve implies that consumers are more reactive to price changes. If the corrupt government official reduces the bribe it charges, the quantity demanded would increase a lot, and the social welfare would be restored a lot. In other words, the incentive scheme is more valuable and the central government is willing to allocate more resources to implement it. Lastly, for a government with more tax revenues, the same incentive scheme is relatively cheaper due to the concavity of \( v(g) \), and therefore the government can afford to pay for a larger incentive scheme.

The comparative statics on the size of the deadweight loss \( DWLoss^M_t \) are generally the same with those on the total payment \( T^M (\hat{Q}^M) \) with the exception of tax revenues \( g \). The general intuition is that when it is more efficient to implement the incentive scheme which leads to higher \( T^M (\hat{Q}^M) \), there is also more room for profits for the corrupt official and hence larger \( DWLoss^M_t \). Specifically, a higher \( W \) and (or) a lower \( c \) indicates higher consumer surplus and therefore more profits for the corrupt official leading to a larger deadweight loss. A lower \( a \) implying higher elasticity of demand to price, which gives the corrupt official more bargaining power in abusing its
monopoly power and turn it into profits. Thus, $DWLoss^M$ decreases in $a$. Finally, although a “wealthier” government spend more tax revenue on the incentive scheme, the benefit of reducing corruption overweighs the cost. To see why this is the case, consider two governments with different budgets. Suppose the deadweight loss generated under optimal incentive scheme for the resource-constrained government is $D_1$. If the resourceful government were to implement the same incentive scheme, the resulting deadweight loss $D_2$ must be smaller. Yet the resourceful government would optimally choose a larger incentive scheme leading to deadweight loss $D_3$. Since $D_3$ is generated under optimal choice, it must be smaller than $D_2$, therefore smaller than $D_1$.

Next suppose that the government sets up two suppliers for provision of the service (results would be very similar if there are more than two suppliers), and all consumers are perfectly informed of the fees charged by both suppliers. This can occur if in any region, where the good is provided, there are two government branches/offices from which agents can purchase the service. This can also occur if agents can move from one region to another (to exploit differences in fees) without any costs. In either case there is competition among officials. Since in most cases the officials set and announce the user fees to all potential buyers, we assume that there is Bertrand competition for the same service.\footnote{Alternatively, government officials may choose the quantity to sell and the same (per unit) fee for the service is determined in the market place. In this case we have Cournot competition and the output level is higher than the monopoly case but lower than the Bertrand competition case.}

Given that there are no costs in resetting prices and that the pricing information becomes immediately known to all agents in the economy, similar to standard one-period Bertrand competition models, there is a unique Nash equilibrium in this case, where each supplier will set the user fee to be the marginal cost of supplying the last unit. But this is exactly the same condition in the First Best, indicated in (1). Hence the total units supplied in the economy is the First Best level, $Q^*$ again. Since each official is earning zero profits under Bertrand competition, it does not matter
how they split the total supply between them; without loss of generality we assume each official provides exactly half of $Q^*$. Hence Bertrand competition generates outcomes that are identical to the First Best solution in Figure 1, and the equilibrium fee can be found by equating the marginal cost function to the demand curve. The key for the above results is that, if the fee set by one of the officials is higher than marginal cost of producing the last unit, by undercutting the fee by $\epsilon$ the other official can capture the entire market (recall that all agents can move to another region without costs) and maximize profits, in the process of doing so also driving the demand for the official with the higher user fee to 0. In this case, competition also completely eliminates the agency problem, therefore the central government doesn’t need to pay the local officials to align their incentives with the social optimum.

**Proposition 3** With two or more officials providing the same government service, the First Best is restored, and the unique equilibrium excess user fee for each unit is set at $f^B = 0$, resulting in a total of $Q^B = Q^{FB}$ units supplied.

Bertrand competition not only yields the First Best output level for the provision of the government good, it also requires almost no monitoring of the officials. This is because the market mechanism of competition is self-enforcing due to each official’s incentive to undercut the user fee set by other officials and capture the entire market demand for the same good. However, all the analyses in this paper rely on the assumption that the officials cannot collude on reducing supplies to achieve higher profits.
III.3 Agency Problem: Imperfect Bertrand Competition with Transaction Costs

In the previous subsection we considered two extreme cases of how the government good is provided. More generally, the industrial organization structure in the provision of the service will often lie between monopoly and perfect Bertrand competition. In this subsection, we consider imperfect Bertrand competition, in that the agents from each region can move to another region at a constant cost $K$ (we assume that $K < \frac{W-c}{2}$)\(^8\). The cost $K$ can also be interpreted as the cost of acquiring information about the fee charged by the non-local government official. Since now agents cannot move from region to region to explore differences in user fees for free, each of the two officials has some monopoly power in setting the user fee. In particular, each official knows that, in order to capture the entire market of demand for the same government good, he must undercut the other’s user fee by at least $K$, as any smaller cut would not attract any agents to move from the high-fee region to his region. On the other hand, if there is room to cut the user fee by $K$ and still have a positive profit margin, then an official will indeed cut the fee by $K$.

