Effects and (In)tractability of Decentralized Corruption

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Abstract

Corruption is defined in an occupational choice model as extra fees that must be paid by some entrepreneurs. Higher corruption leads to lower wages and total output. Income inequality follows a Kuznets relationship with both corruption and income. Two types of decentralization of the bribe-setters are distinguished, regional and bureaucratic. When mobility is imperfect, bureaucratic decentralization increases, and regional decentralization decreases, corruption. Sufficient bureaucratic decentralization results in such high corruption that entrepreneurship is suppressed and incomes are low.

Decentralization determines the effectiveness of two anti-corruption mechanisms, electoral accountability and efficiency wages. Greater bureaucratic decentralization makes both more ineffective due to the negative externalities across bribe-setters that it creates. In the limit, neither mechanism can make a dent in corruption. In contrast, regional decentralization makes both mechanisms more effective. Thus, a sort of increasing returns is present: bureaucratic decentralization is more inherently corrupt and more resistant to anti-corruption mechanisms, while regional decentralization is less inherently corrupt and more tractable.
1 Introduction

How does decentralization affect corruption? A key idea of Shleifer and Vishny (1993) is that decentralization raises total bribe demands as bureaucrats over-extract from a common pool. This idea has been formalized in various contexts by Ehrlich and Lui (1999), Berkowitz and Li (2000), and Waller et al. (2002), and is featured in Bardhan’s (1997) review.

Another view is that decentralization (federalism) reduces corrupt bureaucratic demands by fostering competition across regions. It can be found in Brennan and Buchanan (1980), Weingast (1995), and Shleifer and Vishny (1993), among others. This view seems to be less prominent in economic discussions of corruption, as most applied work views decentralized corruption as worse than centralized. However, it has some empirical backing.\(^1\)

The extent to which these are competing theories and the circumstances under which one effect dominates the other are not entirely clear. This paper formalizes both effects of decentralization within a single model, and analyzes their interaction.

The main contribution of the paper is to show the effectiveness of two key anti-corruption mechanisms in a decentralized context. The two mechanisms, efficiency wages and electoral competition, have been analyzed extensively.\(^2\) With few exceptions (discussed below), they are not analyzed in settings that involve decentralized corrupt agents. The literature is thus essentially silent regarding how well efficiency wages and electoral competition can neutralize any adverse effects of decentralization. We address this question here.

The analysis is embedded in a simple occupational choice model. This highlights the economic effects of the endogenously determined corruption. We find that widespread and costly corruption can indeed occur in equilibrium, even when optimal anti-corruption strategies are employed, conditional on the degree of decentralization. The organization of power – centralized vs. decentralized – thus emerges as fundamental to controlling corruption.

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\(^1\)This is found in Huther and Shah (1998) and Fisman and Gatti (2002). Treisman (2000) finds an opposite result using a different measure of decentralization. See Fisman and Gatti (2002) for a discussion of potential reasons for the different results.

\(^2\)For the former, see Becker and Stigler (1974), Besley and McLaren (1993), and Mookherjee and Png (1995). For the latter, see Ferejohn (1986), Myerson (1993), and Persson et al. (1997).
The economic model focuses on choice between three occupations: full-scale entrepreneurship, wage labor, and petty activity or subsistence. Corruption is quantified as the amount in bribes that must be paid to bureaucrats to operate a full-scale firm, by those without political capital. Thus the focus is on systemic corruption that is costly to the firm, rather than corruption that is beneficial to the firm but costly to society, such as paying to avoid regulation, or grand corruption, such as diverting aid. Ample evidence supports this focus.\(^3\)

The model generates clear economic effects of corruption. The wage declines with corruption. Corruption restricts access to full-scale entrepreneurship and thus lowers labor demand and raises labor supply. Average income declines with corruption. Corruption raises barriers to entry for agents lacking political connections. As a result, connected agents rather than high-ability agents set up firms. Also, corruption pushes agents toward inefficient small-scale activity where bribes can be minimized. Income inequality rises then falls with corruption, due to simple Laffer-curve logic. This gives rise to a corruption-induced Kuznets relationship between average income and income inequality. Empirical evidence is supportive of the latter two predictions.\(^4\)

The level of corruption is determined as follows. Corrupt fees are set in \(M \geq 1\) different regions by \(N \geq 1\) independent bureaucracies per region. Each of the \(M \times N\) agencies chooses its fee to maximize income. A firm operating in region \(M\) must pay all \(N\) bureaucracies there. We solve for the symmetric Nash corruption level as a function of \(M\) and \(N\).

The parameters \(M\) and \(N\) capture the degrees of ‘regional’ and ‘bureaucratic’ decentralization, respectively. We show that the degree of mobility determines which brand of decentralization matters. If there is perfect mobility, \(N\) is essentially irrelevant and corruption declines with \(M\) due to competitive pressure; if there is no mobility, \(M\) is irrelevant and

\(^3\)Brunetti et al. (1997) survey over 3600 entrepreneurs from 69 countries, 58 of which are considered less developed. Respondents ranked corruption as the second most significant obstacle to doing business, ahead of lack of infrastructure and lack of financing and behind only “tax regulations and/or high taxes”. Other quantitative evidence can be found in de Soto (1989), Shleifer (1997), and Berkowitz and Li (2000), Johnson et al. (2002), and others.

\(^4\)Strong negative correlations exist between virtually all published corruption measures and GDP per capita. Tanzi and Davoodi (2000) provide one such example. Li et al. (2000) find an inverted-U relationship of inequality with corruption.
corruption increases with $N$ due to the common pool problem.

In a case of imperfect mobility, both kinds of decentralization affect corruption: ceteris paribus, increasing $M$ reduces corruption and increasing $N$ raises corruption. In fact, as $N$ increases, corruption can get so high that virtually no agents lacking political connections become entrepreneurs and no bribes are paid. Uncoordinated corrupt agents can thus end up on the far end of the Laffer curve from where they and society would want to be. This can help explain lack of private enterprise in some ethnically fractionalized African states as well as popular support for strong central authorities such as Putin in Russia and Nazarbayev in Kazakhstan, given that the alternative may be bureaucratically decentralized corruption.

The main results come from introducing two sources of discipline into the model. In the first case, the politically weak agents can coordinate and commit to paying wages to agencies conditional on their level of corruption. In the second case, a dynamic extension, they can vote to rotate out of office any agency after observing its level of corruption. Each mechanism can lower corruption from the level that would obtain in its absence. Voting, however, can never fully eliminate it, since some electorally permissible rents are needed to ensure that removal from office is a potent threat.

We define the effectiveness of each mechanism as the fraction by which it can reduce corruption. These fractions depend strongly on $M$ and $N$. They tend to increase with $M$ and decrease with $N$. As $N$ gets large, the corruption reduction fractions approach zero. Thus, a kind of increasing returns arises. Bureaucratic decentralization leads to high corruption levels without any mechanism, and very little fractional reduction with a mechanism. Regional decentralization leads to lower corruption levels without any mechanism, and a large further fractional reduction with a mechanism. In reality, then, some bureaucrats may be optimally receiving relatively low wages, since compensation can be ineffective in a strongly bureaucratically decentralized environment.

The economic model adds to the literature by formalizing the effect of corruption on wages and income inequality. It also proposes a different kind of talent misallocation. In
the existing corruption literature, talent is wasted because relatively talented agents are attracted by the bureaucracy rather than entrepreneurship; here, high-ability agents are attracted by wage labor instead of entrepreneurship because they do not have the political capital to rebuff bribery demands.\(^5\) This has indirect support in Fisman’s (2001) finding that political connections significantly affected firm profitability in Suharto’s Indonesia.

The results on decentralization in the absence of anti-corruption mechanisms have strong precedents in Shleifer and Vishny (1993) and elsewhere,\(^6\) and are included partly for completeness. However, they are novel in formalizing and distinguishing the two types of decentralization and the role of mobility assumptions in their interaction. For example, they provide a case of limited mobility in which both kinds of decentralization are operative. Noteworthy is that regional decentralization decreases corruption in this setting even though competition across regions for exploitable factors is assumed away; its effect comes from an externality operating through the wage. This shows that federalism need not rely on perfect mobility to have an effect.

Our main contribution is on the effectiveness of optimal efficiency wages and voting in the context of decentralization. Few studies exist on this topic. Closest to our efficiency wage analysis is Waller et al. (2002). We discuss several differences in approach in section 4.1; for example, we derive optimal wages from the standpoint of the general public, while in their model wages are paid by a corrupt autocrat. Closest to our voting analysis is Persson et al. (1997). They find that voting will restrain rent-seeking less when there are two macro-political bodies rather than one, unless they are required to coordinate in some way. They also find that voting cannot completely eliminate rents, as we do. However, decentralization of the type studied here is not their focus.\(^7\)

\(^5\) Talent misallocation of the former type occurs in Murphy et al. (1991) and Acemoglu and Verdier (1998). Parallels to the latter type of talent misallocation exist in the literature on wealth inequality and credit constraints, in Lloyd-Ellis and Bernhardt (2000) for example.

\(^6\) There are also parallels with the tax competition literature, from which the closest papers to this analysis are Keen and Kotsogiannis (2002, 2003). They examine equilibrium taxation under regional decentralization, in conjunction with a central government that taxes the same base. In contrast, we abstract from a central bureaucracy and focus on multiple bribe-demanders within regions.

\(^7\) Bardhan and Mookherjee (2000) examine determinants of local versus central government capture in a
A simple theme emerges from our results. When rule of law is weak and interregional mobility imperfect, even when key anti-corruption mechanisms are available, there is great economic benefit to be had from a system in which firms need interact with only one bureaucratic entity.

We introduce the basic model and examine economic effects of given levels of corruption in Section 2. In Section 3, the level of corruption is derived as a function of the degrees of bureaucratic and regional decentralization, in the absence of anti-corruption mechanisms. Section 4 analyzes the effectiveness of two anti-corruption mechanisms, wage incentives and democratic accountability. Section 5 concludes.

2 Economic Effects of Corruption

The population is a continuum of measure one, indexed by $i$. Agents maximize consumption of the single good. Each agent is endowed with one unit of labor, which can be supplied in one of three occupations. He can work for a full-scale firm, earning the market-clearing wage, $w$. Alternatively, he can ‘subsist’, working alone to produce $w \geq 0$. This occupation represents the fall-back option of small-scale, unspecialized private production, from roadside retail to family food plots. Finally, he can work as a full-scale entrepreneur, which requires hiring one$^8$ worker and operating a full-scale firm. We assume that full-scale firms are more efficient than subsistence, but also harder to hide and more vulnerable to bribe demands.

Agents differ in entrepreneurial ability; output of a firm run by agent $i$ is $y_i$. Ability $y_i$ is distributed in the population over $[y_0, y_1]$ according to $F(\cdot)$. For simplicity, we assume $F(\cdot)$ to be uniform. Let $L \equiv y_1 - y_0$ be the ability range, and $y_{1/2}$ be the median ability. We assume that $y_0 = 2w$. This implies that subsistence is less productive than entrepreneurship, regardless of the ability level of the entrepreneur.$^9$ Thus the two professions differ in productivity due to scale and scope for specialization (here entrepreneurship is favored), as

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$^8$The qualitative results in this paper do not change if entrepreneurs must hire $k > 1$ workers.

$^9$The least able entrepreneur and a worker would produce $y_0$ as a firm and $2w$ as two subsisters.
well as in *vulnerability* to extra fees (here subsistence is favored).

There is a second dimension of heterogeneity: political capital. It can take one of three values, leading to three types of agents. Type A agents, of measure $\alpha \in (0, 1)$, have high political capital (are ‘in power’). Their political capital translates into the ability to set bribe levels for some full-scale firms in their jurisdiction. This is costless in terms of labor. It also frees them from paying fees if they operate a firm. Type C agents, of measure $\gamma \in (0, 1 - \alpha]$ have low political capital (are ‘unprotected’). They must pay $c \geq 0$ to operate a full-scale firm. The ‘level of corruption’ will be synonymous with $c$. Type B agents, of measure $1 - \alpha - \gamma$, have moderate political capital (are ‘connected’). They cannot charge fees to others, but need not pay to operate their own firm.

Analysis is focused on the case involving weak rule of law and widespread potential for corruption. In particular, we assume for the remainder of the paper that $\gamma > 1/2$. We also assume that political capital and entrepreneurial ability are independently distributed.

The power to extract bribes may be rooted in underlying informational asymmetries that are not explicitly modeled, but there is no assumption that the distribution of political capital is the result of some optimal societal arrangement. Further, there is no assumption that the extra fees purchase any good other than the freedom to operate. These assumptions differ from those of Acemoglu and Verdier (1998, 2000), but are in line with the rent-seeking literature of Murphy et al. (1991, 1993) and Ehrlich and Lui (1999).

However, this model departs from the rent-seeking literature in that collecting bribes requires (political) capital but not labor. Thus type A agents can work in a productive occupation *and* collect rents. In defense of our approach, it is not uncommon that the same powerful households are behind both government rent-seeking and control of large and profitable businesses. Further, this assumption incorporates two relevant motivations into

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10 We normalize all other taxes to zero. Waller et al. (2002) incorporate both kinds of taxes and study their interaction.

11 Political capital is assumed non-transferable.

12 All results in the paper hold for $\gamma \leq 1/2$, except in section 4.2 where it is vital that type C agents constitute a voting majority. Proof extensions are available upon request.
bribe setting: rent extraction as well as wage suppression and entry barrier creation. At any rate, all results would go through under the assumption that type A agents could not engage in a productive occupation. The more crucial difference with the rent-seeking literature is that the power to extract rents has to do with a stock of accumulated political capital, rather than existing as an option equally available to all.\textsuperscript{13} Endogenizing these political endowments as the result of investments over time is left for future work.

Given corruption level $c$, an occupational equilibrium consists of a wage $w$ and an occupational choice for each $(ability, capital)$ combination $(a, \tau) \in [y_0, y_1] \times \{A, B, C\}$. Each occupational choice must maximize earned income,\textsuperscript{14} given $c$ and $w$. In addition, $w$ must equate labor supplied by workers and labor demanded by entrepreneurs.

Agents of type A or B will choose entrepreneurship iff it is more profitable than both wage labor and subsistence, i.e. $y_i - w > \max\{w, w\}$. We show below that the wage will never fall below $w$. Thus type A or B agents with $y_i > 2w \equiv y_{AB}$ choose entrepreneurship; the rest choose wage labor or subsistence. The analogous cutoff for type C agents, $y_C$, equals $2w + c$, since the payoff to entrepreneurship is $y_i - w - c$. Since $y_C > y_{AB}$ when $c > 0$, it is clear that corruption raises the bar of entry into entrepreneurship higher for the unprotected population than for those in power or connected to it.

Labor demand equals the number of entrepreneurs, because each entrepreneur needs one worker. Summing up both types of entrepreneurs gives labor demand equal to

$$\gamma[1 - F(y_C)] + (1 - \gamma)[1 - F(y_{AB})].$$

The same reasoning gives that labor supply is

$$\gamma F(y_C) + (1 - \gamma)F(y_{AB}).$$

\textsuperscript{13}This is the approach taken by Ehrlich and Lui (1999), but not Murphy et al. (1991, 1993).

\textsuperscript{14}There may also be rent income accruing to type A agents, but it is independent of occupational choice.
if \( w > \overline{w} \). Labor supply jumps to zero for \( w < \overline{w} \), since subsistence would dominate. For \( w = \overline{w} \), it can take on any value between zero and expression 2 evaluated at \( w = \overline{w} \).

Equating labor supply and demand produces a unique equilibrium wage. This wage is decreasing in \( c \), as we show in proposition 1 below: higher corruption lowers the potential entrepreneurial payoff of the unprotected and makes them more willing to work and less willing to demand labor.

The wage and corruption level in hand, key economic variables can be explicitly calculated. This is done in the appendix and leads to the following proposition.

**Proposition 1.** For a given level of corruption, a unique equilibrium wage exists and is contained in \([\overline{w}, \overline{\overline{w}}]\). The wage \( w \) and total output \( Y \) are decreasing in the level of corruption. The number of subsisters \( S \) is increasing in the level of corruption.

*Proof. See Appendix.*

Driving this proposition are two sources of inefficiency associated with corruption. First, corruption exacerbates talent misallocation by making political capital a key determinant of entry costs. A higher \( c \) raises the cutoff ability level for the unprotected, \( y_C \), but lowers it for those in power or connected to it, \( y_{AB} \) (since it decreases the wage).\(^{15}\) Consequently, politically connected agents of lower ability replace unconnected agents of higher ability as entrepreneurs. Indeed, one can show that the average ability of active entrepreneurs generally declines with corruption. Second, the less productive occupation, subsistence, grows with corruption because it is not vulnerable to it.

Corruption that reduces efficiency by causing substitution toward a technology that is less productive but less vulnerable to corruption – for example, keeping firms small by avoiding large investments or pushing them into the informal sector where resources are wasted on secrecy – is also found in Shleifer and Vishny (1993), Tirole (1996), and Waller et al. (2002). Supporting empirical evidence is found in Friedman et al. (2000) and Schneider

\(^{15}\)This implies that type B agents on average benefit from corruption, though they do not pay bribes. Corruption makes entrepreneurship, the profession for which they have a comparative advantage, more profitable by lowering labor costs.
and Enste (2000), who document that the size of the unofficial economy is positively related to corruption. Corruption as a phenomenon that makes political connections more important and thus misallocates talent, on the other hand, does not seem to have been modeled in the literature. This idea has some empirical backing: Fisman (2001) finds that political connections were a key ingredient of firm profitability in recent Indonesia.

The model can also be used to calculate the distributional effects of corruption. *Earned* income of each agent is calculated using the equilibria outlined in the proof of proposition 1. Total *rent* income is simply the number of unprotected entrepreneurs times the corruption level; we assume this is divided evenly among type A agents. The gini coefficient as a function of corruption and several values of $\gamma$ is graphed in Figure 1. There it is also graphed against output, as corruption varies. Inequality is seen to exhibit an inverted U-shaped relationship with both corruption and output.