Given the above intuition, it is then straightforward to show that without the compensation scheme offered by the central government, the equilibrium pricing strategy for each local official is to set the fee $K$ above the marginal cost of providing the last unit:

$$MC(Q) + K = P(Q),$$

(15)

which yields a lower total quantity supplied (with each of the two officials supplying half of the total),

$$Q^B_k = \frac{W-c-K}{a},$$

than that under perfect Bertrand competition ($Q^B$), and a higher excess user fee

\(^8\) If $K \geq \frac{W-c}{2}$, it is too costly for an agent to move to another region, and we get back to the monopoly case.
\[ f^B_K \equiv K, \]

than that under perfect Bertrand competition \( (f^B) \). Note that it is implicitly assumed that each local official can charge different user fees for local and nonlocal agents. Specifically, the excess fee charged for nonlocal (local) agents is 0 \( (f^B_K = K) \), so that all agents, local or nonlocal, are all indifferent between going to any of the two officials for the public good. If we assume the cost of moving to another region \( K \) is a deadweight loss, then all agents going to the local official is socially optimal. The equilibrium fee and quantity (relative to the perfect Bertrand competition) are illustrated in Figure 2. The current structure of government good provision will also result in a deadweight loss (shaded area), however smaller than the monopoly case:

\[ DWLoss^B_K \equiv \frac{1}{2} \times (Q^{rb} - Q^B_K) \times K = \frac{K^2}{2a}. \quad (16) \]

**Insert Figure 2 here.**

Now we explore the central government’s optimal payment scheme under imperfect Bertrand competition. Since the severity of the agency problem lies in between the monopoly and the perfect competition, intuitively, the payment contract should also lie in between the two cases. Below is the formal characterization of the central government’s problem:

\[
\begin{align*}
\max_{t,s} & \quad \frac{1}{2} Q(W - c + P(Q) - c) - v(g - T(Q)) \\
\text{subject to} & \quad Q = \max \left[ W - c + t, \frac{Q^B_K}{2a} \right] \\
& \quad T(Q^B_K) \geq 0
\end{align*}
\]

\[ \quad \text{subject to} \quad Q = \max \left[ W - c + t, \frac{Q^B_K}{2a} \right] \quad (18) \]

\[ \quad T(Q^B_K) \geq 0 \quad (19) \]

When \( K \leq K \), the imperfect Bertrand competition outcomes are already close to the First Best case. The bonus required to incentivize the local government officials to cut their profit from corruption further is so costly that the central government would rather leave the moderate level of corruption.
as it is. To see it clearly, the quantity supplied with the incentive scheme is

\[ \hat{Q}_K^b = \max \left\{ \frac{W - c + t}{2a}, \frac{W - c - K}{a} \right\}. \]

Hence a effective payment scheme needs to have pay-for-performance \( t > \frac{W - c - 2K}{2a} \) which decreases in \( K \). When the friction is relatively small, \( t \) needs to be high to induce the corrupt officials to reduce their bribe charges further and therefore the total payment of the incentive scheme would be large. Therefore, the equilibrium excess fee charged \( \hat{f}_K^b = f_K^b \), the quantity supplied \( \hat{Q}_K^b = Q_K^b \), the total payment to local officials \( T_K^b (\hat{Q}_K^b) = 0 \) and the deadweight loss \( DWLoss_{K,F}^b = DWLoss_K^b \). Proposition 4 (see proof in Appendix A.3) below summarizes the results for the imperfect Bertrand competition case with low transaction cost.

**Proposition 4** With imperfect Bertrand competition and transaction cost \( K \in (0, K] \), the central government optimally choose to offer zero payment contract.

When \( K > K = \frac{(W - c)v'(g)}{1 + 2v'(g)} \), the optimal salary contract is \( \{v_K^b, s_K^b\} \) is such that

\[ v'(g - \frac{t_K^b(t_K^b + 2K - W + c)}{2a}) = \frac{W - c - t_K^b}{2(2t_K^b + 2K - W + c)} \]

(20)

\[ s_K^b = t_K^b Q_K^b. \]

(21)

The equilibrium excess user fee charged is

\[ \hat{f}_K^b = \frac{W - c - t_K^b}{2} \in (0, \hat{f}^M), \]

(22)

resulting in the quantity of public good supplied

\[ \hat{Q}_K^b = \frac{W - c + t_K^b}{2a} \in (\hat{Q}^M, \hat{Q}^{FB}). \]

(23)
The central government needs to allocate
\[ T(\hat{Q}_k^B) = \frac{t_k^B(t_k^B + 2K - W + c)}{2a} \in \left(0, T(\hat{Q}_k^M)\right) \] \hspace{1cm} (24)
in total to pay the local officials, and the total social welfare loss compared to the first best case is
\[ DWLoss_{k,T}^B = \frac{(W - c - t_k^B)^2}{8a} + v(g) - v\left( g - \frac{t_k^B(t_k^B + 2K - W + c)}{2a} \right) \in (0, DWLoss_T^M). \] \hspace{1cm} (25)

Note that under the optimal incentive scheme, the imperfect Bertrand competition case is always closer to the first best than the monopoly case, i.e. \( \hat{f}_k^B < \hat{f}_M, \hat{Q}_k^B > \hat{Q}_M \) and \( DWLoss_{k,T}^B < DWLoss_T^M \). Proposition 5 (see proof in Appendix A.3 and A.4) below summarizes the results for the imperfect Bertrand competition case with high transaction cost.

**Proposition 5** With imperfect Bertrand competition and transaction cost \( K \in (K, \frac{W - c}{2}) \), the central government optimally offers payment contract \( \{t_k^B, s_k^B\} \) as in equation (20) and (21), and the excess user fee charged for each unit is set at \( \hat{f}_k^B \in (0, \hat{f}_M) \) as in equation (22), resulting in a total of \( \hat{Q}_k^B \in (\hat{Q}_k^M, Q_{FB}^B) \) units supplied in the economy as in equation (23). The total payment to the monopolistic official \( T_k^B(\hat{Q}_k^B) \) as in equation (24) increases when: i) \( a \) decreases; ii) \( g \) increases; and iii) \( K \) increases. The deadweight loss of the monopolist supplier \( DWLoss_{k,T}^B \in (0, DWLoss_T^M) \) as in equation (25) increases when: i) \( a \) decreases; ii) \( g \) decreases; and iii) \( K \) increases.