The intuition is that when $c$ is low or high, few bribes exchange hands, while some intermediate value of $c$ maximizes the flow of bribes. If $\gamma$ is large enough relative to $\alpha$, bribe income of type A agents is the chief source of inequality. Thus the inverted-U relationship between inequality and corruption is observed. This relationship, combined with the
monotonicity of output in corruption, gives rise to a corruption-induced Kuznets relationship between output and inequality.

Interestingly, Li et al. (2000) document empirically a cross-country inverted-U relationship between inequality and corruption, as we find here. Of course, one may doubt that corrupt earnings are detected in empirical inequality measures. However, quite a few of their inequality numbers are constructed from expenditure data rather than income data, and thus may well capture all kinds of incomes. We therefore view this evidence as qualified support for the model.

3 Corruption and Decentralization

Building on the model of section 2, we next derive the corruption level conditional on a fixed, decentralized organization of power. The economy is assumed to be divided into $M$ identical regions. In each region, those in power (agents of type A) are divided into $N$ identical bureaucracies or agencies. It is assumed that type C entrepreneurs operating in a given region must pay all $N$ bureaucracies in that region.\textsuperscript{16} The idea is that multiple regulatory agencies or officials have effective veto power over a firm’s operation.\textsuperscript{17}

$M$ and $N$, strictly positive integers, are intended to capture the degree of \textit{regional} and \textit{bureaucratic} decentralization, respectively. Thus, $M$ resembles the Weingast type of decentralization (federalism) while $N$ captures the Shleifer-Vishny decentralization, characterized by overlapping authority. The case where $M$ and $N$ are both one corresponds to complete centralization of control. Notationally, the index $j \in \{1, \ldots, M\}$ will refer to the region and both $j$ and $k \in \{1, \ldots, N\}$ to the bureaucracy.

Each agency $jk$ maximizes its total income by setting the bribe level it charges, $\tilde{c}_{jk} \geq 0$.

\textsuperscript{16}Thus regulation of firms is completely regional, the kind of decentralization discussed in Weingast (1995). An alternative model would include both national and regional bureaucracies regulating firms, and regional decentralization would involving moving bureaucracies from the national to the regional level. The same forces would be at work in this setting as in the one we analyze.

\textsuperscript{17}Examples of this kind of overlapping regulatory authority and its use are plentiful; see, for example, Frye and Shleifer (1997), Berkowitz and Li (2000), and De Soto (1989).
Thus a type C entrepreneur operating in region $j$ must pay total fees of $c_j \equiv \sum_{k=1}^{N} \tilde{c}_{jk}$. For notational purposes, we will equivalently consider the agencies as maximizing over $c_{jk}$, where $c_{jk} \equiv N\tilde{c}_{jk}$. The charge faced by a type C agent in region $j$ can thus also be written as $c_j = \sum_{k=1}^{N} c_{jk}/N$.

The (normalized) fees charged by all other agencies except $jk$ will be denoted as $c_{-jk}$. We restrict attention to symmetric Nash equilibria, so $c_{-jk}$ will be considered a scalar. Similarly, the scalar $c_{-j}$ will denote the total fees charged in each region except $j$.

The firm’s output level, $y_i$, is assumed to be the entrepreneur’s private information. Each agency knows only the underlying distribution of ability and sets a single fee level for all entrepreneurs. This rules out price discrimination by bureaucrats, for which there is some empirical evidence in Svensson (2003). However, as long as perfect price discrimination is not possible, the qualitative results of the section are likely to hold.\(^{18}\)

### 3.1 No Mobility

We first analyze the benchmark case in which agents cannot move at all between regions. Each region is an identical, isolated economy with population $1/M$ and its own regional wage, $w_j$. Type C agents who operate a firm must do so in their own region and pay each of the $N \geq 1$ agencies in power there.

Define $\Pi(c_{jk}, c_{-jk})$ to be the total income of an agency charging $c_{jk}$ while others charge $c_{-jk}$. Then

$$
\Pi(c_{jk}, c_{-jk}) = \frac{c_{jk}}{N} \cdot e_{C,j}(c_j, w_j) + E(w_j).
$$

The first term is \textit{rent} income: the agency charges $\tilde{c}_{jk} \equiv c_{jk}/N$ to a measure $e_{C,j}$ type C entrepreneurs in region $j$; $e_{C,j}$ depends on the regional corruption level $c_j$ and the regional wage $w_j$. The second term $E(w_j)$ is \textit{earned} income of the agency: income from entrepreneurship and wage labor. It depends on corruption only through the wage $w_j$.

Analogous to the reasoning in section 2, we have that region $j$’s entrepreneurial ability

\(^{18}\)Price discrimination and repeated extortion are issues addressed by Choi and Thum (2003, 2004).
cutoff for type C agents is \( y_{C,j} = 2w_j + c_j \). Hence \( e_{C,j} = (\gamma/M)[1 - F(2w_j + c_j)] \); this is the fraction of the region-\( j \) type C population, \( \gamma/M \), who are above the cutoff \( y_{C,j} \). Let \( E(w_j) \) denote per-capita earned income of agency \( jk \). Then agency \( jk \)’s payoff can be written

\[
\Pi(c_{jk}, c_{-jk}) = \frac{\gamma}{MN}c_{jk}[1 - F(2w_j + c_j)] + \frac{\alpha}{MN}E(w_j).
\]

The last term is per-capita earned income times the number of people in agency \( jk \), \( \alpha/MN \).

Recall the corruption lowers the wage. This raises entrepreneurial payoffs, the occupation for which type A agents have a (political) comparative advantage, and thus raises type A earned income. Thus, the fact that type A agents are also productive agents gives them an added incentive to raise corruption, to lower the wage and raise earned income.

For a given corruption level \( c_j \), region \( j \)’s economic outcomes are analyzable exactly as in section 2: the population scaling by \( 1/M \) makes no difference for any per capita outcome, including the wage. Thus \( c_j \) delivers a unique wage \( w_j \) as outlined in the proof of proposition 1. It is straightforward to calculate best responses and solve for symmetric Nash equilibria; the results under a minor assumption are contained in proposition 2.

**Assumption 1.** If two fee levels \( c_1 \) and \( c_2 < c_1 \) give an agency the same payoff, the agency strictly prefers to charge the smaller, \( c_2 \).

**Proposition 2.** Under Assumption 1 and no interregional mobility, the unique symmetric Nash equilibrium level of corruption is increasing in the degree of bureaucratic decentralization \( N \) and independent of the degree of regional decentralization \( M \).

**Proof:** contained in the proof of proposition 4.

Regional decentralization does not affect corruption because the lack of mobility shuts off interregional spillovers. Bureaucratic decentralization increases corruption because it heightens a common pool problem. It makes a marginal fee increase more attractive, since the agency loses \( c_{jk}/N \) in revenue from each entrepreneur who exits as a result.
The proof of proposition 2 shows that $c \to L \equiv y_1 - y_0$ as $N$ gets large. As $c \to L$, the wage, total output, and entrepreneurial ability converge to their lower bounds; the number of subsisters converges to its upper bound; and there are no type C entrepreneurs (see the proof of proposition 1). Evidently, a high degree of bureaucratic decentralization can lead to rampant equilibrium corruption where entrepreneurship by the unprotected is all but eliminated and many are using small-scale, inefficient technology.\textsuperscript{19}

3.2 Perfect Mobility

In the opposite benchmark case, agents can freely move across regions to pursue their chosen occupations. In this case, it is clear that there will be a single economy-wide wage and that type C entrepreneurs will go to the region(s) that charge the least amount of fees. Thus power groups will be competing Bertrand-style and the analysis is mostly straightforward. In particular, any number of regions $M \geq 2$ eliminates corruption, regardless of $N$.\textsuperscript{20}

**Proposition 3.** Under Assumption 1 and perfect interregional mobility, the unique symmetric Nash equilibrium level of corruption is decreasing in the degree of regional decentralization $M$ and independent of the degree of bureaucratic decentralization $N$.

Thus regional decentralization and perfect mobility can eliminate the adverse effects of even the most decentralized local power structure; regional decentralization can trump bureaucratic decentralization.

3.3 Imperfect Mobility

Two opposite results are obtained under opposite benchmark assumptions about mobility. In this section, we consider an intermediate case in which agents can work in any region but only operate a business in their own. That is, they are assumed mobile as workers.

\textsuperscript{19}In this case there are incentives for agencies to merge or coordinate to lower corruption. These may be kept at bay by uncertainty about preserving share in the former case, and by deviations in the latter case. See the discussion in Shleifer and Vishny (1993).

\textsuperscript{20}The proof is available on request.
but immobile as entrepreneurs. This assumption has empirical validity in a country with significant interregional variation in law, language, or culture: operating a full-scale firm in a different region could be far more difficult than working in one. It is analytically interesting because it shuts down direct competition between regions for entrepreneurs; thus the standard argument for federalism involving interregional competition is shut down. Each region has a monopoly on its type C entrepreneurs, but the regions are interconnected via the national labor market.\(^{21}\)

Incorporating a single economy-wide wage, total income for agency \(jk\) is then

\[
\Pi(c_{jk}, c_{-jk}) = \frac{\gamma}{MN} c_{jk} \left[ 1 - F(2w + c_j) \right] + \frac{\alpha}{MN} \mathcal{E}(w),
\]

(5)

identical to equation 4 except that the wage is not indexed by \(j\).

We next sketch the rationale for the result. Let subscripts denote partial derivatives. Necessary for \(c\) to be a symmetric Nash equilibrium is that \(\Pi_{c_{jk}}(c, c; M, N) = 0\). When this condition is also sufficient, the symmetric level of corruption varies with \(M\) according to

\[
\frac{dc}{dM} = \frac{\Pi_{c_{jk}, M}}{-(\Pi_{c_{jk}, c_{jk}} + \Pi_{c_{jk}, c_{-jk}})},
\]

and similarly for \(dc/dN\). Since the denominator is always positive, \(M\) and \(N\) affect corruption in the same direction that they affect the marginal payoff from increasing \(c_{jk}\), \(\Pi_{c_{jk}}(c, c; M, N)\).

Using equation 5, the condition that \(\Pi_{c_{jk}}(c, c; M, N) = 0\) can be written

\[
\gamma \left[ 1 - F(2w + c) - cf(2w + c) \left( 2 \frac{dw}{dc_{jk}} + 1/N \right) \right] + \alpha \left[ \mathcal{E}'(w) \frac{dw}{dc_{jk}} \right] = 0.
\]

(6)

A higher \(M\) gives a lower marginal payoff. It does this by making the economy-wide wage \(w\) less responsive to a change in the local corruption level \(c_{jk}\), i.e. by increasing \(dw/dc_{jk}\) toward zero. A less responsive wage means that after a fee increase, more marginal entrepreneurs

\(^{21}\)Analysis of the opposite case, mobile entrepreneurs and immobile workers, is complicated by the fact that the wage differs by region. However, the results of this section appear to go through in that environment.
exit since the wage decline compensates for it less; and earned income goes up by less (since \( E'(w) < 0 \), as we will show). In contrast, a higher \( N \) gives a higher marginal payoff. It does this by decreasing the loss of revenue due to exiting entrepreneurs: \( c/N \) is lost for each of the \( f(2w + c) \) marginal entrepreneurs.\(^{22}\)

**Proposition 4.** Under assumption 1 and labor mobility but not entrepreneurial mobility, the unique symmetric Nash equilibrium level of corruption is decreasing in the degree of regional decentralization \( M \) and increasing in the degree of bureaucratic decentralization \( N \).

**Proof.** See Appendix.

Thus both types of decentralization affect the corruption level in this case of imperfect mobility. It is interesting that regional decentralization decreases corruption even in the absence of any competition between regions for exploitable factors. As noted above, this is because an increase in the number of regions dampens each agency’s downward influence on the wage and makes a fee increase less attractive.\(^{23}\) The result is thus distinct from the focus of Weingast (1995) and others on interregional competition for mobile factors.

The results also formalize a setting in which both views on decentralization hold simultaneously. Since the two kinds have opposite effects, it appears crucial to distinguish between them. The key distinction is whether power is decentralized in a way that creates overlapping jurisdictions or whether each group has undivided control over its constituents. For example, it appears that primarily regional decentralization has been occurring in China, presumably mitigating the corruption level (it has been ranked consistently as less corrupt than Russia by Transparency International). Putin’s re-centralization of Russia appears to have occurred along the regional dimension also, which does not bode well; however, if it is also occurring along the bureaucratic dimension, net economic prospects could be positive.

\(^{22}\)It has a similar effect on \( dw/dc_{jk} \) as \( M \) does, but this effect is always dominated.

\(^{23}\)This suggests that if regions varied by size, larger regions would be more corrupt.
4  (In)Tractability of Decentralized Corruption

The baseline cases of section 3 formalize results already seen in the literature, though in an integrated framework and with some different assumptions and emphases. The focal work of this paper is to introduce two oft-cited mechanisms for controlling corruption – electoral accountability and high bureaucratic wages – into this context of decentralization. Specifically, how does their effectiveness change as $M$ and $N$ vary? These two mechanisms are similar in one key respect. They set up the unprotected class over the bureaucrats as a monitor, in a principal-agent relationship. The agents (bureaucrats) weigh the payoff of the behavior prescribed by the principal against a deviation payoff. It turns out that the effectiveness of both methods depends on the way in which a bureaucrat’s deviation payoff changes as the equilibrium level of corruption is lowered. Thus, key to the analysis are the externalities between the corrupt agents.

4.1 Optimal Compensation under Decentralization

Since the study of Becker and Stigler (1974) on optimal compensation of corruptible law enforcers, paying higher-than-necessary wages has been seen as a promising avenue for mitigating corruption. However, the literature to date has yet to address fully what is often a fundamental feature of the problem: strategic interaction between corruptible agents.\footnote{For example, in the Becker-Stigler model, police officers are assumed able to collect a bribery payoff $b$, say, independent of what any other police officer is doing.} The model of decentralization in this paper provides a natural setting for examining these externalities. In this section we introduce the possibility of paying bureaucratic wages and solve for optimal compensation schemes.

The underlying framework is the imperfect mobility one of section 3.3, in which agents can work in any region but operate a firm only in their own. To this we add the assumption that type C agents have the ability to \textit{act collectively} (thus maximizing group income) and to \textit{commit} to paying wages to type A agencies, conditional on their level of corruption. More
specifically, at the beginning of the period, type C agents announce a wage schedule that they will pay type A agencies at the end of the period. Next, bribe levels are set by the agencies, and production and corruption take place. Finally, incomes are realized by all agents, and wages are paid from type C to type A agencies according to the pre-announced schedule.\textsuperscript{25}

As before, we focus on symmetric Nash equilibria. Denote the total income of the type C population when corruption is $c$ as $\Pi_C(c)$, with $\Pi_A(c)$ and $\Pi_B(c)$ defined similarly. Further, denote the total wages that will be paid to an agency charging $c$ as $v(c) \geq 0$. The type C population maximizes its total income $\Pi_C(c)$ net of total wages paid to agencies.

We first examine what wages must be paid to enforce a given corruption level. For $c$ to be an equilibrium,\textsuperscript{26} it must be that no agency wants to deviate away from it, accounting for its income and the wage scheme:

$$\Pi(c, c) + v(c) \geq \Pi(c_{jk}, c) + v(c_{jk}), \forall c_{jk} \geq 0.$$  \hfill (7)

The left-hand (right-hand) side of 7 represents the payoff to an agency of charging $c$ ($c_{jk}$), given all other agencies charge $c$, and earning wage $v(c)$ ($v(c_{jk})$).\textsuperscript{27} This constraint makes clear that in order to implement $c$, the type C population can do no better than to set $v(c_{jk}) = 0$ for all $c_{jk} \neq c$, since this minimizes the right side of inequality 7. Incorporating this policy, and defining the deviation payoff when other agencies charge $c$ as

$$\Pi^*(c) \equiv \max_{c_{jk} \geq 0} \Pi(c_{jk}, c),$$

\textsuperscript{25}The assumptions of commitment ability and collective action are stark and favor the ability to compensate, putting in greater relief the results obtained below on the limits of compensation schemes. The assumption on commitment ability could be relaxed in a dynamic model.

\textsuperscript{26}In the exposition we assume the type C population is content to implement $c$ as a Nash equilibrium that is not necessarily unique. This is not necessary for the result, as we argue in footnote 30.

\textsuperscript{27}The incentive constraints in much of the literature incorporate an exogenous probability of getting caught, $p$, and the confiscation of income if corruption is detected. Here, $p$ is implicitly set to one and confiscation or removal from power is not possible; only the bonus wage can be withheld. Propositions 5 and 6 would still hold if we considered $p < 1$ and confiscation, the former as long as $p$ was not too low. In section 4.2, we incorporate the power to remove from office.
we\textsuperscript{28} can rewrite incentive constraint 7 as follows:

\[ v(c) \geq \Pi^*(c) - \Pi(c, c). \]  \hfill (8)

In other words, each agency must be paid enough to cover the gains from deviating to its preferred bribe level.

The type C population then chooses \( c \) to maximize its income net of wage payments:

\[ \Pi_C(c) - MNv(c), \]

subject to the incentive constraint 8. Since compensation is costly, \( v(c) \) will come from condition 8 at equality. We can then rewrite the objective function as

\[ \Pi_C(c) + MN\Pi(c, c) - MNP^*(c) = \Pi_C(c) + \Pi_A(c) - MNP^*(c), \]  \hfill (9)

where the equality is due to the fact that if all agencies charge \( c \), each just receives a fraction 1/\( MN \) of \( \Pi_A(c) \).