The comparative statics on the total payment of the incentive scheme \( T^M(\hat{Q}_k^M) \) are intuitive. Similar to the monopoly case, a lower \( a \) implies a more elastic demand and also a more valuable incentive scheme (a small reduction in bribe induces a large increase in demand), therefore the
central government is willing to allocate more resources to implement it. For a government with more tax revenues, the same incentive scheme is relatively cheaper due to the concavity of \( v(g) \), and therefore the government can afford to pay for a larger incentive scheme. Lastly, the total payment decreases in friction \( K \). The intuition is that when the friction is relatively small, it is very costly to induce the corrupt officials to reduce their bribe charges further and therefore the government would not spend much on the incentive scheme. Since the objective welfare function and the constraints are all continuous in \( K \), this intuition also explains that when \( K \leq K^* \), the optimal incentive scheme payment reduces to zero.

The comparative statics on the size of the deadweight loss \( DWLoss^M \) are also intuitive. A lower \( a \) implying higher elasticity of demand to price, which gives the corrupt official more monopolistic profits. Thus, \( DWLoss^M \) decreases in \( a \). A government with sufficient tax revenues (high \( g \)), has more power and flexibility in controlling corruption, and therefore the resulting deadweight loss is small. Finally, the deadweight loss increases in the transaction cost \( K \), because the corrupt officials have more monopoly power if the friction \( K \) increases. In addition, as \( K \) increases, the imperfect Bertrand competition case approaches the monopoly case explained in Proposition 2 (and if \( K = \frac{W-c}{2} \) these two cases are identical).

Note that competition helps alleviate the agency problem in two ways. First, as the friction in competition \( K \) decreases, the power that the officials have in extracting surplus from the agents decreases directly, as evidenced by \( Q^p_k = \frac{W-c-K}{a} \) decreasing in \( K \). Secondly, as the friction in competition \( K \) diminishes, the payment that the central government makes decreases holding everything else equal. From another perspective, the competitiveness in the supply side of the service and the compensation contract can be thought of as substitutes in reducing corruption.
Lowering competition friction, on one hand, reduces corruption, while on the other hand, making incentive scheme less effective and more costly to implement. In terms of policy implication, if a central government has sufficient tax revenues, it has more tools and flexibility in controlling corruption. However, if a central government has limited resources to allocate on salary payment, the central government can instead work on reducing the frictions in competition among local officials.

IV. Discussion

The premise of our model is that the reason corruption occurs is an agency problem, and the government can use a compensation contract to mitigate the problem and reduce corruption. Our model implies that another and perhaps more effective method to reduce the pernicious effects of corruption is setting up the provision of government services so that there is competition. Corruption, in this case, is a legitimate way of collecting user fees to cover the cost of provision of the service. In the ideal case of perfect Bertrand competition (without transaction costs), corrupt officials (by charging a fee equal to the cost of provision) do not have any distortionary effects, and the central government does not need to pay bonuses to the officials. In more general cases with imperfect Bertrand competition while the outcome is not First Best, the competition among officials still yields a better outcome than having a monopolist official providing the service, which is the worst case.

An important reason for the damaging effects of corruption is the secrecy of corrupt officials’ activities (including fees charged and bribes received), leading to distortions of incentives and resource allocations as stressed by Shleifer and Vishny (1993). Having a competitive environment for the provision of government goods and services lessens this problem, because each official providing the services has the incentive to disclose his fee structure for granting the services
so as to attract more clients. In Asian countries such as China, there are usually publicly known ‘market’ prices for government services or goods, and with such transparency bribes can ‘grease the wheels’ and improve the process of providing these services and goods.

The results of our model are broadly consistent with evidence on corruption and growth. First, consistent with existing research, corruption is more likely to occur in countries whose governments have low taxing ability and tax income, most of which are developing countries. There is also evidence that corruption is more prevalent in developing countries or regions with higher tax rates or higher federal transfers, all of which proxy for lower government taxable income, while corruption is less prevalent where government activities are more decentralized (e.g., Fisman and Gatti 2002a,b; Fisman and Wei 2004). Second, in large and regionally diverse countries such as China, India and Indonesia, there is a limited amount of bribes officials can extort because of regional competition. The bribes are fees in excess of the cost of provision and are very limited due to competition, and incentives are efficient. In some African and South American countries with homogeneity across regions (in part due to historical reasons from colonial eras), corrupt officials effectively have monopoly power. As a result we get the bad equilibrium with under supply of the government service and overcharging by officials and extracting much larger amounts of rents, which in turn significantly reduces the level of economic activities. In fact, consistent with the implications of our model, there is cross-country evidence on the negative relation between “openness” of an economy (e.g., exports/GDP) and corruption, and a positive relation between corruption and excessive regulation of entry of new firms (e.g., Djankov et al. 2002; Svensson 2005). In addition, a recent empirical paper, Hanousek et al. (2015), presented evidence that greater variance in perception of corruption is associated with more efficiency. The argument is that a high variance indicates different local sub-environments, among which the competitive ones are relatively efficient and improves the welfare of the whole environment.
The main policy implication from our analysis is that setting up the provision of government goods and services in a competitive environment reduces the damaging effects of corruption and promotes growth. A natural follow-up question would be how to introduce more competitiveness to the government services market. In large and diversified countries, this can be achieved by encouraging inter-regional economic activities and lowering the costs (and bureaucracy) of relocation across regions and entry barriers for firms and agents. In small and homogeneous countries this can be done by encouraging international trade and lowering the costs of relocation across countries and entry barriers in different countries. These policies are more effective in promoting economic growth in emerging countries than those intending to eliminate corruption, because governments in emerging countries are more budget constrained and do not have the resources to buy cleanness. This problem cannot be mitigated by the alternative of raising the payments to officials until the country’s economic conditions have been significantly improved (in the long run) and the government has the ability to raise sufficient tax revenues to cover the payments to government officials. In Appendix B.1, we generalized our model to multiple government goods case, and showed that the above policy implications are robust to this variation. Moreover, the central government can combat corruption by encouraging competition for supplying substitutes and encouraging cooperation for supplying complements.