This formulation makes clear some possibilities and pitfalls of compensation. As we will show, the sum \( \Pi_C(c) + \Pi_A(c) \) is decreasing in \( c \). The reason is that corruption not only redistributes from type C to type A (and type B), which might leave the sum unaffected, but it also reduces total output. The key term in objective function 9 is thus the deviation payoff \( \Pi^*(c) \). It is non-decreasing in \( c \) when corruption of agencies other than \( jk \) imposes non-negative externalities on agency \( jk \). If this condition is met, the objective function is decreasing in \( c \) and the optimal compensation will set wages at \( v(0) \) to enforce the corner solution of zero corruption.

**Proposition 5.** If there are not negative externalities of corruption across agencies, that is, if \( \Pi^*(c) \) is not decreasing in \( c \), the optimal compensation scheme pays wages that enforce

\textsuperscript{28}\( \Pi^*(c) \) is well-defined: as the proof of proposition 4 makes clear, there always exists a best response.
zero corruption.

Proof. See Appendix.

Compensation here is like a Coase bargain between type C and type A agents. Efficiency gains from eliminating corruption drive a bargain that rewards type A agents their potential corruption earnings in a non-distortionary, non-corrupt way. It should be noted that this extreme result would be dampened by inability of the type C population to coordinate costlessly and to commit to their wage schedule; but it provides a useful benchmark.

Note that if there are positive externalities across agencies, the wage bill that eliminates corruption is actually less than total corrupt profits would be without a compensation scheme. This is because the wage needs only to cover deviation profits at $c_{-jk} = 0$, which are less than profits at $c_{jk} = c_{-jk} = c_{NE}$, where $c_{NE}$ is the corruption level in the absence of compensation. Positive externalities thus make the bargain all the more attractive to the type C population, adding a reduction in total rent extraction to efficiency gains.

In our model, there are non-negative externalities whenever there is no bureaucratic decentralization, i.e. $N = 1$. The case of $M, N = 1$ is complete centralization where there is no externality. If $N = 1$ and $M > 1$, the externality is positive: higher corruption in regions other than $j$ results in a lower economy-wide wage and an increased willingness to set up firms and pay bribes in region $j$. Thus these political structures which are inherently less corrupt, as shown in section 3.3, are also very amenable to compensation schemes.

If there are negative externalities across agencies, deviation payoffs at zero corruption are

---

29To be complete, we would want to include type B agents in the bargain. They would be willing to compensate type A agents to maintain high levels of corruption. The result would not change, since there is a net inefficiency in the economy that could be bargained away.

30However, the non-compensation corruption level $c_{NE}$ remains a Nash equilibrium. If agencies believe all other agencies are ignoring the incentive scheme, they find it optimal to do so themselves, since the wage bonus is less than what they gain from corruption at $c_{jk} = c_{-jk} = c_{NE}$. It appears proposition 5 would still go through even if the type C population is content only to implement a wage policy that leads to a unique equilibrium. This is because they can always eliminate the equilibrium of section 3.3 by paying each agency (slightly more than) what it makes in that equilibrium. This amounts to carrying out the same redistribution in a non-distortionary way, and the efficiency gains accrue to the type C population. Externalities’ effects on contracting in a different context are addressed by Segal (1999, 2003).

31Also, one can show that when $\gamma \in (1/2, 3/4)$, $N = 2$, and $M \geq \max\{\gamma/(2\gamma - 1), \gamma(1 + \alpha)/(3 - 4\gamma)\}$, the externality is positive.
more than what agencies would earn in the absence of a bargain; the attempted suppression of corruption only makes it more attractive to each agency. Therefore the compensation required to eliminate corruption is higher than the original amount of redistribution. Net negative externalities between agencies generally occur when there are multiple bureaucracies per region, i.e. \( N > 1 \), because agencies are dipping into a common pool. It turns out that as \( N \) gets large, compensation ceases to be effective.

**Proposition 6.** Under assumption 1, as the number of bureaucracies \( N \) gets large, strictly positive wages will always be paid but the fraction of corruption eliminated by an optimal compensation scheme goes to zero.

*Proof. See Appendix.*

Note that this result obtains even though type \( C \) agents can coordinate and raise internal funds costlessly. The intuition is as follows. Positive wages essentially attempt to hold some segment of the common pool of rents off limits. As the number of bureaucracies increases, each agency’s share of the pool of rents that is not off limits shrinks toward zero, while the segment that is off limits stays fixed. Since any agency can deviate and capture the entire amount of off-limits rents, the temptation becomes overwhelming. This force makes the wage bill of enforcing any given fraction of corruption reduction too costly if there are enough bureaucracies per region.

Strategic interaction can thus significantly affect the potency of compensation schemes. Results from two computational examples are pictured in Figure 2. The percent reduction is defined simply as \( 1 - c_{CM}/c_{NE} \), where \( c_{CM} \) is the optimal corruption level under compensation and \( c_{NE} \) is from the equilibrium without compensation. As these examples suggest, compensation generally leads to a greater percent reduction the higher is \( M \) and the lower is \( N \).\(^{32}\) It is also evident that the fractional reduction approaches zero as \( N \) gets large.

\(^{32}\)Both \( c_{CM} \) and \( c_{NE} \) are monotonically increasing in \( N \), but for monotonicity in the percent reduction, the former must increase faster than the latter. This appears to be the usual case, though the results indicate there can be non-monotonicities.
Thus there exists a kind of increasing returns. Regional decentralization is both inherently less corrupt and more amenable to the eradication of corruption; and the reverse for bureaucratic decentralization.\footnote{Waller et al. (2002) find a seemingly different result: a greater degree of bureaucratic decentralization reduces corruption when efficiency wages are used. There are three key differences behind the results. First, the efficiency wages are exogenous in their model. Second, their principal/monitor is not the general populace, but a corrupt autocrat. Third, they compare bureaucratic payoffs across two equilibria, one in which all agencies ignore the efficiency wages and one in which all agencies abide by them, while we look at a unilateral deviation from the latter equilibrium.}

The results warn of misspecification in cross-country empirical work on corruption and bureaucratic wages. These quantities are negatively associated in the data, as Van Rijckeghem and Weder (2001) show.\footnote{Di Tella and Schargrodsky (2003) find a similar relationship using micro data.} One interpretation is that higher bureaucratic wages are lowering corruption. An alternative interpretation suggested by our analysis is that omitted variables, $M$ and $N$, may be causing both low bureaucratic wages and high corruption, or the reverse. Countries with more bureaucratic decentralization (optimally) compensate less and endure higher corruption. Given strategic complementarities, one cannot be confident that a compensation policy that works in one environment will have the same effect in another.
4.2 Electoral Accountability under Decentralization

Electoral accountability, or political competition, is often regarded as a candidate for reducing corruption. Shleifer and Vishny (1993) and Shleifer (1997) stress this and point out that the threat of being voted out can lead to lower corruption even if political turnover does not actually take place. In this section, however, we find that even a strong form of democracy can be ineffective against corruption under the Shleifer-Vishny kind of decentralization.

The model is extended to be infinitely repeated, with future payoffs discounted at rate $\beta < 1$. To facilitate comparison with the earlier static results, we restrict attention to Markov-perfect equilibria.

In each period, corruption, occupational choice, and production occur first, as in section 3.3. At the end of the period, a majority vote is taken on each agency. An agency that loses the vote enjoys type B status in the next period (i.e. they cannot collect bribes, but need not pay them). It is replaced by a randomly chosen equal measure of type B agents from the same region. Thus the size and structure of the bureaucracy cannot be affected and only type A and B agents have political mobility. However, since type C agents constitute a majority ($\gamma > 1/2$), they control the political mobility.

These assumptions isolate a specific aspect of democracy, namely the ability to hold those in power accountable for corruption. Democracy here is not, however, the ability to reorganize the government or the regulatory environment. The assumptions, though simple, seem reasonably to approximate situations where political entry barriers are high and the bureaucratic structure is entrenched.

The type C population chooses a voting strategy so as to minimize the (symmetric and stationary) corruption level. This is their consensus strategy, since every type C agent’s income is decreasing in corruption: an increase in corruption lowers workers’ wages and raises entrepreneurs’ bribe obligations more than it lowers their wage bill.

Assume the unprotected class wants to implement corruption level $c$. In such an equilibrium, $\Pi_{jk\mid A}(c, c) \equiv \Pi(c, c)$ would be the payoff for an agency in office. Denote the payoff to
an agency out of office, i.e. existing as type B, as $\Pi_{jk|B}(c, c)$; it is exactly equal to the earned income component of $\Pi_{jk|A}(c, c)$. Since $\Pi_{jk|A}(c, c)$ also includes rent income, we know that $\Pi_{jk|A}(c, c) \geq \Pi_{jk|B}(c, c)$. Consequently, the electorate can maximize the prescribed payoff relative to the deviation payoff by keeping in office with certainty any agency abiding by $c$, and by removing from office with certainty any agency that deviates from $c$.