Our model also implies that corrupt officials have an incentive to increase their monopoly power, since the total amount of bribes received by a monopolist official is much higher than a counterpart in a competitive environment. They can regain market power by, for example, blocking information about similar goods and services provided in other regions/countries, or by increasing the transaction costs for agents to relocate. Solving problems of this sort must involve the central government. For example, the central government can reward officials whose regions have shown the fastest economic growth and attracted the largest amount of economic activities (and investment)
from *non-local* sources. These policies encourage inter-regional competition among officials and induce more government services and goods supplied and higher levels of growth. In China, one of the key yardsticks in measuring the performance of local officials is economic growth and the amount of investment from non-local sources (e.g., Li 1998; Li and Zhou 2005); in other countries the most corrupt government officials hold the highest positions in the government, making it infeasible to implement incentive-aligning policies for lower level officials.

The situation depicted in Proposition 4 with imperfect Bertrand competition is perhaps a more general case. With transaction costs, each of the officials providing the services or goods captures some rents by setting prices above marginal costs of supplying them by exactly the size of the transaction costs (of agents). But the distortion is less than that of a monopolist official. An implication of this result is that economic agents can alleviate the damaging effects of corruption through reducing their own transaction costs. For example, small firms are easier to relocate than large firms; firms operate in industries that require small scales of investment in fixed assets can also relocate at low costs.

Consistent with this prediction, in both China and India, the sectors that have witnessed the fastest growth are small- and medium-sized mobile firms from services and labor- and technology-intensive industries (e.g., Allen et al. 2005, 2006). On the other hand, as Table 4 indicates, Russia’s economy is dominated by large corporations in natural resources (“other” industry in the last column) and heavy manufacturing industries. Firms in these industries face much higher relocation costs and hence the damaging effects of corruption may be one of the reasons that economic development in post-Soviet Union era (of Russia) has been lagging behind that of many smaller former socialist countries in Eastern Europe. Further empirical studies can systematically examine the impact of corruption on different industries across countries or different regions within the same country.
We close this section by pointing out some limitations of our simple model. First, each agent may need multiple services and goods from various government offices and agencies (e.g., an entrepreneur is required to deal with numerous government offices to set up a new firm as in Shleifer and Vishny (1993). In this situation, ensuring coordination among various officials is perhaps as important as creating a competitive environment to reduce user fees set by each official. Second, the cost structure for providing the same service or good may differ across officials, and these cost structure may be private information. The literature on defense procurement contracts has shown how to design these contracts with producers (with unknown production costs) in order to produce the desired weapons at minimum total cost. Third, our simple model implies that the central government should decentralize and delegate the provision of goods and services to local government officials. A potential problem with this delegation is quality control (e.g., driving tests before issuing a driver’s license; see, e.g., Bertrand et al. (2006) for details). As shown in the literature on franchising, designing uniform and enforceable contracts across the board and monitoring the local officials effectively are necessary conditions to ensure that the quality of the goods and services provided is not compromised under decentralization.

V. Summary and Concluding Remarks

This paper proposes an explanation for the puzzling fact that rampant government corruption is not associated with slower economic growth at the country level. We focus on corruption associated with the provision of government goods and services, including those to the public such as driver’s license and those to firms such as a banking license for financial firms. We first show that corruption occurs because of an agency problem, and the government cannot effectively control corruption without sufficient revenues to pay the officials. The bribes received by officials can be regarded as user fees in excess to the cost of provision of the service. We then
argue that the structure of the provision of government services and goods partially determines the negative effects of corruption and the cost of curbing it: when multiple officials undertaking the same project, the fee is determined competitively such that the pernicious effects of corruption are minimized, and the payments to the officials are also minimized; when each official is a monopolist in the provision of the services and goods and the damaging effects are much higher, as are the payments to the officials.

The main policy implication from our analysis is that there are two substitute ways to control corruption: setting up the provision of government services and goods in a competitive environment and incentivizing officials with performance-sensitive payment contracts financed by tax revenues. In large and diversified countries competition can be introduced by encouraging inter-regional economic activities and lowering the entry barriers for firms and agents from different regions. In small and homogeneous countries this can be done by encouraging international trade and lowering the costs of relocation across countries. Economic agents can make the competition mechanism more effective by reducing their own transaction costs when moving from region to region. An implication for this result is that corruption has a smaller negative impact on small firms and firms that have smaller amount of fixed assets. Finally, the central government can also control corruption of this type by rewarding officials whose regions have shown the fastest economic growth and attracted the largest amount of economic activities from local and non-local sources. These policies encourage inter-regional competition among officials, and are more effective in promoting growth than policies aiming at eliminating corruption considered in our paper in emerging countries that do not have sufficient tax revenue for the appropriate compensation of local officials.
References

Appendix A  Proofs

A.1 Central Government’s Maximization Problem: Monopoly

Denote the optimal contract as \( \{ t^M, s^M \} \), the induced quantity supplied as \( \hat{Q}^M \) and the induced excess user fee charged as \( \hat{f}^M = P(\hat{Q}^M) - Q^T_B \).

First, assume \( t^M > 0 \), which implies that \( \hat{Q}^M = \frac{W - c + t^M}{2a} > Q^M \). Note that the total social welfare decreases in \( T(Q) = T(Q^M) + t(Q - Q^M) \), thus decreases in \( T(Q^M) \). Therefore the limited liability condition (equation 8) must bind, i.e. \( s^M = t^M Q^M \). Plug in \( s = t^M Q^M \) and \( Q = \frac{W - c + t}{2a} \) into the expression for the total welfare. Denote the total welfare as \( L(t) \). The maximization problem can then be simplified as follow,

\[
\max_t L(t) = \frac{3(W - c)^2}{8a} + \frac{t(W - c)}{4a} - \frac{t^2}{8a} + \nu \left( g - \frac{t^2}{2a} \right)
\]

The first order derivative of the above simplified problem is

\[
L'(t) = \frac{W - c - t}{4a} - \frac{t}{a} \nu \left( g - \frac{t^2}{2a} \right)
\]

Note that \( L'(0) = \frac{1}{4a} (W - c) > 0 \) and \( L'(W - c) = -\frac{W - c}{a} \nu \left( g - \frac{(W - c)^2}{2a} \right) < 0 \), which implies the optimal \( t^M \in (0, W - c) \) and verifies the assumption made at the beginning of the proof. By equating the first order derivative to zero, we can solve for the optimal sensitive to pay \( t^M \), which solves \( \nu \left( g - \frac{t^M}{2a} \right) = \frac{W - c}{4t^M} - \frac{1}{4} \).
Since \( t^M \in (0, W - c) \), the induced quantity supplied is \( \hat{Q}^M = \frac{W - c + t^M}{2a} \in (Q^M, Q^{FB}) \) and \( \hat{f}^M = \frac{W - c - t^M}{2} \in (0, f^M) \). The total payment made by the central government is

\[
T(\hat{Q}^M) = \frac{t^M}{2} \cdot 2a.
\]

The welfare in the first best case is \( Welfare^{FB} = \frac{(W - c)^2}{2a} + v(g) \), and the resulting deadweight loss with the optimal incentive scheme is

\[
DWLoss^M = Welfare^{FB} - L(t^M) = \frac{(W - c - t^M)^2}{8a} + v(g) - v\left( g - \frac{t^M}{2a} \right) > 0. \quad \text{Since} \quad t^M > 0, \quad L(t^M) > L(0)
\]

and \( DWLoss^M = Welfare^{FB} - L(t^M) < Welfare^{FB} - L(0) = DWLoss^M \).

A.2 Comparative Statics in Proposition 2

Given that the optimal sensitive to pay \( t^M \) is such that \( v\left( g - \frac{t^M}{2a} \right) = \frac{W - c - 1}{4t^M} \). By implicit function theorem, \( \frac{d}{da} t^M = \frac{-2v\left( g - \frac{t^M}{2a} \right)}{a^2(W - c - 4t^M) av\left( g - \frac{t^M}{2a} \right)} > 0 \). Similarly, it can be verified that \( \frac{d}{dW} t^M > 0 \), \( \frac{d}{dc} t^M < 0 \) and \( \frac{d}{dg} t^M > 0 \).

Given that the deadweight loss is \( DWLoss^M = \frac{(W - c - t^M)^2}{8a} + v(g) - v\left( g - \frac{t^M}{2a} \right) \). The signs of the partial derivatives can be verified to be \( \frac{\partial}{\partial t^M} DWLoss^M = 0 \), \( \frac{\partial}{\partial a} DWLoss^M < 0 \), \( \frac{\partial}{\partial W} DWLoss^M > 0 \), \( \frac{\partial}{\partial c} DWLoss^M < 0 \) and \( \frac{\partial}{\partial g} DWLoss^M < 0 \). Intuitively, since \( t^M \) minimizes
deadweight loss, the first order condition ensures that $\frac{\partial}{\partial t^M} DWLoss_t^M = 0$.

Given that $T(\hat{Q}^M) = \frac{t^M}{2a}$, it can be verified that $\frac{\partial}{\partial t^M} T(\hat{Q}^M) = \frac{t^M}{a} > 0$,

$$\frac{\partial}{\partial a} T(\hat{Q}^M) = -\frac{t^M}{2a^2} < 0 \text{ and } \frac{\partial}{\partial W} T(\hat{Q}^M) = \frac{\partial}{\partial c} T(\hat{Q}^M) = \frac{\partial}{\partial g} T(\hat{Q}^M) = 0.$$  

The total derivatives can then be calculated as follow,

$$\frac{d}{dx} DWLoss_t^M = \frac{\partial}{\partial x} DWLoss_t^M + \frac{\partial}{\partial t^M} DWLoss_t^M \frac{d}{dx} t^M = \frac{\partial}{\partial x} DWLoss_t^M \text{ and }$$

$$\frac{d}{dx} T(\hat{Q}^M) = \frac{\partial}{\partial x} T(\hat{Q}^M) + \frac{\partial}{\partial t^M} T(\hat{Q}^M) \frac{d}{dx} t^M.$$  

Plugging in the signs, it can be verified that $\frac{d}{dW} DWLoss_t^M > 0$, $\frac{d}{dc} DWLoss_t^M < 0$,

$$\frac{d}{da} DWLoss_t^M < 0 \text{ and } \frac{d}{dg} DWLoss_t^M < 0.$$  

Similarly, it is straightforward to verify that

$$\frac{d}{dW} T(\hat{Q}^M) > 0, \frac{d}{dc} T(\hat{Q}^M) < 0 \text{ and } \frac{d}{dg} T(\hat{Q}^M) > 0.$$  

As for the sign of $\frac{d}{da} T(\hat{Q}^M)$, it takes a few lines to calculate:

$$\frac{d}{da} T(\hat{Q}^M) = -\frac{t^M}{2a^2} + \frac{t^M}{a} \frac{-2v^* \left( g - \frac{t^M}{2a} \right) t^M}{a^2 (W-c) - 4t^M av^* \left( g - \frac{t^M}{2a} \right) 2a^2 (W-c) - 8t^M av^* \left( g - \frac{t^M}{2a} \right)} < 0.$$  

A.3 Central Government’s Maximization Problem: Imperfect Bertrand Competition

Denote the optimal contract as $\{t^B_K, s^B_K\}$, the induced quantity supplied as $\hat{Q}^B_K$ and the induced excess user fee charged as $\hat{f}^B_K = P(\hat{Q}^B_K) - Q^FB$. 
First, assume \( t_k^b > W - c - 2K \), which implies that \( \hat{Q}_k^b = \frac{W - c + t_k^b}{2a} > Q_k^b \). Note that the total social welfare decreases in \( T(Q) = T(Q_k^b) + t(Q - Q_k^b) \), thus decreases in \( T(Q_k^b) \). Therefore the limited liability condition (equation 19) must bind, i.e. \( s_k^b = t_k^b Q_k^b \). Plug in \( s = tQ_k^b \) and \( Q = \frac{W - c + t}{2a} \) into the expression for the total welfare. Denote the total welfare as \( H(t) \). The maximization problem can then be simplified as follow,

\[
\max_t H(t) = \frac{3(W - c)^2}{8a} + t(W - c) - \frac{t^2}{8a} + v\left(g - \frac{t(t + 2K - W + c)}{2a}\right)
\]