Thus the following voting strategy is optimal: reward compliance with indefinite tenure in office and punish deviation with indefinite removal from office. It gives rise to the following agency incentive constraint:

$$\frac{\Pi_{jk|A}(c, c)}{1 - \beta} \geq \Pi^*(c) + \Pi_{jk|B}(c, c) \frac{\beta}{1 - \beta},$$

(10)

where $\Pi^*(c)$ is again the maximum over $c_{jk} \geq 0$ of $\Pi_{jk|A}(c_{jk}, c)$. Since the unprotected class aims to minimize the corruption level, the minimum-corruption equilibrium is simply the minimum $c$ that satisfies constraint 10.\(^{35}\)

Constraint 10 depicts those in power deciding whether to charge the electorally permissible level of corruption and enjoy type A payoffs indefinitely, or to charge whatever they want and face removal from office prematurely. Not surprisingly, electoral accountability reduces corruption below the equilibrium level that would occur in the absence of voting, call it $c_{NE}$. On the other hand, corruption cannot be reduced to zero. If it were, the threat of being removed from office would be empty, since no one collects rents whether in or out of power. Any group in power would prefer to deviate from zero corruption and collect strictly positive rents for one period, then leave office and earn what they would have had they complied.

**Proposition 7.** Under Assumption 1, democracy reduces the minimum symmetric equilibrium corruption level, but not to zero.

**Proof.** See Appendix.

\(^{35}\)Note that in the absence of electoral accountability, $\Pi_{jk|B}(c, c)$ on the right-hand side of constraint 10 is replaced by $\Pi_{jk|A}(c, c)$. In that case, the constraint becomes $\Pi_{jk|A}(c, c) \geq \Pi^*(c)$, and the only equilibrium is clearly the one-shot equilibrium of section 3.3 repeated indefinitely. This allows easy comparison with the static results of the earlier sections and is our reason for restricting attention to Markov-perfect equilibria.
Figure 3: Democracy’s effectiveness rises with $M$ and declines with $N$.

Thus electoral accountability reduces, but does not eliminate, corruption.\(^{36}\) Next we show how its effectiveness varies as the degree of decentralization gets large.

**Proposition 8.** Under Assumption 1, the fraction of corruption eliminated by democracy approaches zero as the number of bureaucracies $N$ gets large.

*Proof. See Appendix.*

Like bureaucratic wages, democracy attempts to keep some fraction of equilibrium rents off limits, while allowing access to the rest. As $N$ increases, the rents that are not off limits are divided among more and more groups, while the fraction that is off limits to these groups remains fixed in size. Since any one group can claim all off-limits rents by deviating, the temptation to deviate becomes overwhelming for $N$ high enough.

Results from two computational examples are shown in Figure 3. The percent reduction is defined as $1 - c_{DM}/c_{NE}$, where $c_{DM}$ is the minimum corruption level under democracy. The results indicate the same sort of increasing returns as under wage compensation. Not only does $c_{NE}$ decrease with $M$ and increase with $N$, but the fractional reduction relative

\(^{36}\)This result is similar to, and driven by the same logic as, Proposition 1 of Persson et al. (1997).
to $c_{NE}$ increases with $M$ and decreases with $N$.\textsuperscript{37}

A corollary to proposition 8 is that a sufficiently bureaucratized, democratic country will experience higher corruption than a completely centralized, non-democratic one.\textsuperscript{38} It seems that the structure of power must be changed for democracy to have its most potent effect. These results offer an explanation for the limited effect democracy in early-transition Russia had on reducing corruption compared to non-democratic China, or even to the historical Soviet Union. It may not have significantly reduced corruption because the voting populace left the government some rents so they would have incentive to remain in office. This could also help explain why democracy is an imperfect predictor of lack of corruption in general.\textsuperscript{39} India is an example of a relatively high-corruption, heavily bureaucratized democracy, while Singapore is an example of a centralized state with less corruption.

5 Conclusion

This model features an intuitive measure of corruption, with clear causes and effects. It fits well with empirical findings on corruption, including those related to income levels, income inequality, and decentralization. It also raises a key selection issue in measuring corruption, suggesting that the preferred measure is not the bribe the representative \textit{active} firm pays, but the bribe a \textit{potential} entrepreneur of no special political standing would pay. In other words, an ideal empirical measure would account for the selection of people with high political capital (and thus low bribe liability) into entrepreneurship. Svensson’s (2003) findings of high variation across entrepreneurs in bribes demanded, probably related to bargaining power,

\textsuperscript{37}Quantitatively, a key parameter is $\beta$. The length of a period here corresponds to one term in office. Given this length, as well as a potentially large amount of uncertainty that affects reelection chances but is outside the control of the official, $\beta = .6$ and even lower may be reasonable. All models of this kind, including Ferejohn (1986) and Persson et al. (1997), predict that shorter election cycles reduce rent extraction, effectively raising $\beta$.

\textsuperscript{38}In the former case, corruption approaches $L$, as we show in the proof of proposition 8. In the latter, it is the amount $c_{NE}(1,1)$ from equation 16 of the proof of proposition 4, strictly less than $L$.

\textsuperscript{39}Treisman (2000) finds that \textit{long exposure} to democracy, but not \textit{contemporaneous} democracy, significantly predicts lower corruption. This accords with our model under the assumption that the \textit{structure} of government (e.g. decentralized or not) is slow to respond to democratic pressure even if the \textit{composition} of government (e.g. who holds power) is quick to respond.
support this point: it seems that some firms are indeed connected and need pay less while others suffer relatively high corrupt demands.

Our main results suggest that the distribution and organization of political capital wins out over two prominent anti-corruption mechanisms as the key determinants of corruption. A relatively equal distribution of political capital is clearly important: for example, by strengthening the level of protection offered by the judicial system to the average citizen (moving agents from types C and A to type B) this distribution can be improved. The organization of power is also fundamental. Increasing the number of independent non-overlapping jurisdictions (regions), even if there is imperfect mobility between them, will both reduce corruption and make anti-corruption efforts more potent. What is perhaps most vital for reducing corruption is to decrease the number of independent bureaucracies (in a setting of weak rule of law) with which firms have to deal. Without such a reform, even high-powered voting or wage mechanisms are doomed to make little dent in the corruption level.

A disadvantage of this work is that the distribution of political capital is taken as given. Endogenizing this distribution as it evolves dynamically due to optimal investments appears to be a fruitful extension.
References


A Proofs of Propositions

Proof of Proposition 1. Using the uniform distribution, equating expressions 1 and 2, and noting that the wage is bounded below at \( w \) (since for \( w < w \) labor supply is zero while labor demand is strictly positive) gives that the wage satisfies

\[
  w(c) = \begin{cases} 
    \frac{y_{1/2} - \gamma c}{2}, & c \in \left[0, \frac{L}{2\gamma}\right] \\
    w, & c \in \left[\frac{L}{2\gamma}, \infty\right)
  \end{cases}
\]
Note that the total numbers of entrepreneurs of types A or B and type C, respectively, satisfy 
\[ e_{AB} = (1 - \gamma)[1 - F(y_{AB})] \] and 
\[ e_C = \gamma[1 - F(y_C)] \]. The measure of agents subsisting satisfies 
\[ S = 1 - 2(e_{AB} + e_C) \]. Total output satisfies
\[
Y = e_{AB}E(y_i|y_i > y_{AB}) + e_C E(y_i|y_i > y_C) + Sw.
\] (11)

Using the above equilibrium wage, the quantities \( Y \) and \( S \) can be calculated as

- \( Y(c) = \begin{cases} 
\frac{y_{1/2} + L/4}{2} - \frac{\gamma(1-\gamma)c^2}{2L}, & c \in [0, \frac{L}{2\gamma}] \\
\frac{y_{1/2} + L/4}{2} + \frac{L}{8} - \frac{\gamma^2}{2L}, & c \in \left[\frac{L}{2\gamma}, L\right] \cdot \\
\frac{y_{1/2} + L/4}{2} + \frac{L}{8} - \frac{\gamma^2}{2}, & c \in [L, \infty) 
\end{cases} \)

- \( S(c) = \begin{cases} 
0, & c \in [0, \frac{L}{2\gamma}] \\
\frac{2\gamma c}{L} - 1, & c \in \left[\frac{L}{2\gamma}, L\right] \cdot \\
2\gamma - 1, & c \in [L, \infty) 
\end{cases} \)

These functions are continuous; \( Y \) is decreasing in \( c \) and \( S \) is increasing in \( c \). □

**Proof of Proposition 4.** The discussion in the text is generally not sensitive to the shape of the distribution, except with respect to the sign of the denominator of \( dc/dM \) and \( dc/dN \). Thus the proof uses the uniform distribution.

We reproduce from equation 6 the key condition that \( \Pi_{cjk}(c, c; M, N) = 0 \):
\[
\gamma \left[ 1 - F(2w + c) - cf(2w + c) \left( \frac{2}{dc_{jk}} + 1/N \right) \right] + \alpha \left[ \mathcal{E}'(w) \frac{dw}{dc_{jk}} \right] = 0.
\]

Note that \( \mathcal{E}(w) \) can be written
\[
\mathcal{E}(w) = F(2w)w + [1 - F(2w)] [E(y|y > 2w) - w].
\] (12)

The first and second term include, respectively, the income of wage laborers, \( w \), and the average income of entrepreneurs, \( E(y|y > 2w) - w \), each multiplied by the fraction who
choose that occupation. Differentiating gives that $E'(w) = 2F(2w) - 1$. This is negative for $w \leq y_{1/2}/2$, which is true in equilibrium by proposition 1.

Next we look at the determination of the wage. It is a continuous, but kinked function of $c_j$ and $c_{-j}$, since it is bounded below at $w$. Equating labor supply and labor demand under the assumption that there are no subsisters gives:

$$\gamma \sum_{j=1}^{M} F(2w + c_j) + \frac{1 - \gamma}{M} \sum_{j=1}^{M} F(2w) = \gamma \sum_{j=1}^{M} [1 - F(2w + c_j)] + \frac{1 - \gamma}{M} \sum_{j=1}^{M} [1 - F(2w)].$$

(13)

This equation produces a unique wage. Unless it is below $\bar{w}$, this is the equilibrium wage. If it is below $\bar{w}$, we know there are subsisters in equilibrium and that $w = \bar{w}$. Three cases arise from these facts and the wage formula from the proof of proposition 1, $w = \max\{(y_{1/2} - \gamma c)/2, \bar{w}\}$.

- First, if $c_{jk} = c_{-jk} = c < L/(2\gamma)$, then $w > \bar{w}$. Equation 13 applies and gives that $dw/dc_{jk} = -\gamma/2MN$.

- Second, if $c_{jk} = c_{-jk} = c > L/(2\gamma)$, then $w = \bar{w}$ and $dw/dc_{jk} = 0$.

- Third, if $c_{jk} = c_{-jk} = c = L/(2\gamma)$, then $w = \bar{w}$, $\lim_{c_{jk} \uparrow L/(2\gamma)} dw/dc_{jk} = -\gamma/2MN$, and $\lim_{c_{jk} \downarrow L/(2\gamma)} dw/dc_{jk} = 0$.

Applying the first case to condition 6 yields a symmetric equilibrium of

$$c_{NE} = \frac{L}{2[1 - \gamma + \frac{1}{N}(1 - \frac{\gamma(1+\alpha)}{M})]}.$$ 

(14)

For this case to apply, it must be that $c_{NE} < L/(2\gamma)$. Some algebra shows that this is true for $N < 1/(2\gamma - 1)$ and $M > \gamma(1 + \alpha)/[1 - N(2\gamma - 1)]$.

Next we apply the second case to condition 6 under the assumption that $2\bar{w} + c < y_1$, 

31
which is equivalent to \( c < L \). This yields a symmetric equilibrium of

\[
    c_{NE} = \frac{L}{1 + \frac{1}{N}}. 
\]  

(15)

For this case to apply, it must be that \( L/(2\gamma) < c_{NE} < L \). Some algebra shows that this is true for \( N > 1/(2\gamma - 1) \).

The second case also applies to \( c > L \), which sets \( f(2w + c) \) and \( 1 - F(2w + c) \) equal to zero and thus satisfies condition 6. However, assumption 1 rules this equilibrium out, since any agency can lower its fee without lowering its rent income, which remains at zero. Also, \( c = L \) is ruled out. Zero rent income is collected there, while a marginal drop in \( c_{jk} \) would result in positive income to agency \( jk \). Technically, the limit of the payoff derivative as \( c_{jk} \uparrow L \) is negative, while the limit as \( c_{jk} \downarrow L \) is zero. Thus a downward deviation would be profitable. In summary, \( c \geq L \) cannot be an equilibrium and the \( c_{NE} \) of equation 15 is the only candidate in the second case.

The third case implies that expression 6 does not exist at \( c = L/(2\gamma) \). However, its limits from above and below do. Necessary for an equilibrium is that the limit from below is non-negative and the limit from above is non-positive, at \( c = L/(2\gamma) \). Some algebra shows that this is true for \( N = 1/(2\gamma - 1) \), as well as for \( N < 1/(2\gamma - 1) \) and \( M \leq \gamma(1+\alpha)/(1-N(2\gamma-1)) \).

Below we verify that these candidate values are indeed equilibria. Putting the three cases together gives

\[
c_{NE}(M, N) = \begin{cases} 
    L & \text{if } N < \frac{1}{2\gamma - 1} \\
    \frac{2\gamma + \frac{M}{N}}{2} & \text{if } \frac{1}{2\gamma - 1} \leq N \leq \frac{1}{1-N(2\gamma-1)} \\
    \frac{L}{2\gamma - 1} & \text{if } N \geq \frac{1}{2\gamma - 1} \\
    \frac{L}{1+N} & \text{if } N \leq \frac{1}{1-N(2\gamma-1)}
\end{cases}
\]  

(16)

What remains to be verified is that condition 6 produces a global best response. This is complicated by the fact that, though the payoff is continuous in \( c_{jk} \), it is not everywhere

\[\text{Some weak inequalities are swapped across cases. The result is not affected, as can be verified.}\]
differentiable due to the kinks in the wage $w$ as a function of $c_{jk}$. However, the following observations establish global optimality.

First, one can show that in regions where the wage is differentiable, the payoff as a function of $c_{jk}$ is either parabolic and concave, or else is flat at zero when $c_{jk}$ exceeds some limit. The parabolic shape is due to the uniform distribution, which gives rise to a linear demand curve. In cases one and two above, the candidate $c_{NE}$ is indeed at the peak of a parabolic piece; in case three it is at a kinked peak joining two parabolic pieces. This establishes local optimality. In summary, when $c_{-jk} = c_{NE}$, the payoff as a function of $c_{jk}$ consists of one or more parabolic pieces and a flat line pasted together.

Next, a deviation to the region of the flat line cannot be profitable, since the payoff is zero there but positive in equilibrium, as can be verified. Further, as long as the parabolic pieces jump down (weakly) in slope at joints, rather than up, the parabolic pieces form a globally strictly concave function. If this holds, the local optimality of the candidate equilibrium extends to global optimality.

Finally, it is in fact the case that the parabolic pieces jump down in slope at joints. Inspection of the slope, expression 6, gives that the only time it jumps is when $dw/dc_{jk}$ jumps; the rest of the variables in the expression are continuous in $c_{jk}$. Since $dw/dc_{jk}$ enters negatively (recall that $\mathcal{E}'(w) \leq 0$), if $dw/dc_{jk}$ jumps up as $c_{jk}$ increases, the entire derivative jumps down as desired. This is indeed the case. For $c_{jk}$ low, the wage is most responsive (negatively) to $c_{jk}$. As $c_{jk}$ increases, the wage can hit its lower bound and become unresponsive: i.e. $dw/dc_{jk}$ jumps up toward zero. One can verify this is always the case.\footnote{More precisely, some algebra verifies that for $c_{-jk} = c_{NE} < L$, the derivative $dw/dc_{jk}$ equals $-\gamma/2MN$ when $c_{jk} \leq \min\{ \frac{MNL}{2(M-\gamma)} + c_{-jk}[1 - \frac{MN(1-\gamma)}{M-\gamma}], \frac{MNL}{2\gamma} - c_{-jk}(MN - 1) \}$ and $c_{jk} \geq \left[ \frac{MN}{\gamma} - (MN - 1)c_{-jk} \right] - \frac{MNL}{2\gamma}$; (17) equals $-\gamma/[2MN[1 - \gamma(M - 1)]]$ when the reverse of inequality 17 holds; and equals 0 otherwise. These guarantee that as $c_{jk}$ increases, $dw/dc_{jk}$ also increases, always from $-\gamma/2MN$ to 0, and in some cases starting at $-\gamma/[2MN[1 - \gamma(M - 1)]]$ before this sequence.} This establishes that the parabolic pieces indeed jump down in slope at joints, forming a
globally concave function. Thus the candidate equilibria do involve global best responses.

The equilibrium level of corruption when \( M = 1 \) and \( N = 1 \), that is under centralization, solves a well-behaved maximization problem, complicated only slightly by the kinked wage. This level of corruption is just equation 16 at \( M = 1 \) and \( N = 1 \). Therefore, equation 16 gives the unique symmetric corruption level for any positive integers \( M \) and \( N \). It is clear that \( c_{NE} \) is continuous, increasing in \( N \), and decreasing in \( M \).