The first order derivative of the above simplified problem is

\[
H'(t) = \frac{W - c - t}{4a} - \left(\frac{2t + 2K - W + c}{2a}\right)v'\left(g - \frac{t(t + 2K - W + c)}{2a}\right)
\]

The first part in the derivative is the marginal benefit, i.e. the marginal welfare restored by increasing the sensitivity of pay for performance. And the second part in the derivative is the marginal opportunity cost, i.e. the marginal burden on other government activities of increasing the sensitivity of pay for performance. The optimal incentive scheme can be found by equating marginal cost to marginal benefit, mathematically by equating the first order derivative to zero. The optimal sensitive to pay \( t_k^b \) is such that

\[
v'\left(g - \frac{t_k^b(t_k^b + 2K - W + c)}{2a}\right) = \frac{W - c - t_k^b}{2(2t_k^b + 2K - W + c)}.
\]

The last step in solving for the optimal incentive scheme is to verify the assumption that \( t_k^b > W - c - 2K \), which is equivalent to verifying \( H'(W - c - 2K) > 0 \). Plug \( t = W - c - 2K \) into the first order derivative:

\[
H'(W - c - 2K) = \frac{K}{2a} - \left(\frac{W - c - 2K}{2a}\right)v'(g) > 0 \Leftrightarrow K > \frac{(W - c)v'(g)}{1 + 2v'(g)}.
\]
If $K \leq K$, the friction in the competition is so small that the equilibrium is close to the first best, and $t$ needs to be really high to induce further reduction in the bribes charged by corrupt officials.

To see it clearly, consider a $K$ close to zero. In order to reduce corruption through incentive scheme, the sensitivity of pay for performance $t$ needs to be close to $W-c$. Since

$$\begin{align*}
H'(W-c) &= -\frac{W-c-2K}{a}v'(g - \frac{(W-c)K}{a}) < 0,
\end{align*}$$

i.e. the marginal benefit goes to zero, yet the marginal cost is strictly positive. Therefore, it is not cost-efficient to offer such huge incentive package, and the optimal incentive scheme to offer is any $t \leq W-c-2K$ and $s = tQ^B_K$, which is outcome-equivalent to offering no incentive scheme. Note that since $K < \frac{W-c}{2}$, the parameter space such that an effective incentive scheme is offered, i.e. $K \in (K, \frac{W-c}{2})$, is non-empty.

Recall that the optimal contract in the monopoly case satisfies $v\left(g - \frac{t^M^2}{2a}\right) = \frac{W-c}{4t^M} - \frac{1}{4}$.

Calculate the first derivative of the total welfare at $t^M$:

$$\begin{align*}
H'(t^M) &= \frac{1}{a}\left(t^M v\left(g - \frac{t^M^2}{2a}\right) - \left(t^M + K - \frac{W-c}{2}\right)v\left(g - \frac{t^M(t^M + 2K-W+c)}{2a}\right)\right),
\end{align*}$$

Since $K < \frac{W-c}{2}$ and $t^M > 0$, it must be true that

$$\begin{align*}
v\left(g - \frac{t^M^2}{2a}\right) > v\left(g - \frac{t^M(t^M + 2K-W+c)}{2a}\right) > 0,
\end{align*}$$

$$\begin{align*}
t^M > t^M + K - \frac{W-c}{2} > 0,
\end{align*}$$

therefore $H'(t^M) > 0$ and $t^R_K > t^M$. Note that $H'(W-c) = -\left(t + \frac{2K}{2a}\right)v\left(g - \frac{K(W-c)}{a}\right) < 0$, 

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therefore the optimal \( t_K^B < W - c \).

Since \( t_K^B \in (t^M, W - c) \), the induced quantity supplied and the bribe charged are

\[
\hat{Q}_k^B = \frac{W - c + t_k^B}{2a} \in (\hat{Q}^M, \hat{Q}^{FB})
\]

\[
\hat{f}_k^B = \frac{W - c - t_k^B}{2} \in (0, \hat{f}^M).
\]

The total payment made by the central government is

\[
T(\hat{Q}_k^B) = \frac{t_k^B(t_k^B + 2K - W + c)}{2a},
\]

and the resulting deadweight loss is

\[
DWLoss_{K, x}^B \equiv Welfare^{FB} - H(t_k^B) = \frac{(W - c - t_k^B)^2}{8a} + v(g) - v\left(g - \frac{t_k^B(t_k^B + 2K - W + c)}{2a}\right) > 0.
\]

Note that \( t^M \) is just a special case of \( t_k^B \) when \( K = \frac{W - c}{2} \), i.e. \( T(\hat{Q}^M) = T(\hat{Q}_{W-c/2}^B) \). To prove that

\[
T(\hat{Q}_k^B) < T(\hat{Q}^M),
\]

it suffices to show that \( \frac{dT(\hat{Q}_k^B)}{dK} > 0 \). By implicit function theorem, we can solve for \( \frac{dK}{dt} \) from equation

\[
v\left(g - \frac{t_k^B(t_k^B + 2K - W + c)}{2a}\right) = \frac{W - c - t_k^B}{2(2t_k^B + 2K - W + c)}.\]

Specifically,

\[
\frac{dK}{dt} = \frac{A \frac{dT}{dK} + B}{A \frac{dT}{dK} + B + 1}
\]

where \( A = -2\nu^*(g - T)(2t + 2K - W + c) > 0 \) and \( B = 4\nu^*(g - T) > 0 \). Finally,

\[
\frac{dT(\hat{Q}_k^B)}{dK} = \frac{dT}{dK} + \frac{dT}{dt} \frac{dt}{dK} = \frac{B(\frac{dT}{dK} - \frac{dT}{dt}) + \frac{dT}{dK}}{A \frac{dT}{dt} + B + 1}.\]

Since \( \frac{dT}{dK} = \frac{t}{a} > 0 \), \( \frac{dT}{dt} = \frac{2t + 2K - W + c}{2a} > 0 \) and

\[
\frac{\partial T}{\partial K} - \frac{\partial T}{\partial t} = \frac{W - c - 2K}{2a} > 0,
\]

it must be true that \( \frac{dT(\hat{Q}_k^B)}{dK} > 0 \) and therefore \( T(\hat{Q}_k^B) < T(\hat{Q}^M) \) for all.
Since $t^K_b$ maximizes the function $H(t)$, it must be true that $H(t^K_b) > H(t^M)$ and

$$\text{DWLoss}^b_{K,T} < \text{Welfare}^F - H(t^M) = \frac{(W - c - t^M)^2}{8a} + v(g) - v\left( g - \frac{t^M (t^K_b + 2K - W + c)}{2a} \right).$$

$$< \frac{(W - c - t^M)^2}{8a} + v(g) - v\left( g - \frac{t^M (t^K_b + 2K - W + c)}{2a} \right) = \text{DWLoss}^M_T.$$  

### A.2 Comparative Statics in Proposition 4

Given that the optimal sensitive to pay $t^M$ is such that

$$V\left( g - \frac{t^K_b (t^K_b + 2K - W + c)}{2a} \right) = \frac{W - c - t^K_b}{2(2t^K_b + 2K - W + c)}.$$  

By implicit function theorem, it is straightforward to show that $\frac{d}{da} t^K_b > 0, \frac{d}{dW} t^K_b > 0, \frac{d}{dc} t^K_b < 0, \frac{d}{dg} t^K_b > 0$ and $\frac{d}{dK} t^K_b < 0$.

Given that $\text{DWLoss}^b_{K,T} = \frac{(W - c - t^K_b)^2}{8a} + v(g) - v\left( g - \frac{t^K_b (t^K_b + 2K - W + c)}{2a} \right)$, the signs of the partial derivatives can be proved to be $\frac{\partial}{\partial t^K_b} \text{DWLoss}^b_{K,T} = 0, \frac{\partial}{\partial a} \text{DWLoss}^b_{K,T} < 0$,

$$\frac{\partial}{\partial W} \text{DWLoss}^b_{K,T} > 0, \frac{\partial}{\partial c} \text{DWLoss}^b_{K,T} < 0, \frac{\partial}{\partial g} \text{DWLoss}^b_{K,T} < 0 \text{ and } \frac{\partial}{\partial K} \text{DWLoss}^b_{K,T} > 0.$$  

Intuitively, since $t^M$ minimizes deadweight loss, the first order condition ensures that $\frac{\partial}{\partial t^K_b} \text{DWLoss}^b_{K,T} = 0$.

Given that $T(\hat{Q}_K^b) = \frac{t^K_b (t^K_b + 2K - W + c)}{2a}$, it can be verified that $\frac{\partial}{\partial t^K_b} T(\hat{Q}_K^b) > 0$,

$$\frac{\partial}{\partial a} T(\hat{Q}_K^b) < 0, \frac{\partial}{\partial W} T(\hat{Q}_K^b) < 0, \frac{\partial}{\partial c} T(\hat{Q}_K^b) > 0, \frac{\partial}{\partial g} T(\hat{Q}_K^b) = 0 \text{ and } \frac{\partial}{\partial K} T(\hat{Q}_K^b) > 0.$$  

The total derivatives can then be calculated as follow,
\[
\frac{d}{dx} DWLoss_{k,t}^b = \frac{\partial}{\partial x} DWLoss_{k,t}^b + \frac{\partial}{\partial t_k^b} DWLoss_{k,t}^b \quad \frac{d}{dx} t_k^b = \frac{\partial}{\partial x} DWLoss_{k,t}^b \quad \text{and}
\]
\[
\frac{d}{dx} T(\hat{\mathcal{Q}}_k^b) = \frac{\partial}{\partial x} T(\hat{\mathcal{Q}}_k^b) + \frac{\partial}{\partial t_k^b} T(\hat{\mathcal{Q}}_k^b) \frac{d}{dx} t_k^b.
\]
Plugging in the signs, it can then be verified that 
\[
\frac{d}{da} DWLoss_{k,t}^b < 0, \quad \frac{d}{dW} DWLoss_{k,t}^b > 0,
\]
\[
\frac{d}{dc} DWLoss_{k,t}^b < 0, \quad \frac{d}{dg} DWLoss_{k,t}^b < 0 \quad \text{and} \quad \frac{d}{dK} DWLoss_{k,t}^b > 0.
\]
Similarly, it can be verified that
\[
\frac{d}{da} T(\hat{\mathcal{Q}}_k^b) < 0, \quad \frac{d}{dg} T(\hat{\mathcal{Q}}_k^b) > 0 \quad \text{and} \quad \frac{d}{dK} T(\hat{\mathcal{Q}}_k^b) > 0.
\]

**Appendix B  Extensions**

**B.1 Multiple Government Goods**

In this section, we compare different forms of government organizations when there are multiple government goods supplied. In particular, if the government goods (service) supplied are substitutes or complements, corruption on one of the goods might have externalities on the others. Therefore, corrupt officials might have the incentive to jointly make the decision on bribe charges and split the profits. We show that such organized corruption generates higher profits for corrupt officials than the case where they charge bribes independently. We also show that the central government can reduce welfare loss by altering organizational structure with the interdependency of different government goods. Specifically, the central government can effectively combat corruption by introducing competition when the two goods are substitutes and introducing cooperation when the two goods are complements. Nonetheless, the results that increasing regional competition and introducing incentive scheme are effective in reducing corruption still hold.