Substituting \( M = 1 \) into equation 16 gives the equilibrium corruption level corresponding to proposition 2. This is because with no mobility, each region is an isolated economy of population \( 1/M \), and the population scaling has no effect on the corruption level. In this case, \( c_{NE} \) is continuous and increasing in \( N \) and independent of \( M \). ■

**Proof of Proposition 5.** It is sufficient to show that type C’s objective function 9 is decreasing in \( c \), strictly so in a neighborhood of \( c = 0 \). Since total output \( Y(c) \) equals the sum of incomes of the three types of agents, \( \Pi_A(c) + \Pi_B(c) + \Pi_C(c) \), the objective function 9 can also be written as

\[
Y(c) - \Pi_B(c) - MN\Pi^*(c).
\]

(18)

The proof of proposition 1 gives that \( Y(c) \) is decreasing in \( c \), strictly so in a neighborhood of \( c = 0 \). Our hypothesis gives that \( -\Pi^*(c) \) is not increasing in \( c \). Finally, note that \( \Pi_B(c) = (1 - \alpha - \gamma)E[w(c)] \); this is the per-capita earned income of type A or B (defined in equation 12) multiplied by the number of type B agents. As established in the proofs of propositions 1 and 4, respectively, \( w(c) \) is not increasing in \( c \) and \( E(w) \) is not increasing in \( w \). Thus \( -\Pi_B(c) \) is not increasing in \( c \). ■

**Proof of Proposition 6.** Define \( c_{NE} \) as the symmetric corruption level in the absence of compensation; it is unique under assumption 1, as shown in the proof of proposition 4. It is clear that no \( c > c_{NE} \) will result from an optimal compensation scheme; type C agents would not pay to increase corruption, given their income is decreasing in \( c \).
First we show that even as $N$ gets large, the optimal compensation scheme will also never result in $c = c_{NE}$. From the proof of proposition 4, for $N$ high enough $c_{NE} = NL/(N + 1) \in (L/(2\gamma), L)$. From the proof of proposition 1, the wage equals $w$ and $Y'(c) = -\gamma c/L$ for any $c \in (L/(2\gamma), L)$. Hence, the derivative of objective function 18 at $c_{NE}$, for $N$ high enough, equals

$$Y'(c_{NE}) - \Pi_B'(c_{NE}) - MN\Pi'(c_{NE}) = -\gamma c_{NE}/L - MN\Pi'(c_{NE});$$

(19)

$\Pi_B(c)$ is unresponsive to $c$ since it only depends on the wage (see the proof of proposition 5).

Now

$$MN\Pi'(c_{NE}) = MN \frac{\partial \Pi(c_{jk}, c_{-jk})}{\partial c_{-jk}}|_{c_{jk}=c_{-jk}=c_{NE}} = -[(N - 1)/N]\gamma c_{NE}/L,$$

where the first equality uses the envelope theorem and the second uses payoff equation 5 of section 3.3, the uniform distribution, and the fact that $w = w$. The derivative 19 then simplifies to $-\gamma c_{NE}/NL = -\gamma/(N + 1)$. Thus no matter how high $N$ is, it is optimal to move below $c_{NE}$, by paying some wages.

Next we show that the fraction by which corruption is reduced vanishes as $N$ gets large. Type C agents choose $c$ to maximize expression 9, reproduced here:

$$\Pi_C(c) + \Pi_A(c) - MN\Pi'(c).$$

Note that by paying zero wages, type C agents can guarantee themselves a positive payoff, $\Pi_C(c_{NE})$. As we will show, for any $\hat{c} < L$, the type C payoff is negative for $c \in [0, \hat{c}]$ and $N$ high enough. This will establish that the optimal corruption level under compensation cannot be in $[0, \hat{c}]$, and thus is converging to $L$ as $N \to \infty$. Since $c_{NE} = NL/(N + 1)$ is also converging to $L$, the percent reduction is converging to zero.

Fix $\hat{c} < L$. Note that the sum $\Pi_C(c) + \Pi_A(c)$ is bounded above by total output, $Y(c)$, which is bounded. If $\inf_{c \in [0, \hat{c}]} \Pi'(c)$ is bounded below by a strictly positive number as $N \to \infty$, then the type C payoff is strictly negative for $N$ high enough and $c \in [0, \hat{c}]$. 
Fix some $c \in [0, \hat{c}]$ and let
\[ c_{jk} = \frac{N(L - c)}{2} + c. \] (20)

This $c_{jk}$ ensures that $c_j$ equals $(L + c)/2$ regardless of $N$; it thus represents a deviation that raises total regional fees (per entrepreneur) halfway from $c$ to $L$. This implies a wage, independent of $N$, corresponding to $(c_j, c_{-j}) = ((L + c)/2, c)$ in equation 13. Using payoff equation 5 of section 3.3, $\Pi(c_{jk}, c)$ can be written as
\[ \Pi(c_{jk}, c) = \gamma MN \left[ \frac{N(L - c)}{2} + c \right] \left\{ 1 - F \left[ 2w\left( \frac{L + c}{2}, c \right) + \frac{L + c}{2} \right] \right\} + \frac{\alpha}{MN} \mathcal{E}(w). \] (21)

Since this payoff depends on $c$, we next bound it below for $c$ in $[0, \hat{c}]$. For $N \geq 2$, the first bracketed term is minimized at the corner $c = \hat{c}$. Next, let $c^*$ be a $c$ in $[0, \hat{c}]$ that minimizes the second bracketed term; this term is continuous in $c$, and thus $c^*$ is well-defined. Then
\[ \Pi^*(c) \geq \Pi(c_{jk}, c) \geq \gamma MN \left[ \frac{N(L - \hat{c})}{2} + \hat{c} \right] \left\{ 1 - F \left[ 2w\left( \frac{L + c^*}{2}, c^* \right) + \frac{L + c^*}{2} \right] \right\}. \] (22)

Since $c$ was arbitrary and this lower bound does not depend on $c$, this is also a lower bound for $\inf_{c \in [0, \hat{c}]} \Pi^*(c)$.

Note that as $N \to \infty$, the right side of inequality 22 goes to
\[ \frac{\gamma}{M} \left[ \frac{L - \hat{c}}{2} \right] \left\{ 1 - F \left[ 2w\left( \frac{L + c^*}{2}, c^* \right) + \frac{L + c^*}{2} \right] \right\}. \]

As long as the bracketed argument of $F$ is strictly less than $y_1$, the whole expression is strictly positive; this is easily verified.\footnote{One can check that for any $c \in [0, \hat{c}]$, there are two possible expressions for $w$: $w_c$ and $((y_1/2 - y_\bar{c})/2$, where $\bar{c} = c_j/M + c_{-j}(M - 1)/M$ and $(c_j, c_{-j}) = ((L + c)/2, c)$. In the former case, $2w + (L + c)/2 = y_0 + (L + c)/2 < y_0 + L = y_1$. In the latter case, $y_1/2 - y_\bar{c} + (L + c)/2 = y_1 - y_\bar{c} + c/2 < y_1 - y_\bar{c} + c/2 < y_1$. Both statements rely on $c \leq \hat{c} < L$ and $\gamma > 1/2$.} Therefore, $\inf_{c \in [0, \hat{c}]} \Pi^*(c)$ is bounded below by a strictly positive number as $N \to \infty$. \hfill \blacksquare
Proof of Proposition 7. At \( c = c_{NE} \), constraint 10 becomes
\[
\frac{\Pi_{jk|A}(c_{NE}, c_{NE})}{1 - \beta} > \Pi^*(c_{NE}) + \Pi_{jk|B}(c_{NE}, c_{NE})\frac{\beta}{1 - \beta}.
\]
The strict inequality follows from the fact that \( \Pi_{jk|A}(c_{NE}, c_{NE}) = \Pi^*(c_{NE}) \), since \( c_{NE} \) is an equilibrium, and that \( \Pi_{jk|A}(c_{NE}, c_{NE}) > \Pi_{jk|B}(c_{NE}, c_{NE}) \). The latter is true since earned income is the same across types A and B, while the fact that \( c_{NE} < L \) (see equation 16) guarantees strictly positive rent income for type A. Since the inequality is strict, the constraint will continue to hold for some \( c < c_{NE} \), as long as all functions vary continuously as \( c \) is reduced below \( c_{NE} \). This is true, since the wage, the payoff function, and the unique best response function and are all continuous.

Next, for \( c = 0 \) to be an equilibrium would require:
\[
\frac{\Pi_{jk|A}(0, 0)}{1 - \beta} \geq \Pi^*_j(0) + \Pi_{jk|B}(0, 0)\frac{\beta}{1 - \beta}.
\]
This is impossible. \( \Pi_{jk|A}(0, 0) = \Pi_{jk|B}(0, 0) \), since both include only earned income, while \( \Pi_{jk|A}(0, 0) < \Pi^*(0) \), since deviating to some positive fee amount, \( NL/2 \) for example, would increase rent and earned income. ■

Proof of Proposition 8. This proof parallels that of proposition 6 closely. Fix \( \hat{c} < L \). We will show that for \( N \) high enough, constraint 10 cannot be satisfied for any \( c \in [0, \hat{c}] \).

This constraint can be rewritten
\[
\frac{\Pi_A(c)}{MN(1 - \beta)} \geq \Pi^*(c) + \Pi_{jk|B}(c, c)\frac{\beta}{1 - \beta}, \tag{23}
\]
since \( \Pi_{jk|A}(c, c) \) equals \( \Pi_A(c)/MN \), the total earnings of type A agents at symmetric corruption level \( c \), divided by the number of agencies. Since \( \Pi_A(c) \) is bounded, the left-hand side converges to zero as \( N \) increases. The right-hand side, and in particular \( \inf_{c\in[0,\hat{c}]} \Pi^*(c) \), is bounded below by a strictly positive number (see the proof of proposition 6). ■