For simplicity, we assume there are two symmetric government goods with demand function
\[
\begin{pmatrix}
P_1 \\ P_2
\end{pmatrix} = \begin{pmatrix}
W \\ W
\end{pmatrix} - \begin{pmatrix}
a & b \\ b & a
\end{pmatrix} \begin{pmatrix}
Q_1 \\ Q_2
\end{pmatrix}.
\]

The elasticity of demand can be shown to be \( \frac{dQ_i}{dP_i} = \frac{-a}{a^2 - b^2} \) and \( \frac{dQ_i}{dP_{-i}} = \frac{b}{a^2 - b^2} \). We assume that \(|a| > |b|\) to ensure that the price change of one good has more effect on the demand of such good than the price change of the other good. Since \( \frac{dQ_i}{dP_{-i}} = \frac{b}{a^2 - b^2} \), the two goods are complements if \( b < 0 \); they are substitutes if \( b > 0 \); and they are independent if \( b = 0 \), in which case each good can be analyzed separately as in the main body. The cost of supplying one unit of good 1 and the cost of supplying one unit of good 2 are both \( c \in (0, W) \). First, we consider the case where two cooperative corrupt officials set \( P_1 \) and \( P_2 \) to maximize their total profits. The maximization problem is as follow,

\[
\max_{0, Q_1} Q_1(W - aQ_1 - bQ_2 - c) + Q_2(W - aQ_2 - bQ_1 - c).
\]

The solution to the maximization problem, i.e. the quantity supplied under monopolistic organized corruption, is \( Q_1^C = Q_2^C = Q^C = \frac{W - c}{2(a + b)} \). And the resulting bribes charged, i.e. the price paid in excess of the cost of supplying one unit of government good, is \( f_1^C = f_2^C = f^C = \frac{W - c}{2} \). While in the first best case, \( f_1^{FB} = f_2^{FB} = f^{FB} = 0 \) and \( Q_1^{FB} = Q_2^{FB} = Q^{FB} = \frac{W - c}{a + b} \). Since the total welfare created in the first best case changes in \( b \), to analyze the effect of \( b \) on welfare changes, we introduce a new measure, the percentage deadweight loss \( \%DWL = \frac{DWLoss}{Welfare^{FB}} \). Following similar calculation as in equation 4, it can be shown that the deadweight loss as a percentage of the total welfare
\[
\% \text{DWL}^C = \frac{1}{2} \left( Q_1^{FB} - Q_i^C \right) \times f_1^C + \frac{1}{2} \left( Q_2^{FB} - Q_2^C \right) \times f_2^C
\]
\[
\frac{1}{2} Q_1^{FB} (W - c) + \frac{1}{2} Q_2^{FB} (W - c)
\]
\[
= 25%.
\]

Note that although the absolute deadweight loss increases in the complementarity between two goods, the percentage deadweight loss remains constant.

To demonstrate the externality of corruption on good to the other, we compare it to the case where there are two non-cooperative corrupt officials each supplying one of the two goods. The maximization problem of official \( i \) is then
\[
\max_{Q_i} (W - aQ_i - bQ_i - c).
\]

The best response of one official to the other can be solved from the first order condition, and it can be shown to be \( Q_i^{BR} (Q, -) = \frac{W - c - bQ_i}{2a} \). By solving the fixed point in the best response mapping, we get a unique equilibrium in which \( Q_1^{NC} = Q_2^{NC} = Q^NC = \frac{W - c}{2a + b} \), \( f_1^{NC} = f_2^{NC} = f^NC = \frac{a(W - c)}{2a + b} \)

and \( \% \text{DWL}^{NC} = \frac{a^2}{(2a + b)^2} \). Note that the percentage deadweight loss increases in the complementarity between two goods. In addition, when the two goods are complements \((b < 0)\), \( \% \text{DWL}^{NC} > \% \text{DWL}^C \); when the two goods are substitutes \((b > 0)\), \( \% \text{DWL}^{NC} < \% \text{DWL}^C \); when the two goods are independent, \( \% \text{DWL}^{NC} = \% \text{DWL}^C \). The intuition is as follow. If the two goods are complements, raising bribe charge on one good reduces the demand for the other good. In the cooperative case, the corrupt officials endogenize this effect and therefore charges lower bribes than in the non-cooperative case, where they don’t endogenize this effect. Similarly, if the two goods are substitutes, raising bribe charge on one good increases the demand for the other good, and therefore the cooperative officials charge higher bribes than non-cooperative officials. Although the social welfare loss is affected by the interdependency of the two goods, the profit made by the two
officials in the cooperative case $2Q^C f^C = \frac{(W - c)^2}{2(a + b)}$ is always higher (strictly higher when $b \neq 0$) than that in the non-cooperative case $2Q^{NC} f^{NC} = \frac{2a(W - c)^2}{(2a + b)^2}$, which implies that the corrupt officials always have the incentive to engage in this type of organized corruption. Therefore, when the two goods are complements, the central government can effectively reduce corruption by encouraging cooperation between the two officials, which is also incentive compatible. While when the two goods are substitutes, the central government would prefer local officials to make decisions competitively. However, since the corrupt officials always have the incentive to engage in cooperative corruption, the central government might need to introduce incentive scheme such as relative performance to increase competition among local government officials.

Regardless, our results in the one good case that both competition and pay-for-performance scheme are effective in combating corruption still hold in the multiple goods case. The corresponding competition under the two goods context is that there exists at least two regions each offering both goods, and consumers in the two regions can pay some transaction cost $K$ to “buy” the goods in non-local regions. Therefore, by nature the goods offered by different regions are substitutes. As analyzed before, by introducing competition among different regions, the central government can effectively reduce welfare loss.